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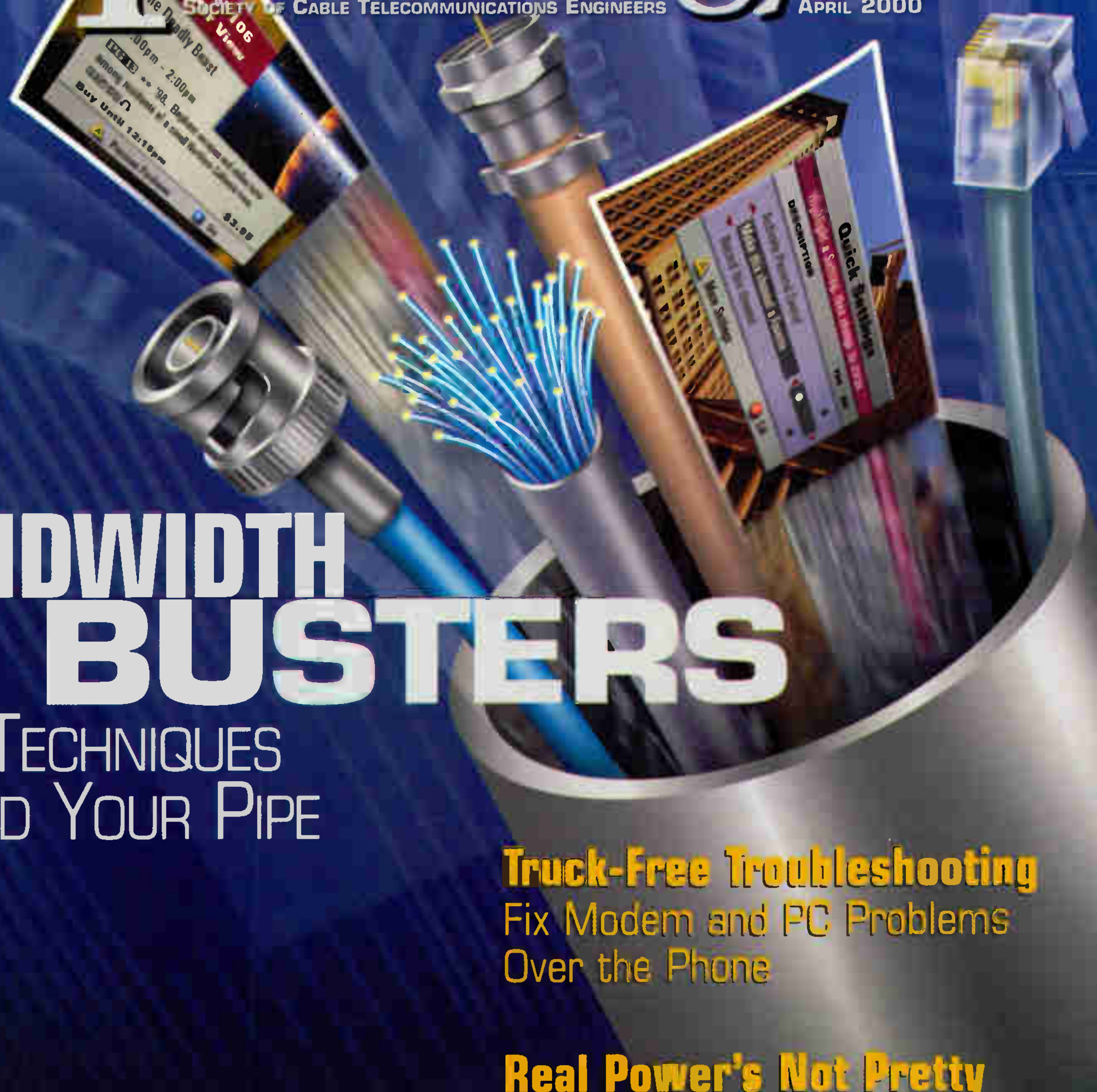
April 2000



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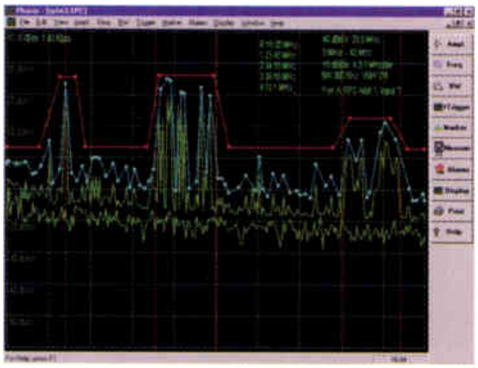

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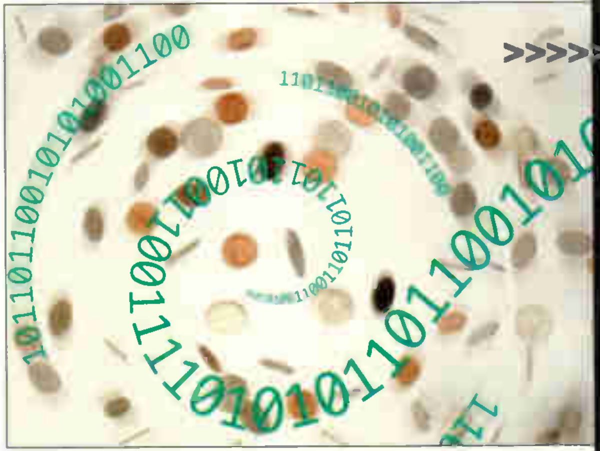

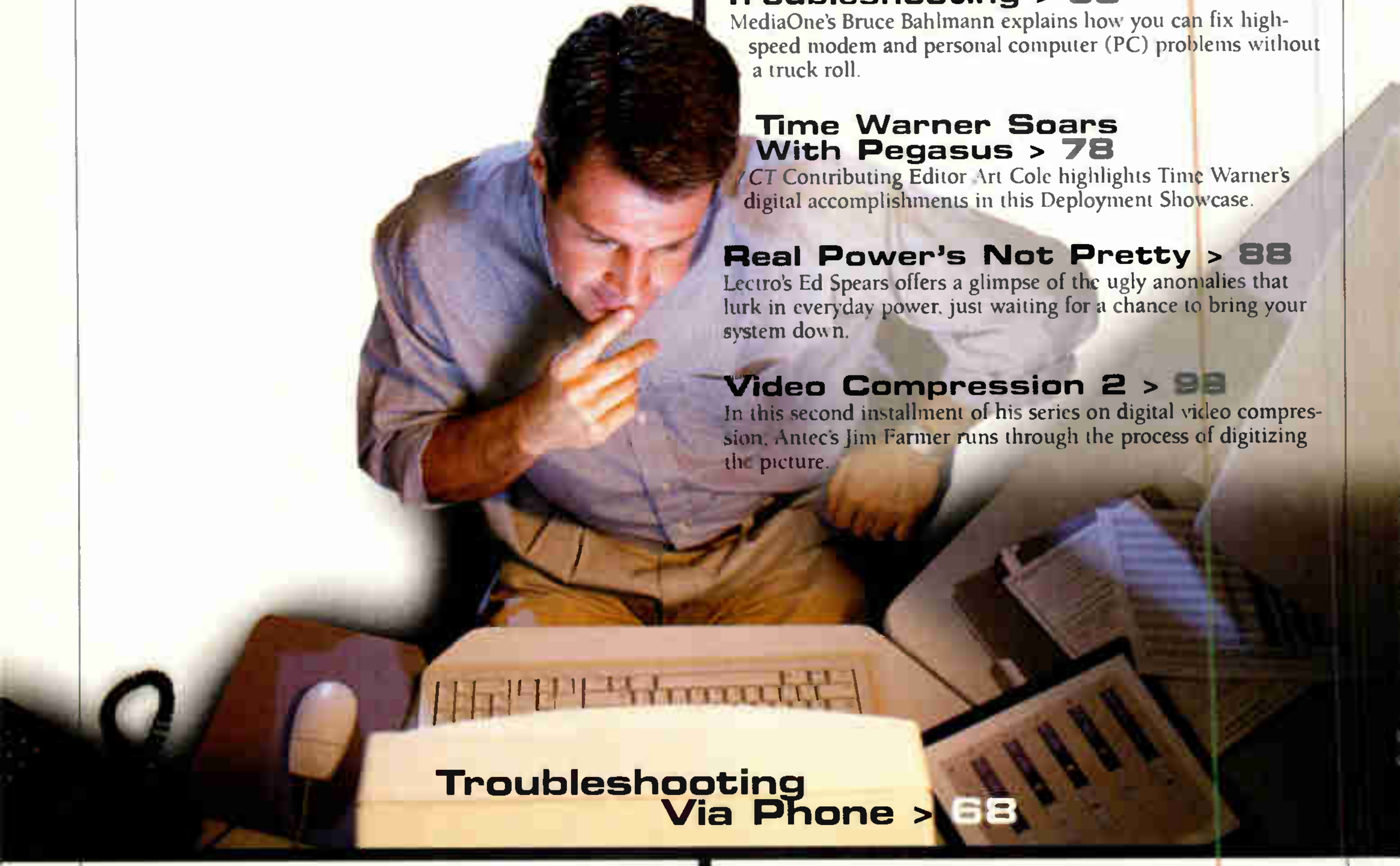

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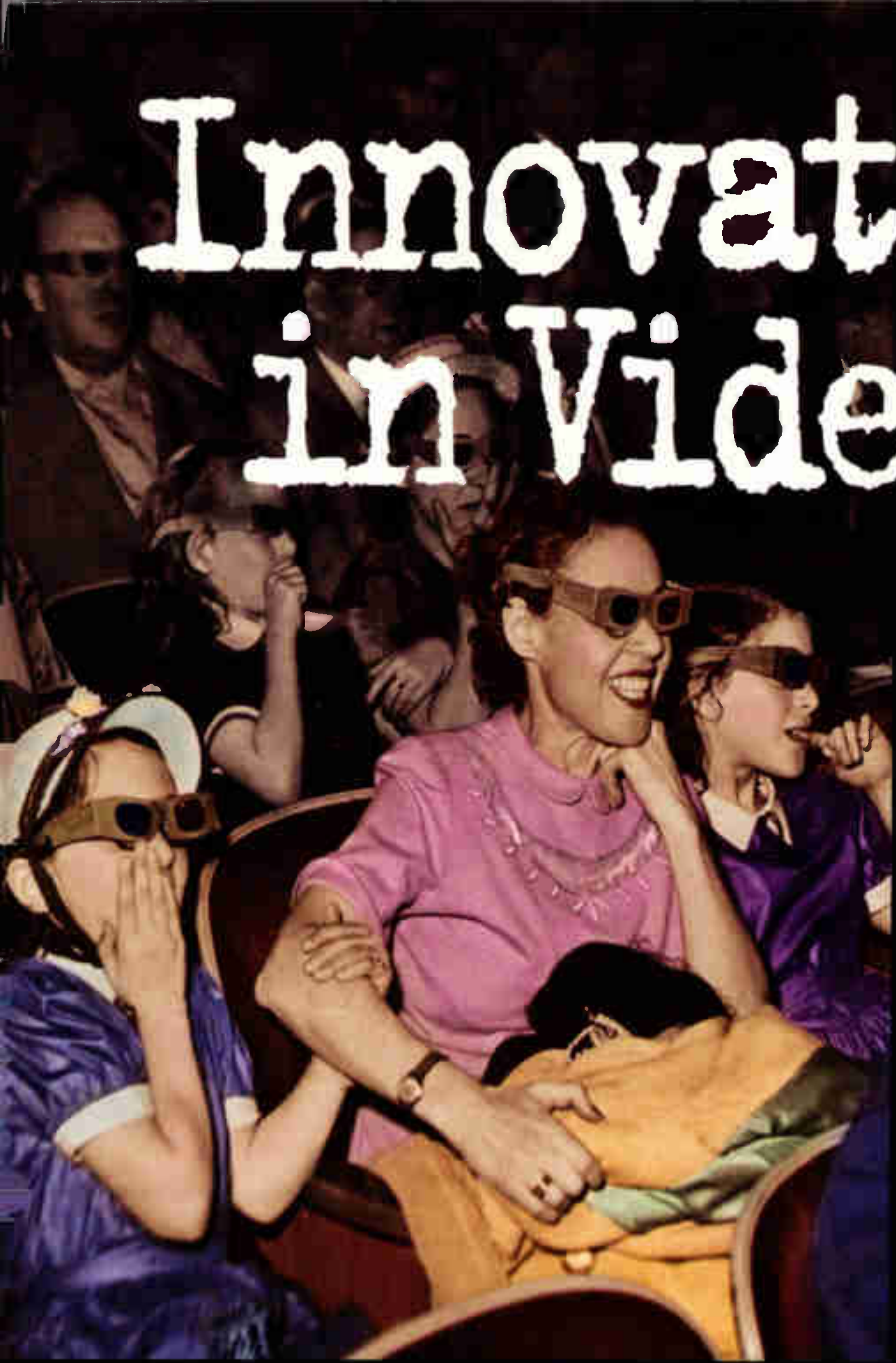

Innovation in Video?

Who Speaks For Us All?

From my earliest days in cable, we've always had visible leaders who acted as spokesmen for our industry. In the '60s and '70s, we had Milt Shapp, Bruce Merrill, Bill Daniels and the like; more recently, we had Walter Kaitz, Bill Bresnan and others to step forward and meet any challenge to our industry's future.

I recently asked a group of industry figures to name anyone they felt was filling the shoes of these great industry leaders. John Malone is no longer in the cable forefront, and Leo Hindery has left. I got no answer.

I notice a new association making headlines now, the American Cable Association out of Pittsburgh. Every week, I receive a new press release about its president, Matthew M. Polka, and his activities to protect the interests of its members, 300 smaller, independent cable businesses serving 3.2 million subscribers in smaller towns and rural areas.

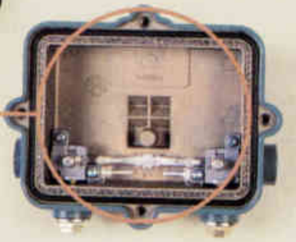
Matt's latest efforts are to get Congress to recognize the "DBS (direct broadcast satellite) industry's attempts to water down the recently passed Satellite Home Viewers Improvement Act of 1999 (SHVIA) and thus to give DBS further advantages over independent cable."

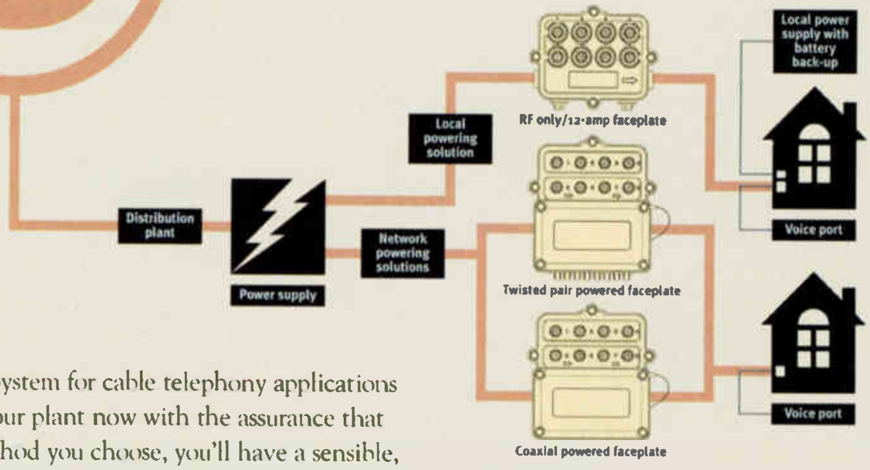
This association's letters to numerous senators read, "They (DBS) claim that they must use their limited capacity to deliver stations for which, frankly, there is negligible consumer demand. Well, we have to deliver all stations in a market, and we do so with one-third the channel capacity of satellite providers .... More appalling to us was the DBS industry's request for extensive and valuable taxpayer resources to serve rural Americans. During this same hearing, they asked that Congress direct the FCC to make additional spectrum available to the DBS providers at no cost. Considering that rare spectrum is now being auctioned by the FCC for billions of dollars, we cannot believe that an industry that is backed by multinational corporate giants would need scarce taxpayer resources to provide services that are an inherent part of any sensible DBS business plan ...."

I'm glad Matt's carrying the torch, but these problems face our whole industry, not just independent operators. I believe in the National Cable Television Association, but who speaks for our industry as a whole?

Rex Porter
Editor-in-Chief


Regal 17
Regal 20
Regal 26




Local power supply with battery back-up
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Local powering solution
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Power supply
Network powering solutions
Voice port
Twisted pair powered faceplate
Voice port
Coaxial powered faceplate


Regal 11

TIM **HERMES**

PUBLISHER'S LETTER

CT's New Face

With the advent of 200-channel digital systems and thousands of new Web pages each day, we frequently hear that "Content is King." While I don't disagree, I think you have to recognize the importance of the delivery vehicle as well. After all, is content really content if no one receives it? If content—video, data, voice—cannot reach the subscriber, then it's not content at all.

And content goes beyond just what the subscriber sees, reads or hears. Content also is determined by speed of delivery, interactivity and bandwidth. Imagine if, rather than simply watching a football game on your local cable channel, that system enabled you to interact with the game—like guessing the play before the snap. In both cases, you enjoy content, but in the latter, the system's capability helps determine the content itself, as well as your enjoyment of it.

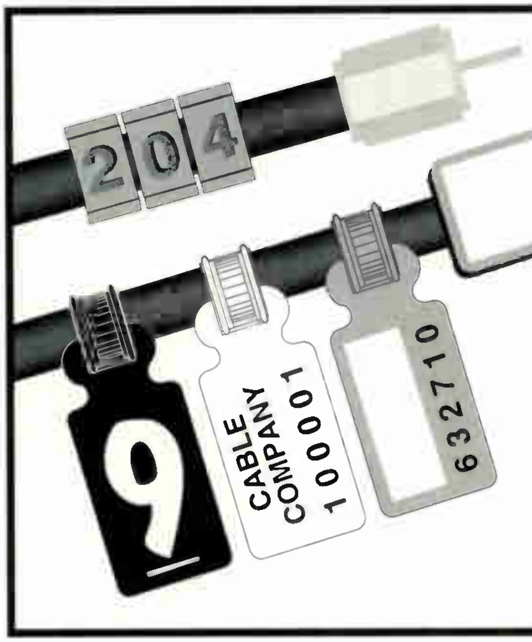
Here at *Communications Technology*, we are in the content business. Our mission is to deliver actionable engineering solutions to help improve your systems. We also have a vehicle, or system, to reach our subscribers—the magazine itself. Our content is the editorial product, and our system, or "container," is how we package the content. Our challenge has always been to make content and container work together as the most powerful, efficient and educational product possible. We want *CT* to be easy to use and navigate, in addition to delivering tools you need.

Therefore, I'm pleased to introduce the redesigned *CT*. Look through this issue, and you'll see a bold new design that will maximize your interaction with the magazine. You'll find cleaner page treatments, larger text, more news and product briefings, and sidebars on "Getting the Gear." You'll also see more Web and e-mail addresses so you can interact with our staff and guest writers. We're also excited about our Webconnect page, which provides quick reference to our advertisers' Web sites.

CT has always been your engineering resource and will remain so. However, just like a broadband system, both the content and the delivery vehicle must be operating at peak performance. I think we've achieved that, and I hope you'll agree.

Let me know what you think. Drop me a line at thermes@phillips.com.

Tim Hermes
Publisher



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> A Tribute to Ed Allen

We at the Society of Cable Telecommunications Engineers Golden Gate Chapter offer our deepest sympathy to Steve Allen in the passing of his father, Ed Allen. Ed was a pioneer in the industry, and we have all benefited from his visionary thinking, which resulted in many meaningful contributions. Furthermore, his optimism and leadership qualities served as a positive influence for the many he came in contact with. All of us in the industry will miss him.

Jay Oldenburg
SCTE Golden Gate Chapter

Editor's response: All of us at "Communications Technology" share your sentiments and extend our best wishes to Steve Allen.

Pan-and-Scan Slammed

Jim:

I just wanted to respond to your article "Digital Video Compression" in the February issue (page 66). The specific point I wanted to address concerns the display of widescreen programming on a standard aspect ratio set. You wrote, "The best is to use 'pan-and-scan' information that can be transmitted with the picture to tell the display which part of the picture to show." I disagree that this is the best method. Among audio and videophile circles, this statement is very close to heresy.

Those who view film as art prefer to see source material displayed at its original aspect ratio, as the director intended. Chopping the picture up using pan-and-scan just to fill a 4:3 screen changes the presentation of the material with a detrimental effect. I don't think this is the best way to show widescreen material on a standard aspect ratio set, and neither do many others. With HDTV looming on the horizon, widescreen aspect ratios are in all of our futures. We had better get used to it now. I prefer to see all of the source content as it was created, not butchered by pan-and-scan.

Mike Witt
Design Engineer
Galaxy Telecom, L.P.

Jim Farmer's response: I stand corrected. My wife accuses me of doing "something funny" to the TV set whenever a letterboxed picture is shown and insists that I put it back the way it was. And I have seen some set-top converters that squeeze the picture horizontally so that everyone looks thin, just so they can get the whole widescreen picture in the standard definition screen. But I didn't think of your point. Thanks for your comments and for reading "CT." —JF

Data Installer Pay?

Bruce,

I read your article on Internet high-speed data installations (February 2000, page 80), and I have a question. My company has just been bought out by Sprint, and they plan on using our microwave signal to run Internet service. My question is whether you know what an installer in the inland Northwest would make per hour doing this type of high-tech installation, or what a tech/installer should be making. I have five years' experience in microwave cable installs and technical knowledge. If you are at liberty to quote on this subject, I would welcome your input.

Microwave cable technician

Bruce Bahlmann's response: Depending on skill level and proficiency—you'd need to be able to do four installs a day, solo—you probably can expect $13-$17 an hour. A computer support tech with this same skill level, supporting technicians in the field on operating system and personal computer issues, probably would be salaried and start around $46,000 a year. Hope this helps. Best of luck with the transition—buy stock with any proceeds. —BB

POD Praise

Jennifer:

I'm finally getting around to reading all the post-Western show publications, and I wanted to let you know how much I enjoyed your column (February 2000, page 32) on the status of the POD (point of deployment module).

Stephen Brown
Ketchum Public Relations

Editor's response: For more info on POD progress, be sure to watch future issues, where we ask the question, "Are PODs ready for retail?"

Cable Center Contributions

Rex:

I was looking through *CT* and read your opening article (highlighting the Cable Center and Museum's acquisition efforts). I have a Jerrold 747 field strength meter in working order. If you are interested in it, you can have it. Keep up the good work.

Bob Stanton

Editor's response: Keep those contributions coming. Let us know if you've got old photos or gear that you can donate to the Cable Center.

> Write to Us

What do you think of this month's issue? If you agree, disagree, or have comments on what you've read, please let us know. Simply e-mail *Communications Technology's* editors at tvrex@earthlink.net and jwhalen@phillips.com.

CT reserves the right to edit letters for clarity and space.

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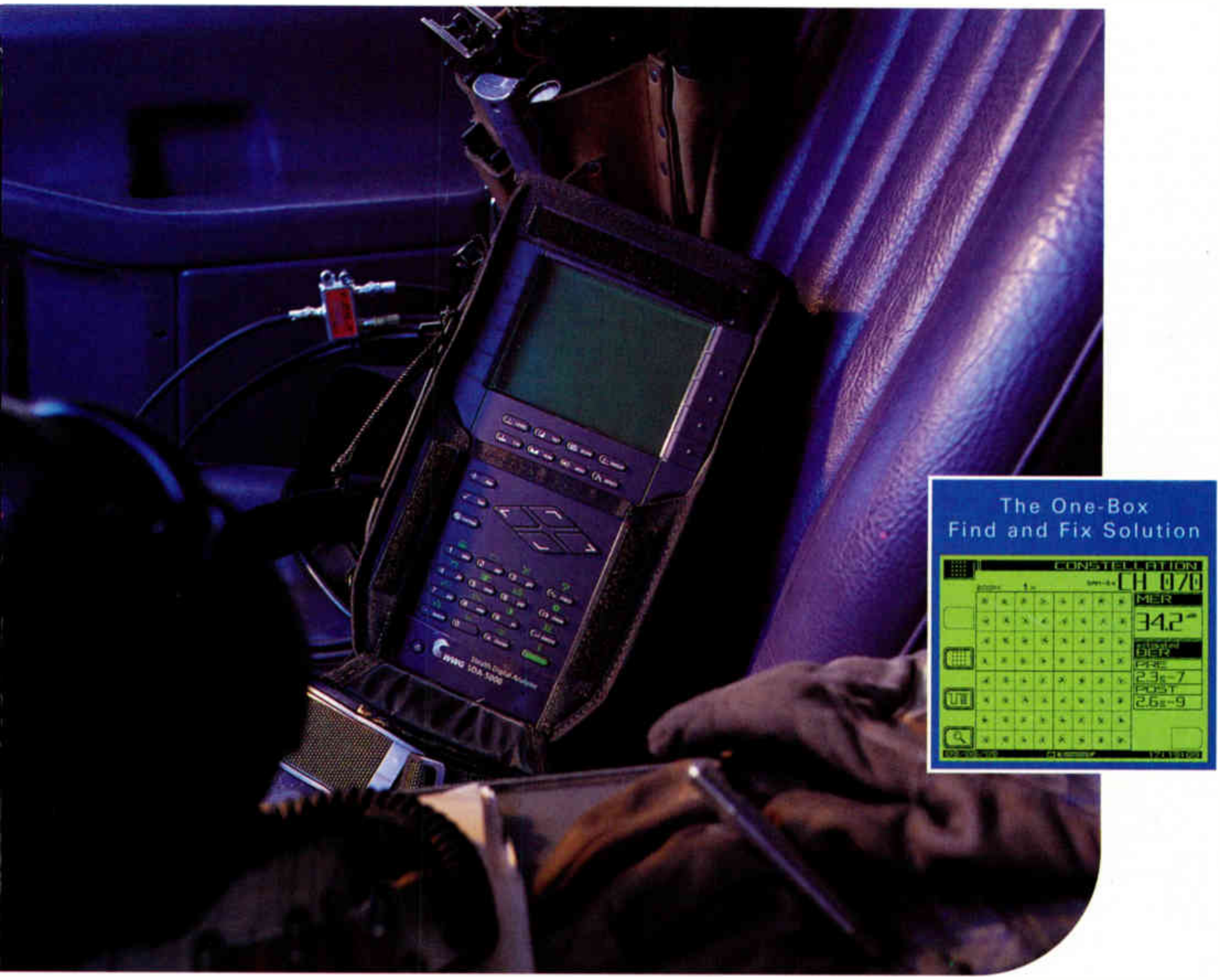

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Fiber Market Sizzles

By Jonathan Tombes,
Deployment Editor

The Optical Fiber Communications Conference typically is a low-key, buttoned-down affair. The tone is more applied physics than marketing hype. But OFC 2000 in Baltimore was different. Preliminary estimates put attendance at 15,000, a 50-percent leap from last year. Even the eggheads were giddy.

TABLE 1 NORTH AMERICAN GROWTH RATES IN FIBER DEMAND BY MARKET SEGMENTS, 1999

Long-haul	80%
CLECs	60%
Cable TV	**50%**
Other	50%
Local Exchange	15%
Premises	0%

Source: Corning, in-house research

Fiber is hot. In-house research by Corning pegged total growth in North American fiber demand at 45 percent, with the cable TV segment growing at 50 percent. (See Table 1.)

What explains the heat? A joint presentation by two Corning vice presidents, Alan Eusden (telecommunications products) and Gerald Fine (photonics technologies), noted that that worldwide demand for optical fiber grew by more than 35 percent and worldwide demand for photonics grew by more than 60 percent over the previous year.

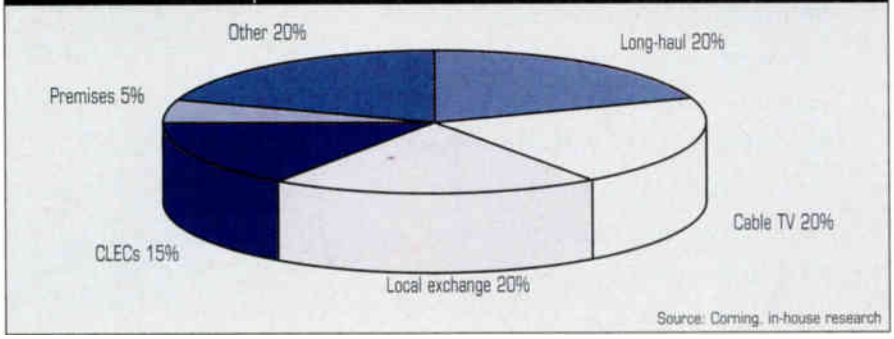
Eusden said, "The demand is increasing as the worldwide appetite for bandwidth continues to grow exponentially." Corning's data have North America accounting for 45 percent of fiber demand in 1999, with cable TV taking 20 percent of the North American volume. (See Figure 1.)

Corning also offered projections for demand in photonic components, reflecting the distinct needs of the long-haul and metro spaces. Erbium-doped fiber amplifiers (EDFAs), for instance, are expected to account for 38 percent of overall demand this year in components for long-haul, but only 11 percent in the metro and access areas. By contrast, projections for multiplexers/demultiplexers are 26 percent for long-haul and 37 percent for metro/access.

The Baltimore event gave evidence of vendors' meeting the growing demand. Corning, for instance, both introduced a fiber product, MetroCor, and announced that Williams Communications has agreed to deploy it. On the component side, ADC Telecommunications debuted a 980 nm pump laser diode and module, its first active optical component product line. (See related story on Lucent's acquisition of Ortel.)

Corning projects compound annual growth rates of at least 50 percent in worldwide demand for all photonic components from 1999 to 2003. Telecom market research firm RHK expects the worldwide market for optical components used in long

FIGURE 1 NORTH AMERICAN FIBER DEMAND BY MARKETS: 1999 (%)



Source: Corning, in-house research

NEWSBITES

> CableLabs Certified

Ten Internet access devices, including the first universal serial bus (USB) modems, received CableLabs certification. Motorola, Dassault and TurboComm captured their first approval. New products from Arris Interactive, Askey Computer, Com21, Thomson Consumer Electronics, Terayon Communications and Toshiba America Information Systems passed the tests. Recertification was awarded to products from Terayon and 3Com. The USB modems came from Arris, Motorola, and Thomson.

> Readers' Choice Awards

Communications Technology will inaugurate its Readers' Choice product awards at Cable-Tec Expo 2000, June 5-8 in Las Vegas. To qualify, a product must have been announced no earlier than May 1, 2000, with a ship date no later than Sept. 1, 2000. To enter, submit a nomination form to *CT* (pg. 110) via certified mail by May 15. Vendors may nominate products in four categories: headend, distribution/line and transmission, customer premise, and network diagnosis. Contact Jennifer Whalen at (301) 340-7788, ext. 2057.

> Adelphia Orders Gear

C-COR.net scored a $33 million equipment order, while Antec signed a $6 million contract with Adelphia for the Cornerstone Cable Modem Termination System (CMTS) 1000.

> Cox Goes Retail

Cox Communications opened its first retail showroom in New Orleans, allowing consumers to sample and buy Cox products and services, pay bills, exchange equipment, and get the latest in DOCSIS-certified modems.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distance telecom and cable TV applications to grow from $6.6 billion to over $23 billion in the same period.

RHK expects the terrestrial dense wavelength division multiplexing (DWDM) segment to expand fastest, at more than 50 percent a year. The firm's analysts explain this growth by higher demand for faster transmission speeds, better price-to-performance ratios and strong traffic growth.

For more information, contact Corning on the Web at www.corning.com and RHK at www.rhk.com.

Lucent Boosts Capacity with Ortel Buy

By Jonathan Tombes,
Deployment Editor

Lucent Technologies' purchase of optoelectronics firm Ortel gives it key components for fiber-optic networks and greater presence in the cable TV equipment market.

What Lucent brings to the table—apart from $2.95 million in stock—is state-of-the-art industrial automation and strength in traditional telecommunications infrastructure.

Lucent spent five years investing heavily in industry automation. As a result, predicted Arlon Martin, marketing director of Lucent's optoelectronics division, "Ortel will be able to develop new products quicker and ramp them faster."

Jeff Rittichier, Ortel director of worldwide marketing, agreed. "If anything, the changes are going to help accelerate the things that we're already doing." Attention already has focused on Ortel's 980 nm uncooled pump lasers, which Lucent will use in amplifiers for metro fiber-optic networks.

"Ortel had no internal capability to either make fiber amplifiers or even to package this in a big way," said Martin. "There are immediately things in our mind that we can do in the metro space, for low-cost, high-volume fiber amplifiers to add capacity."

Capacity constraint is a pressing concern. After declaring its plan to buy Ortel, Lucent said that it would quadruple its optoelectronics components output this year.

Buying the Alahambra, Calif.-based Ortel expands Lucent's market, as well. "We were extremely strong already in the backbone infrastructure in the traditional telecommunications side," said Martin. "But as these markets merge, Ortel creates for us a strong presence on the TV side."

Martin is convinced that Lucent can fill a need. "The whole cable TV market has to figure out how to do telecommunications," he said. "There is no other story in that marketplace."

Lucent Technologies
Bell Labs Innovations

Sales and marketing are subject to change. "We still have obviously a few issues to work out in exactly how do we support our customers so we don't confuse them." Meanwhile, Ortel's Rittichier is eager "to take the things that Lucent is already doing and supply those to the cable business."

How else does this deal impact cable? Antec Vice President of Product Management for Active Electronics Emanuel Vello said that both Ortel and Lucent are valued suppliers. "We look for this to be positive for both companies, to provide products and to increase capacity."

As to whether Lucent poses a competitive threat, Vello is taking a wait-and-see approach. As long as supply is constrained, the more the merrier. "But that could change in 30 nanoseconds," he added.

PEOPLE

> CableLabs Adds Engineers

Visiting engineers working on Data over Cable Service Interface Specification (DOCSIS) issues now include: Aryeh Elkon of Texas Instruments, Allan Fan of Ambit Microsystems, Vincent Randall of Intel and Dan Smith of Broadband Access Systems. PacketCable visiting engineers include John Hedquist of Ericsson. OpenCable visiting engineers are Takashi Hayakawa from Sharp Laboratories and Jong-Won Lim from LG Electronics.

> New Road Runner Prez

William T. Gordon III is the new president of Road Runner. He will oversee all aspects of the business, including day-to-day operations and long-term strategic decisions.

> Nagel Joins Liberate Board

David Nagel, chief technical officer of AT&T and president of AT&T Labs, has joined Liberate Technologies' board of directors.

> Texans Laud Pike

The Texas Cable Association has named Dan Pike, chief technical officer for Prime Cable, the winner of its Johnny Mankin Award.

> PSW Gains Veep

Cathy Hetzel is PSW Technologies' new vice president of the company's eTV and broadband divisions. Hetzel joins PSW from Digital Cable Radio Associates/Music Choice.

> New Faces in California

The California Cable Television Association promoted Lesla Lehtonen to vice president of regulatory and legal affairs. Phillip Enis joined the association as a regulatory director.

GET A RETURN ON YOUR DIGITAL TEST INVESTMENT

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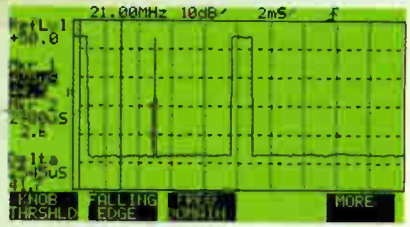

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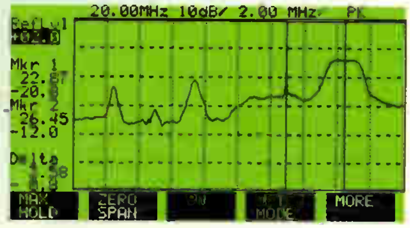

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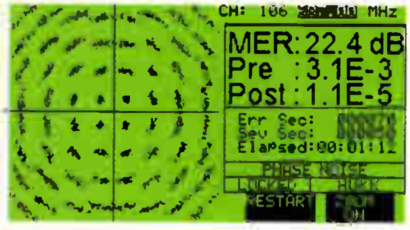

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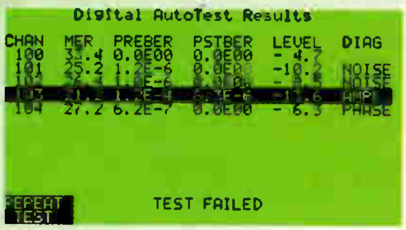

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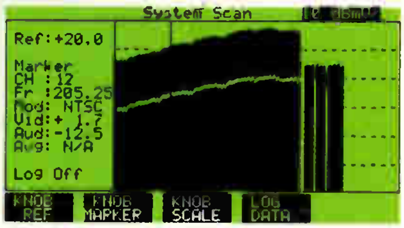

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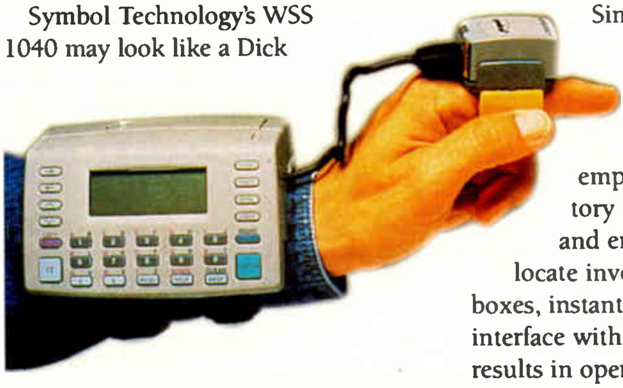
Cablevision Opts for Wireless Warehouses

By Jonathan Tombes,
Deployment Editor

Combine a small scanning engine, a mobile computer and supply chain software, and what do you get? A wearable barcode scanner that has applications, among other places, in the warehouses of cable operators. In fact, Cablevision Systems is using such a device to help warehouse employees perform inventory transactions.

Symbol Technology's WSS 1040 may look like a Dick Tracy gizmo, but don't be fooled. "It's a pretty robust industrial tool, literally a mobile computer with wireless capability," said Girish Rishi, senior director of Symbol's manufacturing enterprise group.



The WWS 1040 runs Oracle-based supply chain software. According to BPA Systems, the software developer, its BP-LINK/SC is the only Enterprise Resource Planning (ERP) Single Connector Emulation (SCE) extension for Oracle.

In the warehouse, the WWS 1040 allows employees to process inventory transactions in real time and enables management to locate inventory, such as set-top boxes, instantly. "The optimized user interface with scanning capabilities results in operations that run smooth, from the loading dock to the end user's receipt of their cable box," said Chadwin Schroder, BPA's marketing director.

The software's "containerization" feature also allows for aggregating transactions. "Instead of scanning each and every serial number," said Schroder, "you just scan one skid, which saves tons of time."

Cablevision reportedly deployed the Symbol/BPA Systems solution at six sites in New York and anticipates a total rollout in 43 warehouses across four states.

BPA said that by automating transactions and optimizing process flows, its product yields productivity increases of 300 percent. Leveraged with Symbol, the solution could conceivably yield greater gains.

Symbol certainly took pains in designing the WWS 1040. Standing behind the hands-free appliance are 40,000 user test hours. "We created it," said Rishi, "through an extensive

Cablevision continues on page 22

The Resurgence Of Wireless Broadband

By Doug Larson, Senior Editor

Shrugged off by many as offering little if any true competitive threat in the local loop access market, broadband wireless access is poised to make significant inroads over the next five years. That, according to a new report from market research firm the Strategis Group titled "U.S. Fixed Wireless Study."

The report, which looks at a number of broadband wireless technologies including multichannel multipoint distribution service (MMDS) and local multipoint distribution service (LMDS), forecasts wireless broadband revenues to grow at a 418.2 percent compound annual rate over the next five years, topping out at more than $3.4 billion in 2003. From 1999 revenues of $11.2 million, this translates into a 300-fold increase.

Just over two years since the Federal Communications Commission held its LMDS spectrum auctions and more than a year and a half since MMDS was authorized to carry two-way services, little has occurred in the way of real-world deployments. With that said, why the renewed faith in the competitive potential for local phone, Internet and video access on the wireless front?

Two reasons. First, LMDS and MMDS build-outs are expected to move into full swing this year, including planned deployments by NEXTLINK and HighSpeed.com. Moreover, vendor offerings are expected to surge. "For LMDS providers, the equipment has been a big hurdle," said James Mendelson, author of the report. "Most of the equipment vendors are behind schedule, and this has pushed everyone's business plans back."

So, while MMDS subscribership fell more than 17.9 percent between June 1998 and June 1999 and now represents only 1 percent of the national multichannel video programming distribution (MVPD) market according to the FCC's annual report, the trend is expected to reverse its course.

But they're not just coming after your video subs. "For multichannel video services, LMDS and MMDS is not going to be a heavy competitor since most fixed wireless operators are not focusing on this space," said Mendelson. "Instead, these operators are going after high-speed Internet and

Wireless continues on page 22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DEPLOYMENT WATCH MONTHLY UPDATE

Provider/Operator	Service/Feature	Communities	Vendor/Partner
AT&T Broadband & Internet Services	Cable telephony	Chicago, San Francisco, Denver, Dallas, Hartford, Pittsburgh, Salt Lake City, Seattle	Arris (an Antec-Nortel joint venture)
Charter Communications	Enhanced TV applications	Bay City, Mich.	Wink (software); General Instrument (set-tops)
Comcast	Digital Transport fiber-optic system	Middletown and New Haven, Conn.	Scientific-Atlanta
Insight Communications	Video-on-demand (VOD)	Evansville, Ind.	Diva (VOD); Motorola (set-tops)
MediaOne	Digital NexTV (200 channels, interactive program guide)	Billerica, Chemsford, Dracut, Lowell, Tewksbury, Mass.	General Instrument (set-tops)
NorthPoint Communications	Live and on-demand video over DSL, Residential DSL	San Francisco Bay area; Dallas, Chicago, San Jose, New York City area	ClearBand (FCC-mandated line-sharing with ILECs)
Time Warner Cable	Interactive customer care application	New York City	Prasara Technologies

Cablevision continued from page 20

research and development process that involved customers like UPS and McKesson and several other customers to define the ergonomics and functionality of the product."

The scanner weighs 1.7 ounces, and the computer 11.3 ounces. Users activate the scanner by pointing a finger at the bar code while pressing their thumb against a trigger at the base of the finger. The computer includes a central processing unit (CPU), backlit display, keyboard, battery pack and Spectrum 24 wireless local area network (LAN) communications.

Such inventory management devices could become common in cable warehouses as operators strive to reduce stock sitting on shelves and become more responsive to changes in demand.

In fact, three years ago, the Society of Cable Telecommunications Engineers issued a report that documented standard procedures on packaging and shipping bar codes. The document said that such standards "will allow the extensive use of computer systems and automation in the efficient acquisition, shipping, warehousing and inventorying of hardware material items."

Cablevision's decision to adopt the Symbol/BPS Systems solution confirms the SCTE's prediction. It also shows, once again, that network architecture is not the only part of cable operations that benefits from technical innovation.

Wireless continued from page 20

voice telephony markets—especially high-speed access—where fixed wireless can be quickly deployed as a new competitor or as the only provider."

The growth of fixed wireless won't only come in the form of competition, however. Mendelson said it also is being used by companies such as Sprint and MCI WorldCom as complementary technology to cable and digital subscriber line (DSL). "Fixed wireless is just another piece to reach the end customer and bypass the constraints of the local loop."

One of the companies leading the MMDS march is Nucentrix Broadband Networks, a provider of wireless broadband network services in medium and small markets in the central United States. Nucentrix controls up to 200 MHz of MMDS spectrum, which passes 7.2 million line-of-sight households in approximately 87 markets. Nucentrix has

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entered a joint venture with direct broadcast satellite (DBS)provider DirecTV, under which it will combine its frequencies with DirecTV's video programming to enable local broadcasts as well as all of the other channels offered by the satellite provider.

The bottom line for the cable industry, said Mendelson, is that fixed wireless will be battling for your high-speed Internet access subs in the very near future. Telephony competition is still a little ways away, but it's coming. "As customers become more comfortable with wireless service through their Internet access, they will begin to switch their voice services to fixed wireless carriers," warned Mendelson.

To purchase a copy of the study, contact the Strategis Group at (202) 530-7500 or on the Web at www.strategis.com.

Testers Merge Again

By Arthur Cole, Contributing Editor

The No. 2 and No. 3 companies in the communications test and monitoring industry have announced a merger that, if successful, will introduce a new player to the global stage and bring quite a bit of pressure to bear on the market leader.

TTC, a unit of Dynatech Corp., plans to merge with Wavetek Wandel Goltermann in a cash and stock deal estimated at $600 million. According to executives close to the deal, the union was sought to marry WWG's worldwide marketing and distribution strengths with TTC's strong U.S. presence. The deal also brings a strong line-up of cable TV products into the TTC fold.

The merger could spell trouble for market leader Agilent Technologies, which dominates the T&M industry with close to $6 billion in sales world wide annually.

Dynatech is likely to rename the company and develop a new logo, most likely a combination of the two names, company officials said. Ned Lautenbach, chairman and chief executive officer of Dynatech, will serve as chairman and CEO of the new

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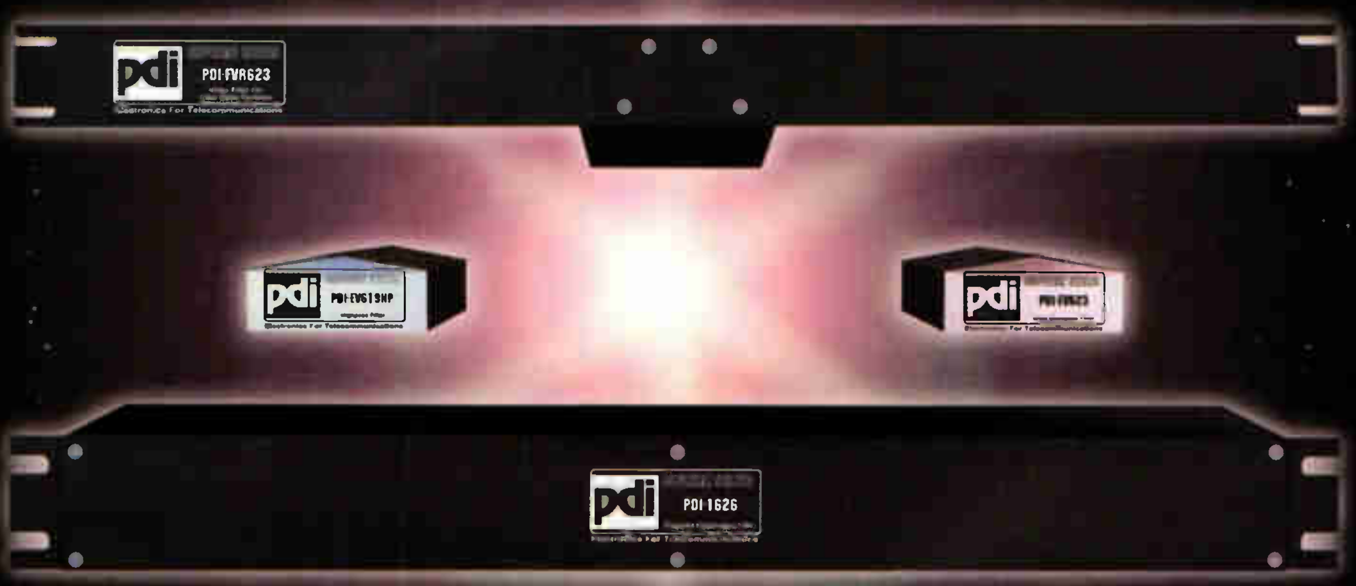

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company. The deal is expected to close in May, provided federal regulators do not throw up any objections.

It is too early to tell whether any product lines will be discontinued or merged, said Gary Culberston, director of marketing for WWG's cable networks division, adding that it looks like most systems will complement each other.

"There doesn't seem to be a tremendous amount of head-to-head product overlap," he said. "Wavetek has a number of products in the cable industry that are very field-focused, while TTC brings a lot of telephony test instruments."

Bruce Hyman, an analyst with Standard & Poor's, said the merger will do away with overlapping competitive efforts at the two companies.

"If you look beneath the surface, you were seeing two companies basically fighting each other," he said. "That duplication of effort largely goes away. WWG had been putting a lot of energy trying to tap into markets that Dynatech is already in."

Hyman said he will watch closely to see how the respective management teams handle the merger process, but that is a normal risk for any merger. S&P rates Dynatech's credit at B+/stable.

This will be the second time in three years that Wavetek has changed hands. The company was purchased by Wandel & Goltermann in September 1998 to form the second-largest T&M company in the telecommunications field.

SCTE Pulls 'Em in

By Marci Dodd, SCTE

The Society of Cable Telecommunications Engineers' 1999 Member-Get-A-Member Campaign yielded 862 referrals from individuals and 525 referrals from chapters. More than 207 members and 53 chapters

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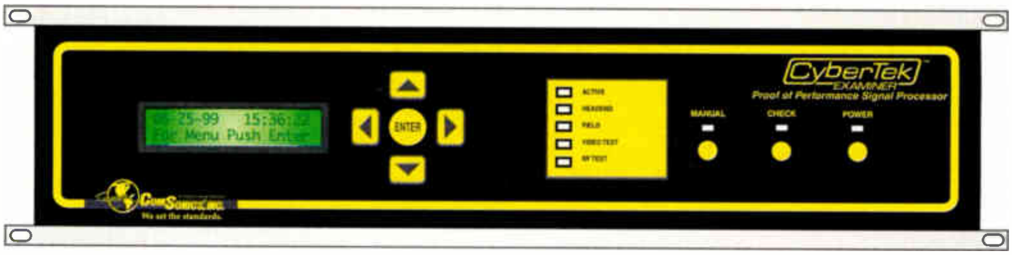

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participated in the program.

Last January, SCTE kicked off its first Member-Get-A-Member Campaign, "The Power of Connection." The purpose of the yearlong program was to encourage members to reach out to their peers, introducing them to the value of SCTE membership.

SCTE members Brian Piekut of AT&T BIS, Francis Gomez of AT&T BIS and Bruce Vines of Time Warner Cable recruited the most individuals. Piekut recruited 90, Gomez 84 and Vines 62. As recognition for their tremendous efforts, they will share in $1,750 of combined prize money.

The leading chapters in the 1999 program included:

- North Country Chapter
- Northern New England Chapter
- New England Chapter
- Golden Gate Chapter
- Mid-South Chapter

SCTE Director of Membership Services Melissa Hicks commented on the program's success, saying: "The overwhelming level of participation is a resounding affirmation of the value SCTE provides to its members' professional development. The headquarters staff looks forward to rolling out the 2000 Member-Get-A-Member program this fall, enabling members to continue their outreach to their colleagues."

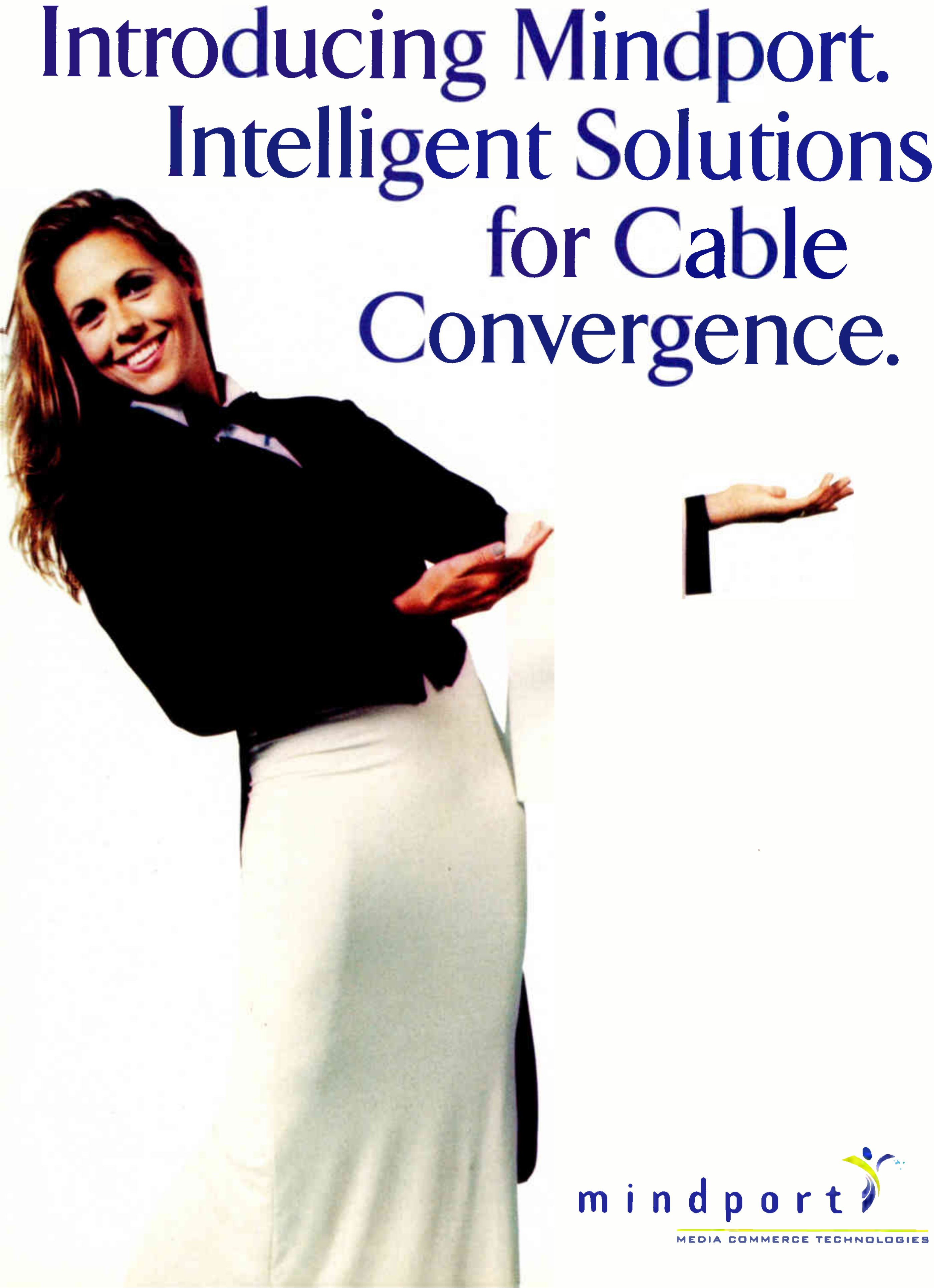
Hicks also said that SCTE has reached a record-high number of members—16,850 as of March 1. The last such record was set back in December 1996 when membership peaked at 15,768.

Hicks continued, adding that the best news is that SCTE's growth shows no signs of slowing down in the near future. On average, 350 individuals are joining SCTE each month, with 494 new members coming aboard in December 1999 alone. And Member-Get-A-Member isn't the only reason for SCTE's growth, say some members.

"One of the most important issues that has faced our industry is keeping the technical professional up to date with technological advances. SCTE provides a solution," said Jason Shreeram of Scientific-Atlanta.

"SCTE provides me with a greater opportunity to meet some industry leaders with other companies besides my employer. Personal networking is a commodity I consider to be priceless," said Darrell Severns of TCI.

The 2000 Member-Get-A-Member Program is scheduled to begin in the fall and will occur over the last quarter of the year. This year's program also will feature a separate competition for chapters and meeting groups.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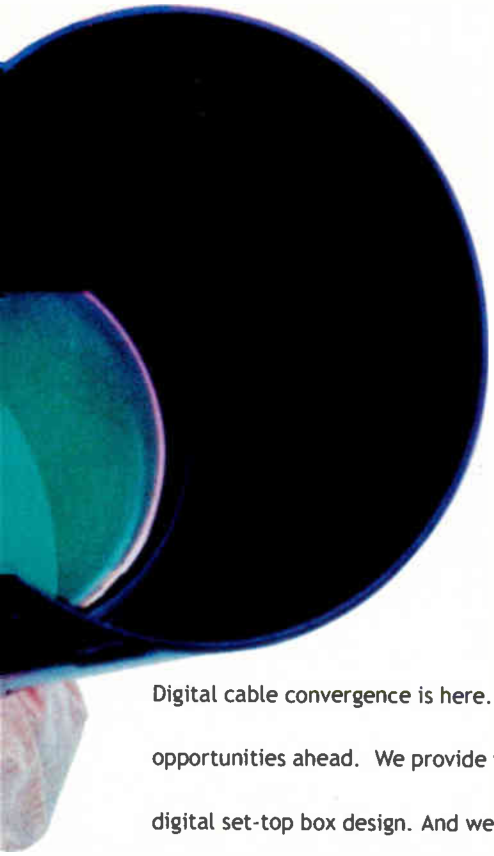

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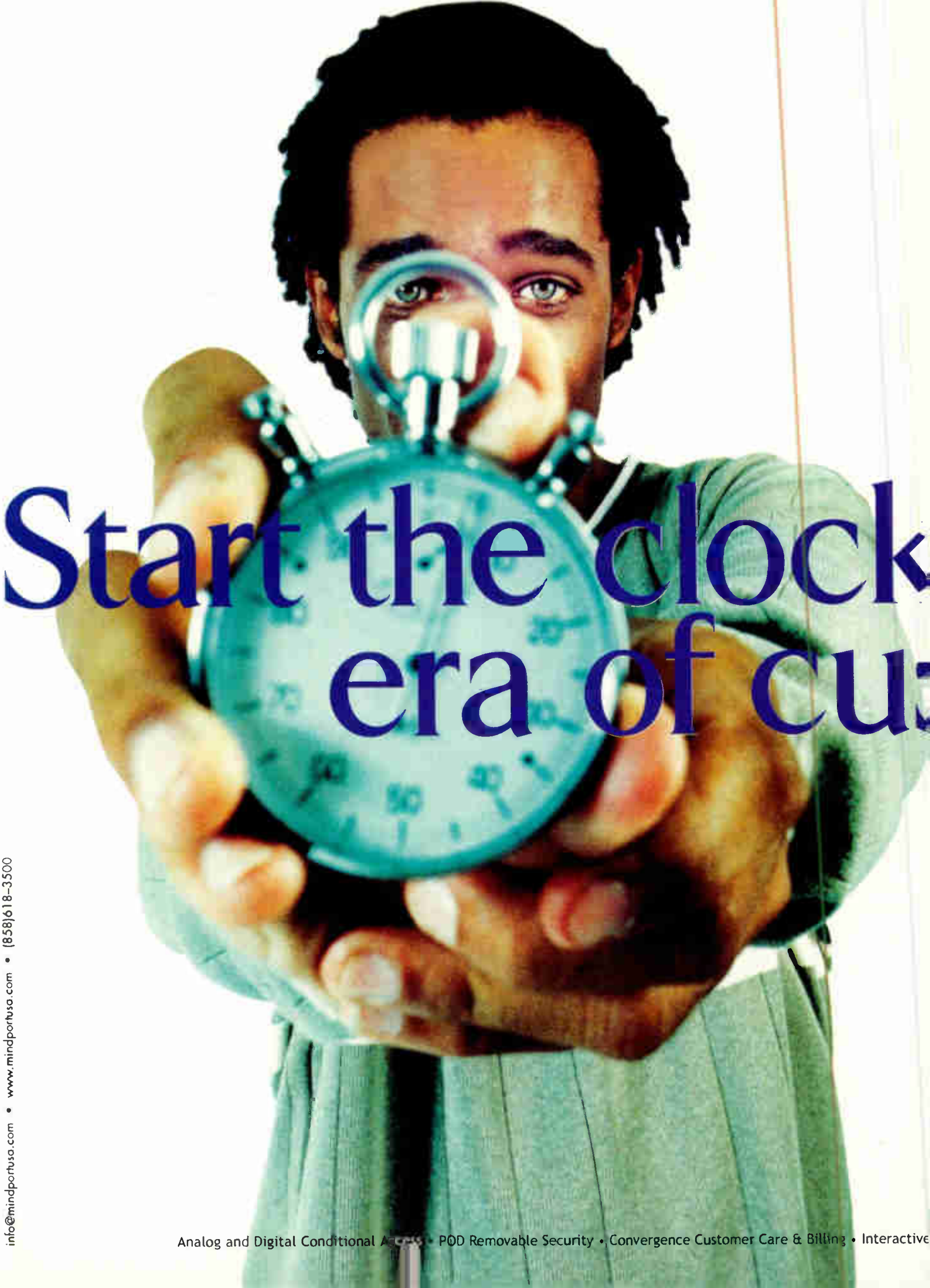
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RON **HRANAC**

dBmV: Power In Terms of Voltage

A couple of recent discussion threads on the SCTE-List are the inspiration for this month's column on power measurements and how to decipher them. In particular, engineers questioned the relationship between dBmV and power measurements.

Here's the question: "When measuring analog video channels, the decibel reference is 1 millivolt. When measuring digital average power, the reference is still 1 mV, right? Since both measurements are relative to actual voltage levels, why isn't it called digital average voltage? Seems to me a digital average power measurement would be in dBm, not dBmV."

Good question, and one that has a logical, but sometimes confusing, answer. To see why, you'll need to get your scientific calculator ready to crunch numbers. Yep, it's math time!

"dB" d-fined

To understand the nuts and bolts of all of this, let's consider the decibel's definition. Technically speaking, the decibel is used to express a ratio between two power levels. That is, $dB = 10\log(P_2/P_1)$, where dB is the abbreviation for decibel, P_1 is input power and P_2 is output power. By itself, the decibel expresses ratios, not absolute levels. For more on this, check out my columns in the September and October '99 issues of *CT*.

If a reference is appended to the decibel, then it's possible to indirectly express absolute levels. For example, one way to express power levels using the decibel is with dBm, which means decibel milliwatt. From a numbers perspective, $dBm = 10\log(P/1\ mW)$, where P is a power level in milliwatts. Let's say you have a laser whose output power is 11 mW. To figure out what this number is in dBm, follow along with your trusty calculator:

$dBm = 10\log(11\ mW/1\ mW)$
$dBm = 10\log(11\ mW)$
$dBm = 10(1.0414)$
$dBm = 10.41$

While we can say 11 mW is +10.41 dBm, technically speaking, dBm actually is the ratio of some number to the 1 mW reference, not an absolute level. In this example, 11 mW is 10.41 dB greater than 1 mW.

Ratios and more

In the world of dBmV, or decibel millivolt, the reference is 1 mV. "Wait a minute, Hranac. A couple paragraphs back you said the decibel expresses a ratio between two power levels. Yet here you've tacked a voltage reference onto the decibel. You'd better check your caffeine level!"

No, my caffeine level is normal. When we use dBmV, we are using the decibel to express ratios between power levels—in a roundabout sort of way. The confusing part is that the decibel is now expressing power in terms of voltage.

You may recall from past columns that $dBmV = 20\log(mV/1\ mV)$. Yes, what you see in this formula suggests voltage is the reference, and in fact it is. But we get there via power, which is why dBmV is expressing power in terms of voltage. Trust me on this.

Which takes me to a related question from the List: "When converting voltage into decibel measurements (dBmV), why is the formula multiplier 20, when the multiplier for power is only 10? Why isn't the formula consistent for voltage?"

> **"When we use dBmV, we are using the decibel to express ratios between power levels."**

Another good question.

Now think back to basic electronics, from which you'll recall that the unit of electrical power, the watt, equals 1 volt multiplied by 1 ampere. Equation-wise $P = EI$, where P is power in watts; E is voltage (electromotive force) in volts, and I is current in amperes. If you substitute the Ohm's Law equivalent for E and I, you get some additional formulas for power: $P = E^2/R$ and $P = I^2R$.

Remember the equation for the decibel? You know, $dB = 10\log(P_2/P_1)$. From the earlier decibel definition, P_1 is input power (P_{IN}) and P_2 is output power (P_{OUT}). Or, $dB = 10\log(P_{OUT}/P_{IN})$. Here's where the real fun starts. If you substitute the power equation $P = E^2/R$ for both P_{OUT} and P_{IN}, you get the following new equation:

$dB = 10\log((E^2/R)/(E^2/R))$
or
$dB = 10\log((E_{OUT}^2/R_{OUT})/(E_{IN}^2/R_{IN}))$>

In this example, R represents the 75-ohm impedance of our cable TV RF cables and components. Since R_{OUT} and R_{IN} are both equal to 75 ohms, these equation terms cancel, leaving us with the equation:

$dB = 10\log(E_{OUT}^2/E_{IN}^2)$

This can be simplified a bit and written as follows:

$dB = 10\log(E_{OUT}/E_{IN})^2$

which is the same as

$dB = 2 \times 10\log(E_{OUT}/E_{IN})$

or

$dB = 20\log(E_{OUT}/E_{IN})$

Finally, this gets us to our familiar dBmV formula:

$dBmV = 20\log(mV/1\ mV)$

That's how "20log" is derived, and it should now make sense why dBmV really is just an expression of power in terms of voltage. Was that so bad?

Get on the List

Back to the SCTE-List: If you're not a subscriber, it's easy to become one. Send an e-mail message to the address listserver@relay.doit.wisc.edu.

You don't need to type anything in the subject line. (If your e-mail program requires it, don't worry—the subject line is ignored.) In the body of the e-mail message, type:

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To send a question or comment to the List, use the e-mail address scte-list@relay.doit.wisc.edu. Remember, any message you send to the List goes to all subscribers. If you decide to unsubscribe, don't send the request to the SCTE-List address. Send it to the listserver address. CT

Ron Hranac is vice president of RF engineering for High Speed Access Corp. He also is senior technical editor for "Communications Technology." He can be reached via e-mail at rhranac@aol.com.

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The instrument of choice for analyzing ingress problems is a spectrum analyzer because of its broad input, excellent resolution, wide dynamic range and high sensitivity.

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Calling All MDUs

It occurred to me a couple of weeks ago that cable engineers getting their initial telephony training stand in danger of seeing only half of the picture. No, this time I'm not talking about Internet protocol (IP) telephony vs. circuit-switched, although that's another strain of technical myopia. I'm referring to single-family residential telephony vs. multiple dwelling unit (MDU) telephony.

"MDUs have good potential for high service penetration."

This month we'll consider what's unique about installing telephony in MDUs, with a focus on buildings with six or more lines. The six-line number is important because it is the lower limit on typical vendor MDU network interface units (NIUs).

Expand your mind

For many in cable, telephony means only single-family residential service. One reason stems from cable telephony's beginnings as single- or two-line service. Another reason may be that most cable telephony training focuses on individual lines.

Whatever the causes behind a view slanted toward single-family residential, it's prudent to remember the importance of an MDU strategy to a cable operator. MDUs have good potential for high service penetration. If the cable company's telephony service is better than the phone company's, word-of-mouth referral spreads faster. Also, when local zoning permits, MDUs often double as locations for small businesses. Thus, they're likely candidates for multiple services.

Separation anxiety

In an MDU, video and telephony usually remain on physically separate distribution systems within the building, even when the cable company provides telephony service. The services may share common risers and entry points, but each service comes from the building entry to the individual units on separate media. The medium for video is coax; telephony from the NIU to the individual living unit is over twisted-pair.

The partial exception to this rule is in large buildings, where several NIUs may be located in wiring closets dispersed throughout the building. In this case, coax carrying both video and telephony may be run to the wiring closet. From the wiring closet to the living unit, however, video and telephony still run on separate media.

Because of this separation of media for the services to the living unit, an NIU for an MDU does not pass a video signal. Hence, a good video signal at the living unit does not necessarily mean a good telephony signal will be present, and vice versa.

This separation of media by service also means that cable management is important, especially in large MDUs. Of course, good cable installation practices demand that the coax, splitters or taps, and any amps all will be neatly mounted and routed, with appropriate fasteners. When cable telephony service is added, however, a whole new dimension of cable management comes with it. With luck, there will be space near the cable company entry point or the existing telephone company entry for mounting a cable telephony NIU. Coax can then be run to the NIU, similarly to any other NIU installation. Telephony cable management begins at the NIU.

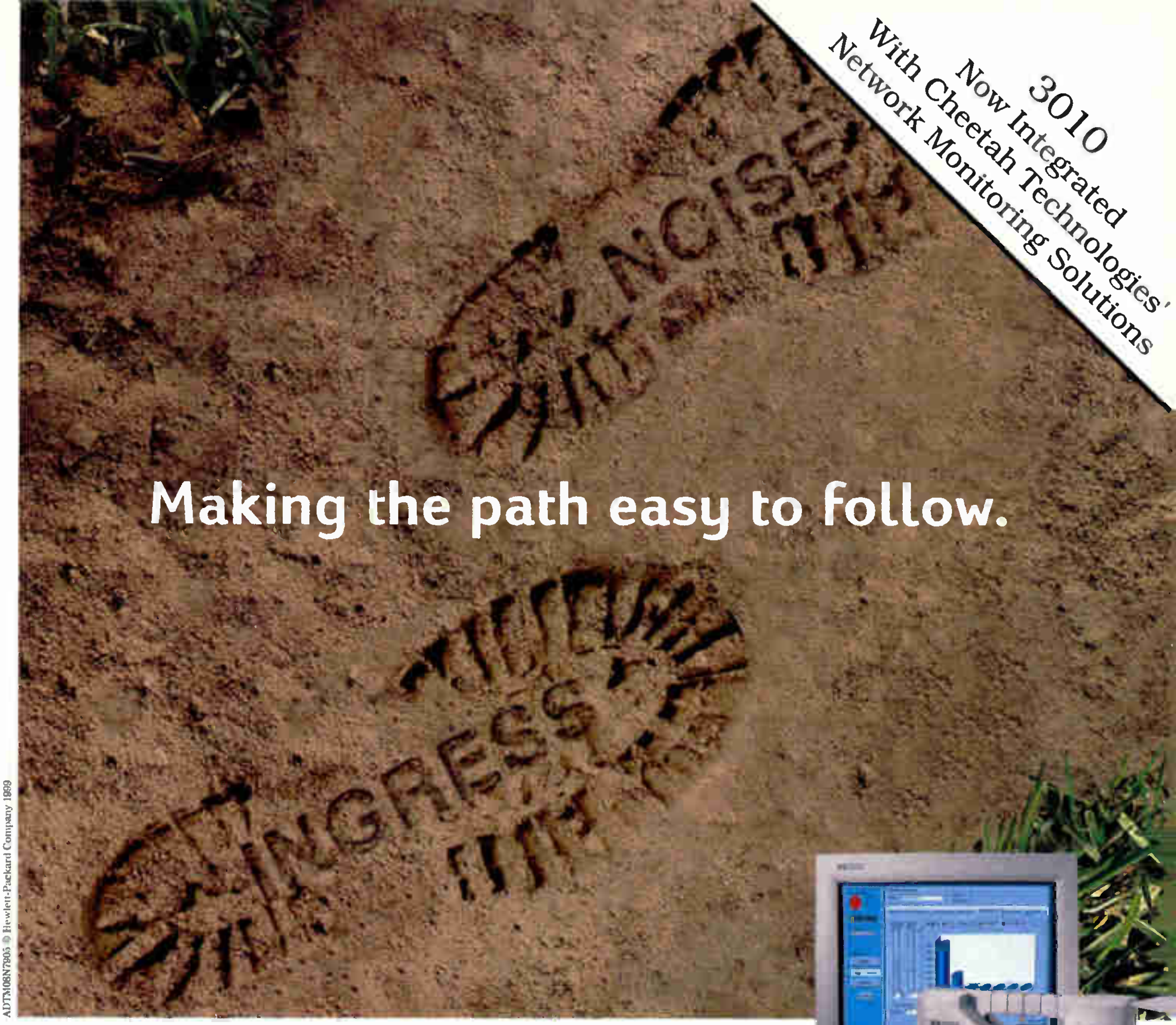
The telephone company may have installed a separate network interface device (NID), or it may have run twisted-pair cable directly to a connecting block. A short clarification: the terms NIU and NID generally are interchangeable. For simplicity's sake, however, let's call the cable company device an NIU and the telephone company device an NID.

Hooking it up

Let's begin by assuming the MDU is an older building that already has phone service from the telephone company. Twisted-pair from each dwelling unit that subscribes to cable telephony must be connected to the appropriate line terminal at the NIU.

Often, the first step is to install a new punch-down connecting terminal block near either the cable company NIU or the telephone company NID or connecting block. This new block will be used to terminate twisted-pair from the cable NIU and building wire pairs that will be served by the cable company.

At first, it may not seem necessary because it is possible to run pairs directly from the NIU to the same block the telephone company uses. A separate connecting block, however, simplifies seeing who owns which lines and isolates cable company maintenance tasks from telco gear. >



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Agilent Technologies
Innovating the HP Way

The connecting block (a common one is a 66-type block) contains rows of insulation-displacing connectors. They cut twisted-pair insulation and provide good contact to the copper wire as the pair is inserted. Installation and removal of pairs on the block require a special punch-down tool.

Cable company twisted-pair wiring connects from the NIU to one side of the new connector block. On the cable company side of the block, each line to the NIU must be labeled with the NIU line number, or otherwise indexed to prestamped connector block labels.

Moving building lines

Once cable telephony service has been provisioned and tested at the cable NIU for the new lines, the existing building lines can be moved from the telephone company block to the building wire side of the new block. The installer needs to identify the appropriate building wire pair at the existing telephone company block by color code, verified with a tone generator/pickup combination. Often, there is not enough slack in the existing building wire to complete the move. In this case, the installer must splice a new cable to the moved wire, using "scotchlok" or similar connectors.

Powering is another consideration. Center conductor power can be used if the total power draw of the NIU is within the limits of the connector. If not, composite power drop or local power must be used. If local power is used, there must be a convenient and secure AC source or a place to mount and secure batteries.

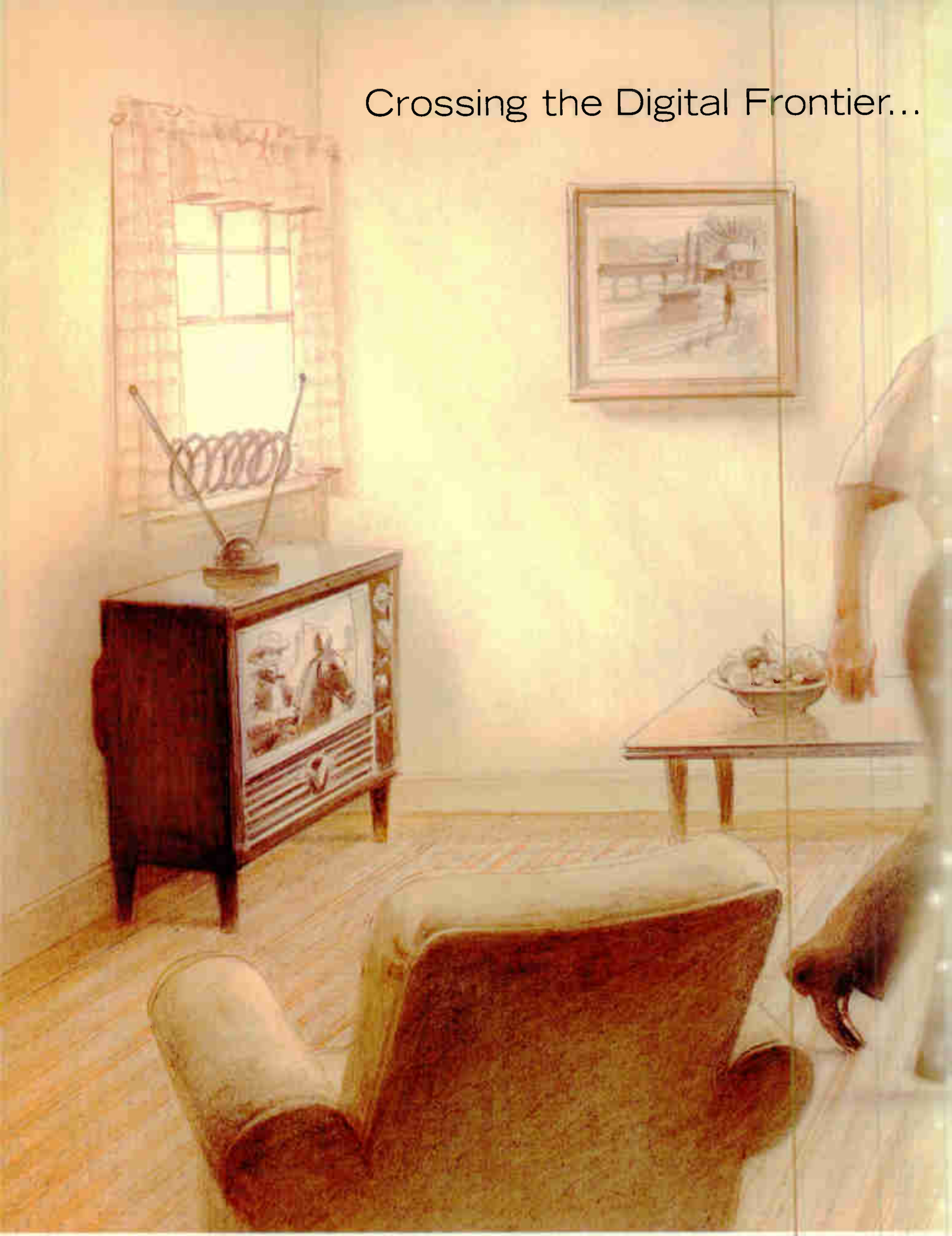
Speaking of security, this is always an issue in MDUs. While most vendor NIUs have lockable covers, it may be advisable to mount all equipment in a secure room, especially in larger buildings, where increased public access is likely. In this case, the operator needs to ensure that the cable company, as well as the building owner, has access to the area for maintenance and changes.

Understanding is key

Of course, there will seldom be an ideal installation, especially in existing MDUs. The installer who knows and understands the model, however, will be better equipped to handle the many variations that occur in the field. CT

Justin Junkus is president of KnowledgeLink and applications engineering director for Antec. He can be reached via e-mail at jjunkus@knowledgelinkinc.com.

Crossing the Digital Frontier...



Resources are the only barrier between an analog existence and a digital reality.
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2000

Open Access a Reality

While the battle for open access may continue to limp along on the local front, it's clear that the issue is largely settled. Open access will come to cable. American Online and Time Warner put the political wrangling to rest with their recent memorandum of understanding (MOU).

Competition for high-speed data customers will get tougher. Not only will you have to protect yourself from the onslaught of digital subscriber line (DSL) services from telcos and the launch of data over satellite, but soon Internet service providers (ISPs) will be competing head-to-head with you on your own network.

What's more, once those exclusive contracts with Road Runner and @Home expire, there's nothing to stop them from offering other ISPs and competitive local exchange carriers (CLECs) access to their state-of-the-art fiber backbones to carry DSL traffic. High Speed Access Corp. already offers DSL through a partnership with Northpoint Communications to cable operators wanting to serve small and mid-sized businesses not on the cable network.

You've got a narrow window to attract as many data customers as you can before competition hits. It's essential that your network be performing at peak efficiency and that you respond immediately to customer outages, and correct potential weak spots in your network before failure.

The devil's in the details

So what exactly did the new AOL Time Warner agree to? It pledged to support 11 different planks in its MOU. Key among those is that the combined AOL Time Warner will:

- Offer consumers choice among ISPs: Consumers will not have to not buy service from an AOL Time Warner affiliate to get broadband access.
- Support diversity of ISPs: AOL Time Warner will not limit the number of ISPs with which it has relationships and will offer those ISPs the choice to partner with its systems on a national, regional or local basis.
- Provide the ISP with a direct relationship to the customer: ISPs and cable operators will be allowed to sell broadband services directly to the customer. The ISP can bill and collect from the customer directly.
- Permit video streaming: AOL Time Warner will not block ISPs from providing streaming video to their customers.

Praise and skepticism

Federal Communications Commission Chairman William Kennard, an advocate for letting the market decide the open access issue, applauded the agreement.

"For some time now, I have encouraged the fast-moving broadband marketplace to find business solutions to consumer demand as an alternative to intervention by government. (This) announcement is a significant step in the right direction," he said.

Kennard added: "It is imperative that Time Warner and other cable companies continue to listen to their customers and foster a robust ISP market. I will keep a close watch to determine if we can continue to forbear from regulation in this area."

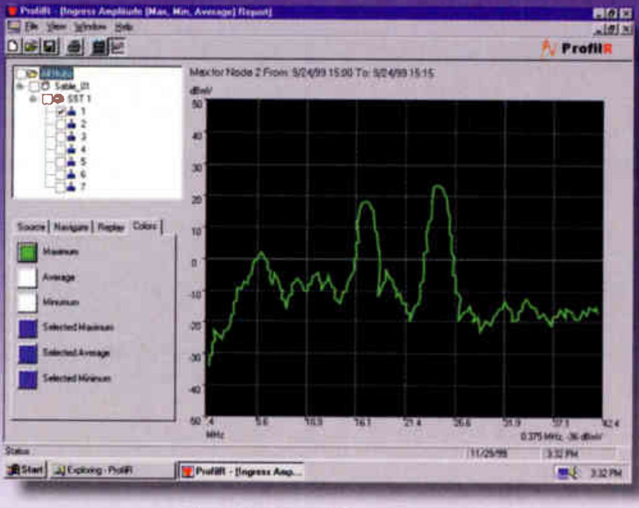
Telcos and ISPs echoed those sentiments and took a few pot shots as well. "This is a strong rebuke to the rest of the cable industry, which has refused to allow their customers to have the same choice of ISPs in the broadband world as they have today with dialup Internet access," said William Barr, GTE executive vice president and general counsel. "It stands in sharp contrast to the hollow statements made by AT&T, which have been so hedged by restrictions and caveats as to be meaningless."

Greg Simon, cofounder of the openNET Coalition, called on the cable industry make the MOU principles "a national standard" for open access.

So when will ISPs have access to the AOL Time Warner net? Well, that depends. The companies say the MOU is subject to Time Warner's existing contracts with Road Runner. However, unlike the agreement earlier this year, where AT&T pledged to open its network to MindSpring once its contracts with Excite@Home expire, AOL Time Warner said it would work with its partners to achieve open access before its current obligations expire. "The question of open access is not whether, but when," said Steve Case, chairman and CEO of America Online during a hearing before Congress. "We can't meet it overnight." CT

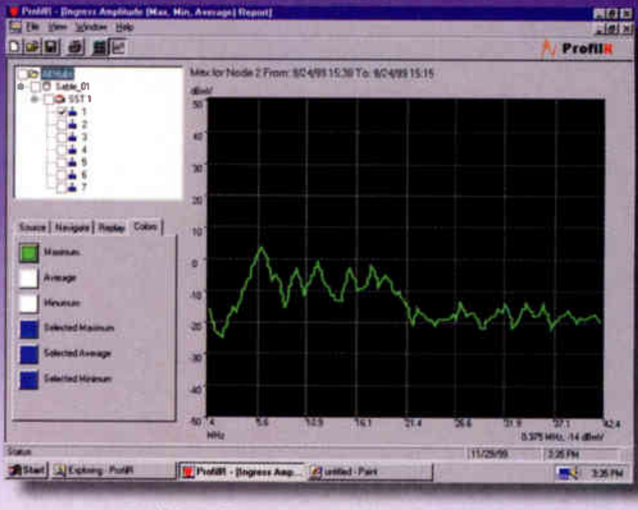
Jennifer Whalen is editor of "Communications Technology." She can be at jwhalen@phillips.com. Eric Ladley, editor of sister publication "ISP Business News," contributed to this report.

Crisis.



Without TraffiControl™, ingress events remain hidden under return traffic

Management.



TraffiControl™ measures and plots ingress spectra of bands fully occupied by return traffic

New *TraffiControl™* lets you see the ingress inside your system's return traffic

TraffiControl™ Now Available On Trilithic's Guardian™ 9580 SST Return Path Analyzer

No doubt about it: where the return path is concerned, ingress is a big problem. Left unchecked, ingress outbreaks can prevent your system from delivering the Internet and other premium services your subscribers have come to expect. It's tough enough now to catch ingress outbreaks and fix them before the phone starts ringing. It'll be even tougher as new services fill your return spectrum, because the majority of ingress will be hidden by the increased return "traffic."

How will you detect ingress when it's hiding in your occupied bandwidths? Fortunately Trilithic, the leader in digital return path maintenance technology, has engineered a solution – a solution that will quite literally change the way you look at ingress. It's called *TraffiControl™* and it's a new feature of the Trilithic Guardian 9580 SST Return Path Analyzer.

TraffiControl is an advanced Digital Signal Processing (DSP) technology that identifies and removes all the legitimate signals from your scanned return spectrum. What remains is the once elusive ingress spectrum of your entire return band, which the system analyzes against user-set ingress limits. The best part is that *TraffiControl* can be programmed to work automatically. Then, when ingress occurs, the system will tell you about it, giving you time to respond before it causes problems.

TraffiControl is the newest addition to the Trilithic Guardian System, the only fully-integrated, fully-digital family of return path maintenance products on the market. With the addition of *TraffiControl*, the Guardian System takes you from the subscriber, through the distribution system, all the way to the headend for complete ingress detection and, most importantly, resolution.

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The Structures Of Success

Most everything has structure. From the atomic structure of elements to the underlying laws that govern the universe, structure is fundamental. Our attention to the details of broadband structures can impact the long-term success of advanced services.

> "For every day you fail to move forward in the Internet, you're probably losing a week to the competition."

We need to recognize the following four critical structural aspects of advanced telecommunications services, as they are critical to successful longevity in this space:

- Physical infrastructure
- Infrastructure management
- Scope and support of services
- Business strategy and operation of the services business

Physical infrastructure

Probably the most critical structure governing long-term success in advanced telecommunications services is the underlying physical service delivery infrastructure. No other structure more directly governs the scope (that is, the concurrently deliverable number) of services, the performance of those services, and the competitive posture defined by those services.

The shared network defined by broadband HFC architectures is unique among competing approaches. The shared bandwidth of broadband networks extends deep into the community, instead of being confined to that segment of the infrastructure where access to the Internet occurs—the central office.

While competitors have attempted to exploit the extended shared bandwidth scenario as a weakness, it simply is not so. The Internet itself is a shared bandwidth network. The broadband approach simply extends this into the community.

In fact, operator awareness of the scope of shared bandwidth in broadband environments is driving the latest thinking in high-performance architectures. Most of these advanced architectures involve a blend of analog and digital technologies that maximize performance while accommodating legacy requirements such as impulse pay-per-view (IPPV) and public, educational or government (PEG) access.

Some of these approaches reduce the scope of Data Over Cable Service Interface Specification (DOCSIS) networks by segmenting them into smaller interconnected DOCSIS domains. This can be done by distributing scaled-down cable modem termination system (CMTS) and other switching components into distribution hub and fiber node hierarchies of traditional HFC networks.

Not only does this maximize available bandwidth to each data sub, but it also enables improvements in physical layer performance as well as advanced security techniques.

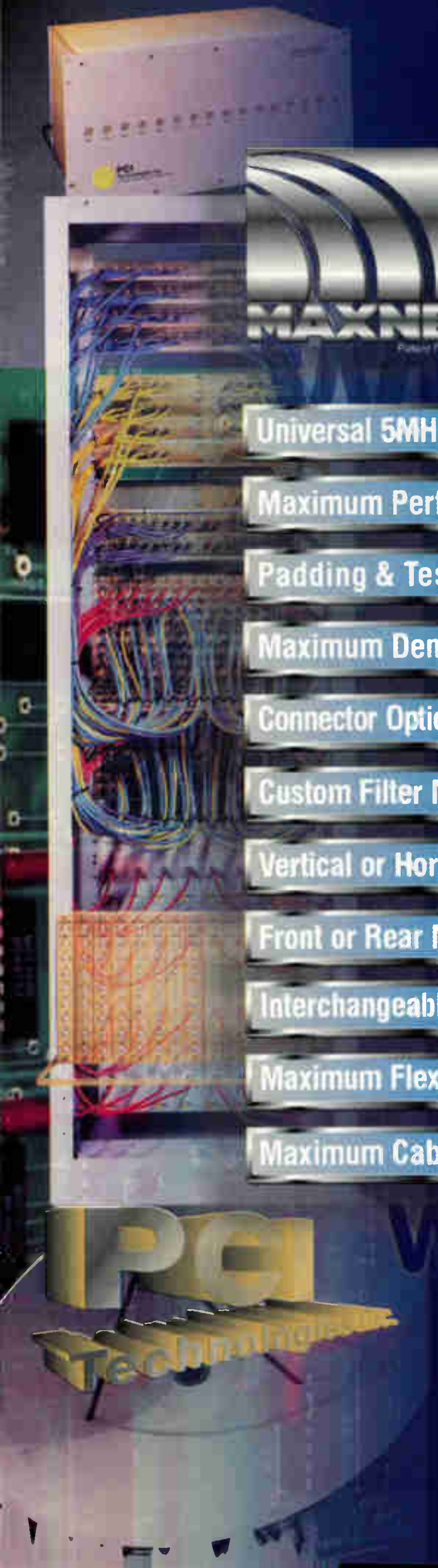
At the recent Society of Cable Telecommunications Engineers Conference on Emerging Technologies 2000, speakers reviewed the latest thinking in advanced broadband transport architectures. These ultra-efficiency high-performance architectures likely will be quite popular in rebuild opportunities and with overbuilders who enjoy a "greenfield" environment because they offer the largest scope of services with the best performance characteristics.

Several architectural advances focus on interim migration products that provide some level of cost and performance improvement, yet accommodate existing legacy HFC designs. However, even these migrating architectures espouse the eventual move to a fully distributed architecture.

Infrastructure management

The second important group of structures critical to long-term success in broadband data services include network and service management systems and all those device-level management information bases that feed status into the management system.

There is more to managing broadband service delivery infrastructure than simple network management protocol (SNMP) SET and GET commands. Unless an out-of-band channel is available to carry management traffic, the challenge is to perform a reasonable level of management without consuming too much bandwidth that subscribers are counting on for high-speed data. >



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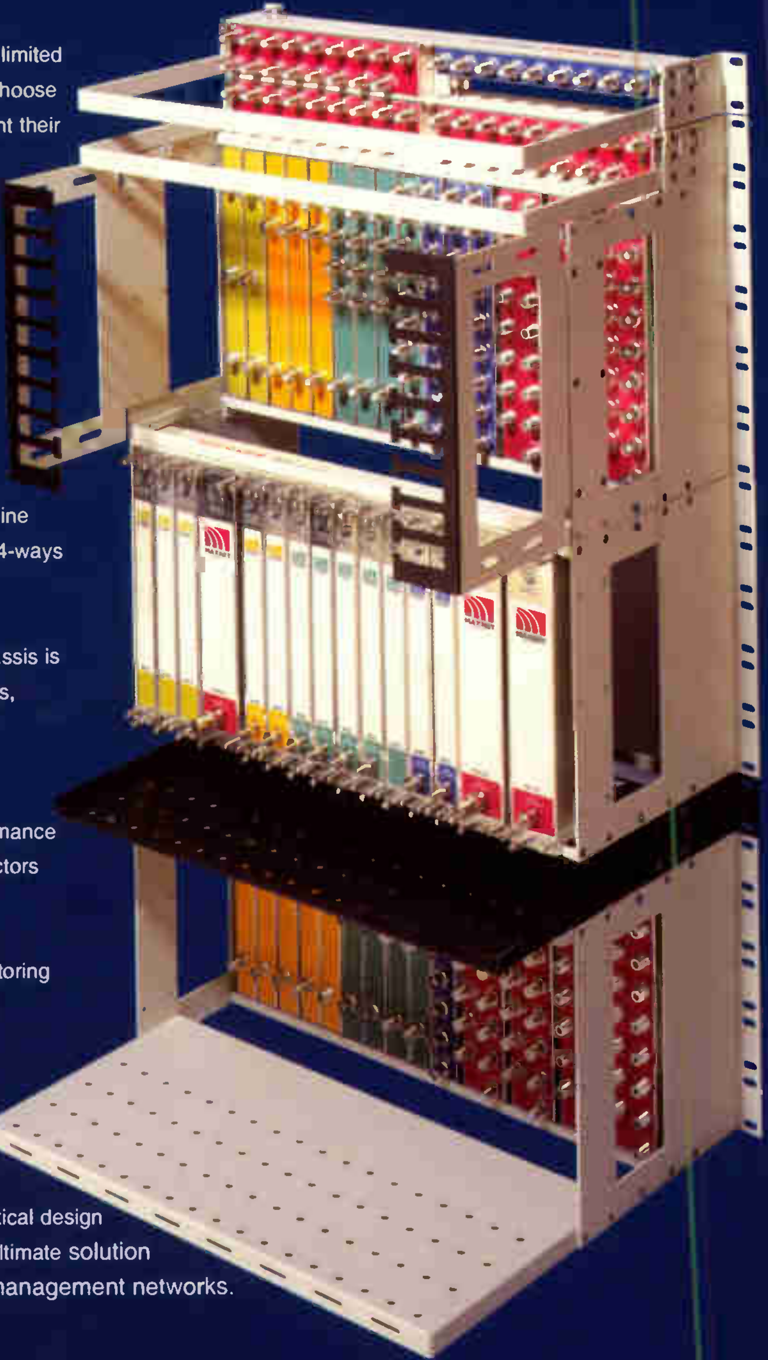

- MAXNET™ provides users with an unlimited number of module configurations to choose from so that they can easily implement their network in any manner they desire. The product lineup includes single function splitting/combining modules (eg. 16, 8, 4 and 2 ways), combination splitting/combining modules (eg. dual 4-way, 4-way/2-way), directional coupler modules and filter modules.
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- MAXNET's 1 rack unit horizontal chassis is capable of housing up to two 16-ways, four 8-ways, four 4-ways and twelve 2-ways.
- MAXNET's digital ready, high performance BNC, CamPort® or Digiport F connectors are available on all modules.
- MAXNET's padding and signal monitoring can be performed without interfering with cables or having to remove the module from the chassis.
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Not only is infrastructure manageient the most complex aspect of the uccessful delivery of high-speed lata, it is also (after the physical netork) the most important. No other spect of high-speed data delivery can elp achieve a proactive posture, nor any other aspect more critical to nabling reliable, consistent service.

Infrastructure management systems iust be able to isolate problems uickly, predict problems and accomiodate emerging services.

cope and support of service

The efficiency of the architecture, ombined with the granularity of ontrol enabled by the management ystem, will determine the scope and uality of your services. The quality of subscriber support you provide vill impact the longevity of your adanced telecommunications offerings.

There is insufficient bandwidth in nost cable networks to accommodate ll services subscribers might wish to onsume. Even worse, the "always n" characteristic of broadband-based ervices is a feature we'd like to take dvantage of, enabling "push" appliations that require continuous subcriber connections.

It's not rocket science. Do the math n how much return bandwidth is onsumed by a single telephone call nd a single videoconference. Now livide that number into the return andwidth a DOCSIS channel proides. The typical HFC network oday can support a paltry number of oncurrent subscribers using either of hese services without corrupting the uality of one or the other.

Once DOCSIS quality of service caabilities are more widely deployed, ie issue of bandwidth scarcity will ecome obvious. The answer lies in ie advanced architectures currently nder development by suppliers and heir goals of deploying broadband ietworks optimized for maximum subscriber concurrency and bandwidth availability.

Strategy and operation

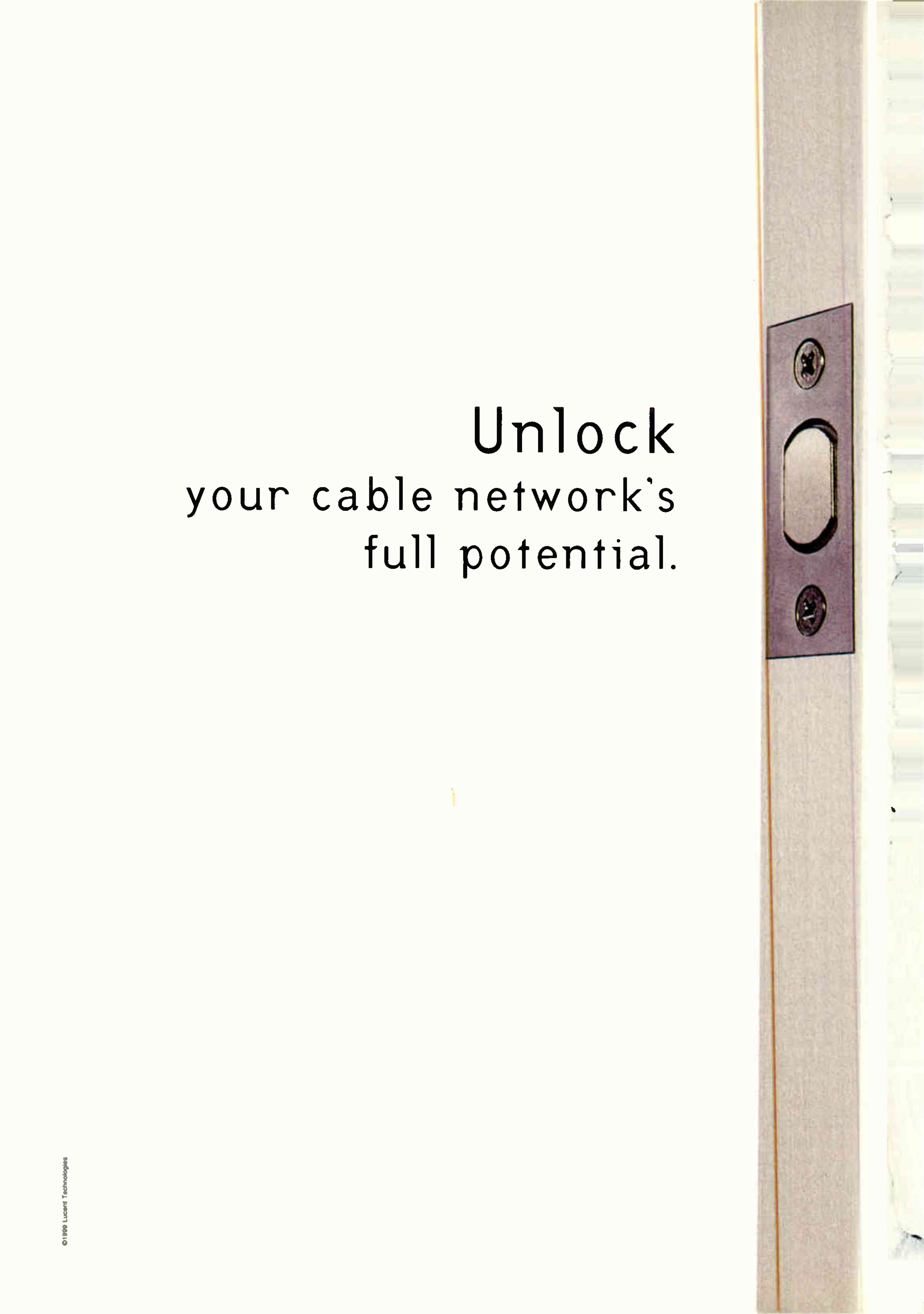
Succeeding in advanced telecommunications services means accepting how much they differ from traditional entertainment. Other than temporary inconvenience, it mattered little in the past if entertainment services occasionally became unavailable, as broadcast TV was the only alternative. Now, however, competition for entertainment services comes from direct broadcast satellite (DBS), utilities and telephone companies. Even more intense competition exists in the advanced services space.

Chalk this up to the phenomenal growth of the Internet and its perceived permanence in our culture, which also happens to be largely responsible for the high valuations most cable franchises now enjoy. Most of the players hope to carve out their piece of cyberspace before it fades into the din of the wired world, as I suggested in my last column.

Competition is fierce and will only get more intense, and few drivers could stabilize cyberspace long enough for traditional business planning techniques to do much good. For every day you fail to move forward in the Internet, you're probably losing a week to the competition. It's moving just that fast.

It's becoming commonly accepted that "Internet time" runs about seven times faster than normal time. Not only do we need to consider the structures of success as different dimensions of the same success formula, but we also need to think about seven times faster than we used to think, about far simpler things. CT

Terry Wright is chief technology officer for Atlanta-based C-COR.net. He can be reached via e-mail at tlwright@c-cor.net.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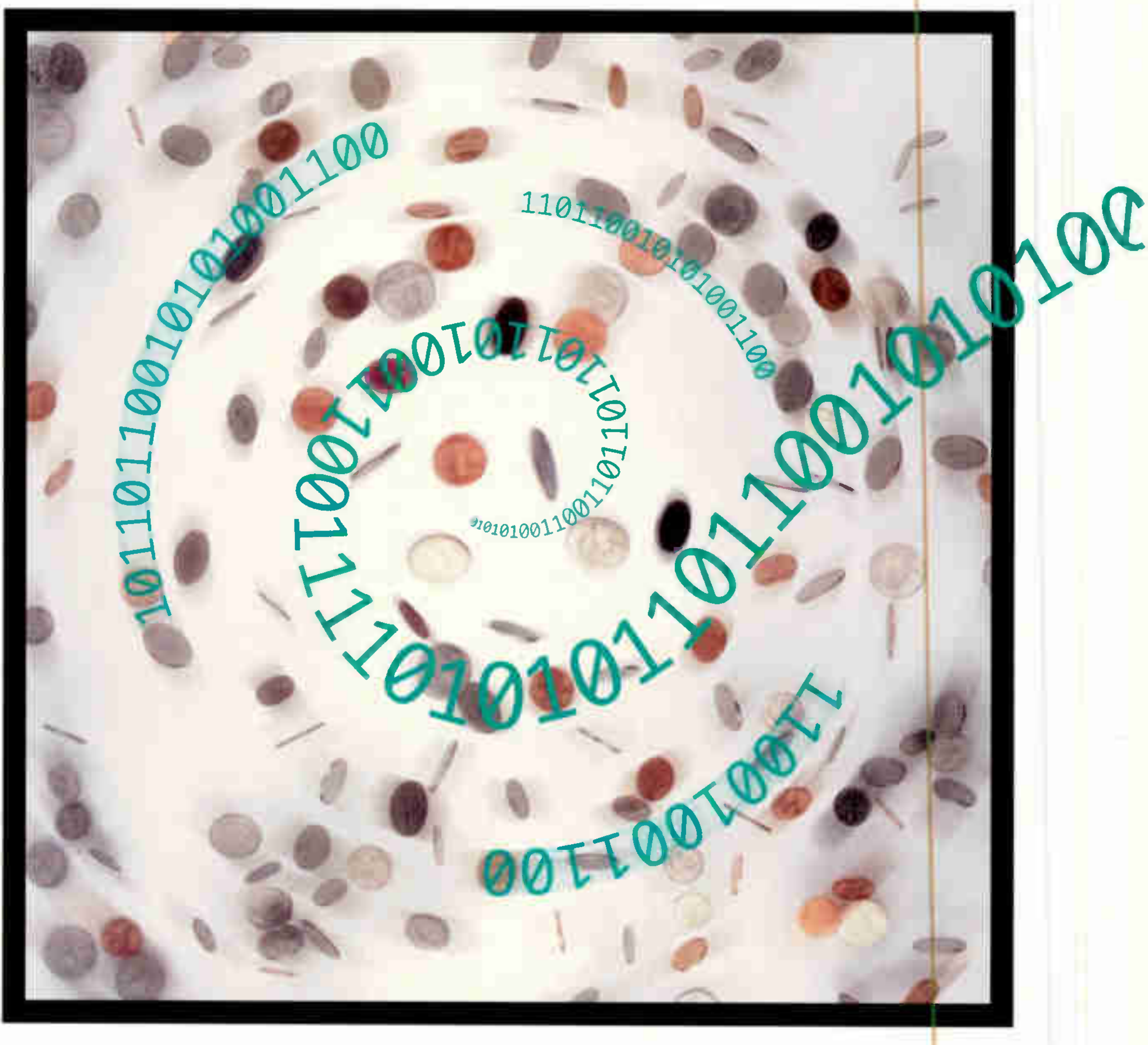
We make the things that make communications work.™

Bandwidth on a



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Budget

Technology, Innovation Stretch Resources

By Doug Larson

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Let's face it, we're heading into a potentially severe bandwidth drought. The launch of interactive services, high-speed data, digital TV (DTV) and telephony is taking its toll on our networks—and our wallets. Unlike victims of a natural disaster, however, we can't write our congressman for federal disaster relief funding to buy more fiber. That's the bad news.

The good news is that getting more capacity out of your existing pipe is not as difficult as trying to squeeze water from the proverbial stone. While there's no $19.95, one-size-fits-all solution, engineers do have a number of technologies available today to maximize their bandwidth without going to the poorhouse in the process. In addition to block conversion in the RF domain, we also now have dense wavelength division multiplexing (DWDM) and digital reverse in the optical domain to cram more of those incremental revenue-generating services through the pipe.

Bandwidth building blocks

While optics quickly are becoming a staple in the transmission world, RF will continue to play a dominant role in signal transport between the home and node. When upstream fiber capacity from the node to hub or node to headend becomes an issue, frequency stacking, or block conversion, is one way to overcome the scarce capacity. It works as follows: Several groups of 5-42 MHz reverse signals—say, from multiple express feeders that converge back at a node—are allocated their own roughly 50 MHz-wide chunk of spectrum in an upconverter.

For instance, one feeder's spectrum of 5-42 MHz signals will maintain their original frequencies; a second feeder's 5-42 MHz spectrum will be block upconverted to frequencies in the 50 to 100 MHz range; a third feeder's 5-42 MHz spectrum will be block upconverted to frequencies in the 100 MHz to 150 MHz range; and a fourth feeder's 5-42 MHz spectrum will be block upconverted to frequencies in the 150 MHz to 200 MHz range. These four groups, now occupying a bandwidth from 5 MHz to 200 MHz, will be combined and fed into a wideband upstream laser and sent to the headend via a single fiber. In the headend, the groups will be block downconverted to their original 5-42 MHz spectrums. Cheaper today than DWDM, block conversion can multiplex as many as 18 5-42 MHz signals onto a single 870 MHz stream, says Mike Whitley, director of product management for outside plant at Antec Network Technologies.

Node-based frequency stacking often is used in existing architectures with large node sizes, where it also can be combined with DWDM to further boost capacity.

"These two technologies, as analog systems, complement each other nicely," says Robert Howald, director of Motorola's transmission network systems engineering group. "(Our) node-based FSS (frequency stacking system) segments four ports, while hub-based DWDM can segment, for example, 16 nodes. As such, an architecture serving 2,000-home nodes can transport 64 independent streams on a single fiber, each stream representing 500 homes, or a guaranteed 70 kHz of simultaneous return path bandwidth per home."

BOTTOMLINE

> Get More out of Your System

The launch of interactive services—high-speed data, digital TV (DTV) and telephony—is taking its toll on our networks and our wallets. Forward and reverse bandwidth is at a premium, and the challenge today is to find innovative ways to get more out of our systems without installing more fiber.

Getting this additional capacity out of our existing pipes is not as difficult as trying to squeeze water from the proverbial stone. Operators today have a number of technology tools available to maximize bandwidth without rebuilding systems. In addition to block conversion in the RF domain, we also now have dense wavelength division multiplexing (DWDM) and digital reverse in the optical domain to cram more of those incremental revenue-generating services through the pipe. As standalone solutions, or in combinations with one another, these technologies will allow you to deliver on the promise of a truly interactive network.

How's that for a convincing economic argument?

At the speed of light

DWDM initially was met with skepticism by cable folks, but now is being deployed to rave reviews.

For John Trail, director of product line management for Harmonic's transmitter systems group, the argument for DWDM is simple.

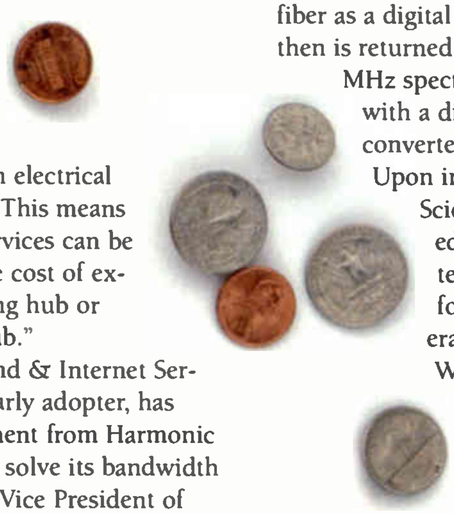
"The primary goal in the new HFC (hybrid fiber/coax) networks is to increase the capability for high bandwidth narrowcast service such as Internet, telephone or video-on-demand (VOD)," says Trail. "DWDM enables operators to create a targeted 'pipe' of narrowcast bandwidth between a central headend and a given node in a specific geographic area without requiring reconversion to an electrical signal at the hub. This means that these new services can be added without the cost of expanding an existing hub or building a new hub."

AT&T Broadband & Internet Services, a DWDM early adopter, has purchased equipment from Harmonic and Antec to help solve its bandwidth needs. AT&T BIS Vice President of Engineering Oleh Sniezko says the operator is deploying DWDM in roughly 30 markets of 100,000 homes passed or larger, as well as some smaller markets. "Wherever we have to deploy secondary hubs, we deploy DWDM," he says.

Dennis Donnelly, manager of customer relations for Synchronous Group, echoes this point.

"The industry is just starting to use the advantage of DWDM to transport QAM (quadrature amplitude modulation) digital (signals) from a central location to many regional facilities," says Donnelly. "DWDM offers the ability to send 16 different digital packages over a single fiber and to cover multiple locations with multiple choices."

Prominent among the potential applications are regional VOD facilities. "The HFC broadband market for forward path DWDM over the next year will continue to see significant demand generated by video-on-demand and, to a lesser extent, telephony and data," says John Decker, fiber-optic group product manager for Philips Electronics.



New kid on the block

Last fall, Scientific-Atlanta and General Instrument introduced the latest weapon in the bandwidth battle, baseband digital reverse. In essence, digital reverse takes the entire 5-40 MHz reverse spectrum and digitizes it, using a high-speed analog-to-digital (A/D) converter, at the node or hub site and then transports it to the headend via fiber as a digital signal. The signal then is returned to the original 5-40 MHz spectrum at the headend with a digital-to-analog (D/A) converter.

Upon introducing its product, Scientific-Atlanta reported that AT&T BIS intended to purchase it for deployment in several markets. For Tony Werner, AT&T BIS' chief technology officer, S-A's baseband digital reverse technology is a critical piece of his company's bandwidth puzzle.

"(Baseband digital reverse) is an essential new tool for network architecture evolution," says Werner. "It provides for cost-effective bandwidth expansion today, but more importantly, it provides the technical performance and economics required to extend fiber deeper into the network." >

> Getting the Gear

Are you feeling the bandwidth crunch? Here follows a list of some of the companies offering bandwidth-maximizing tools to help you get the most out of your system.

Block Conversion

Antec Network Technologies
(678) 473-2000
www.antec.com

Motorola
(215) 323-1000
Toll free: (800) 523-6678
www.gi.com

Scientific-Atlanta
(770) 903-5000
www.scientificatlanta.com

Baseband Digital Reverse

Antec Network Technologies

Motorola

Scientific-Atlanta

DWDM

ADC Telecommunications
(612) 938-8080
Toll free: (800) 366-3891
www.adc.com

Antec Network Technologies

Chromatis Networks
(301) 657-1077
www.chromatis.com

Harmonic Inc.
(408) 5420-2500
Toll free: (800) 788-1330
www.harmonicinc.com

Lucent
(908) 582-8500
www.lucent.com

Philips Broadband Networks
(800) 448-5171
www2.be.philips.com/pbn/index.html

Synchronous Group
(408) 362-4800
Toll free: (800) 659-6750
www.syngroup.com

As with all of these bandwidth-maximizing tools, however, no single solution is right for all operators or all systems. Take Time Warner Cable, for example. Paul Gemme, vice president of plant engineering for TWC, says his company has met with a number of vendors to explore the possibilities of digital reverse, but concluded the technology is a little too late in coming for him to consider using in the distribution plant. TWC is 85-90 percent complete with its plant upgrades, and Gemme says most of the operator's nodes average 500 homes passed and have their own reverse laser feeding a single reverse receiver at the headend or hub site, making digital reverse a moot point.

However, Gemme does see a potential opportunity in using the technology to interconnect some of TWC's remote systems.

"Rather than bearing the expense of establishing a full digital headend for serving small a system that resides, say, 30 or 40 miles from the main division, we could use this technology to provide a reverse path transport on a single fiber from all the nodes in that system, which are combined in the field," he explains. "The technology offers the advantage of muxing several reverse paths together and transporting the data a long way."

Do you want fries with that?

As mentioned earlier, these technologies aren't "either/or" propositions. Frequency stacking or digital reverse can be combined with DWDM within a single network to maximize bandwidth. >

Now your Stealth field unit can "view" headend data from the PathTrak Return Path Monitoring System. Simply put, you can be two places at once to quickly find and fix the source of ingress while cutting down on drive time, manpower and work-related frustration.

Not bad for a day's work. Just one catch — you can only get this Find & Fix solution from Wavetek Wandel Goltermann. Want more good ideas? Take a look at our full line of Find & Fix solutions at ***www.wwgsolutions.com*** or call us at ***1-800-851-1202*** and ***317-788-9351.***

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Communications Test Solutions

How so, you ask? Well, let's take a look at the example of a digital reverse/DWDM implementation.

"These two technologies can be married to great benefit, and in multiple scenarios," says Howald. "Multiple digital streams from either node-based or hub-based transmitters can be combined using WDM or DWDM technology to conserve fiber between the headend and the hub. Because the transmitters are digital, the added length plays a key role in reduction of hub equipment and removal of EDFAs (Erbium-doped fiber-optic amplifiers)."

> **The main issue in the return path is maintaining segmentation and avoiding noise accumulation.**
>
> **—John Trail, Harmonic**

Harmonic's Trail agrees. "The main issue in the return path is how to maintain the segmentation and avoid noise accumulation," he says. "DWDM is an excellent tool for this as it enables aggregation of a variety of different signal types, such as block-converted RF or baseband digital, onto a single fiber."

This is exactly how Charter Communications is combining and deploying the two technologies. In January, Charter announced multifaceted agreements with Scientific-Atlanta to deploy the vendor's 1,550 nm DWDM and baseband digital reverse technologies. Like AT&T, Charter will deploy the technologies in its secondary hubs, which typically serve fewer than 15,000 homes.

"The digital reverse technology provides performance equal to that of an uncooled DFB (distributed feedback) return transmitter at distances of 117 km," explains Don Loheide, director of Charter's engineering staff. "Once the return signal is digitized, DWDM enables the transport of return signals from up to 16 nodes on a single fiber."

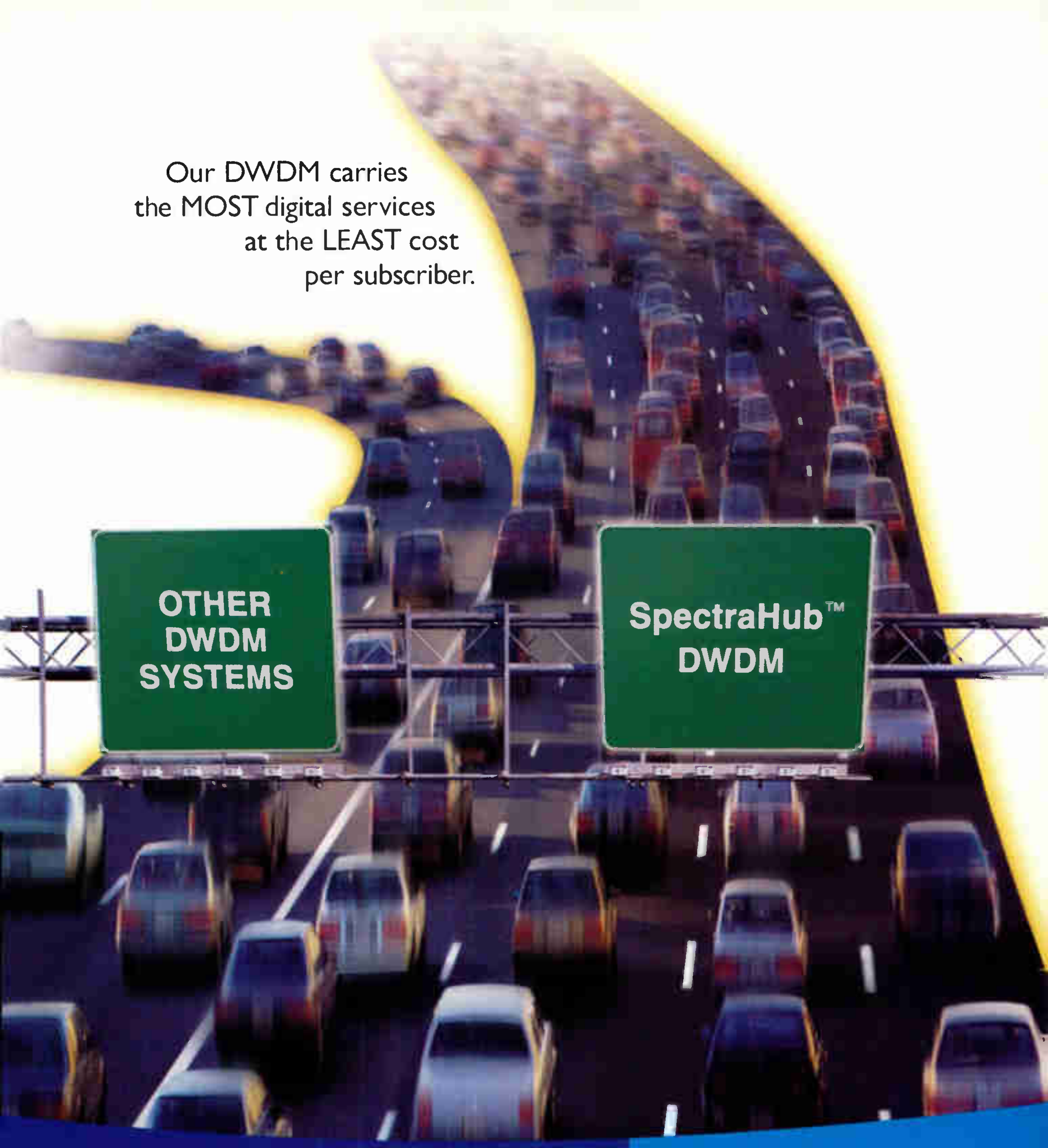
Loheide says his preferred method of deploying digital reverse, and the one Charter is using for all of its upgraded architectures, is to move it to the node.

"In this scenario, the return signal is digitized right in the node," he says. "It is then transported back to the secondary hub on a wavelength on the ITU (International Telecommunications Union) grid. In the secondary hub, the return signals from up to 16 nodes are combined through a DWDM multiplexer on to a single fiber for transport to the headend. The only equipment placed in the secondary hub is passive and requires very little maintenance."

Conclusions ... sort of

So, what's the bottom line for you and your systems? Well, there really isn't a one-size-fits-all solution. Like everything these days, it all comes down to planning for the future. However, the current marketplace abounds with viable possibilities for nearly any system, and the future offers even more. As we move into broadband's future, keep an eye on these pages to help keep up with the ever-changing technoscape. CT

Doug Larson is senior editor of "Communications Technology." He can be reached via e-mail at dlarson@phillips.com.



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DWDM Meets Block Conversion

A Bandwidth-Saving Marriage

By John Kenny and
Emmanuel Vella

Two technologies can be better than one. By combining dense wavelength division multiplexing (DWDM) with RF block conversion, engineers get more return bandwidth on existing fiber and reduce the fiber needed between the hub and headend.

Needing fewer fibers between the hub and headend has several advantages. It lowers cable costs in new installations and reduces the requirement for additional installations. It frees up fibers to provide redundant path diversity, and it reduces the time to fusion-splice fibers after a cable cut. Block conversion and DWDM have each been used independently to concentrate returns from the hub to headend. But they also can be used together.

Block conversion by itself allows up to 18 5-42 MHz or 12 5-65 MHz returns to be carried in the forward band of 45-870 MHz. Initially, the DWDM return path architecture envisioned eight wavelengths being used, and early installations generally had no more than four. Recently reported work, along with experimental verification, derived design rules for analog DWDM systems with up to 32 optical channels. Using both of these technologies together further economizes fiber usage. Eventually, we will be able to carry at least 18 x 32 = 576 independent 5-42 MHz return path signals on a single fiber.

System design

One of the main objectives in system design is to control noise and noise-like impairments. Figure 1 (on page 64) shows sources of noise in a block-converted DWDM system. Most of these noise sources are controlled by proper equipment design and by operating the equipment at recommended RF levels. When designing your system, you'll need to engineer the optical path to keep crosstalk interference and optical path noise contributions in check.

Controlling nonlinear crosstalk among optical carriers on a single fiber is an important consideration in DWDM system design. Fiber nonlinear effects, such as cross-phase modulation, four-wave mixing and stimulated Raman scattering, all contribute to crosstalk among the signals modulating each optical carrier. The level of crosstalk depends on the power per optical carrier launched into the fiber, subcarrier modulation frequency, optical carrier spacing and the number of optical carriers. >

BOTTOMLINE

> ## Combining DWDM and Block Conversion for Upstream Efficiency

Several technologies have been developed to concentrate hub-to-headend return paths onto fewer fibers. Operators must weigh short-term startup costs against longer-term maintenance, upkeep and reliability costs when deploying architectures for the upstream optical network.

Block conversion and dense wavelength division multiplexing (DWDM) have each been used independently to concentrate returns from the hub to headend. Using both of these technologies together further economizes fiber usage. We will eventually be able to carry at least 18 x 32 = 576 independent 5-42 MHz return path signals on a single fiber.

In the power range of interest, the crosstalk degrades at a rate of 20Log(Pf), where Pf is power per optical carrier. Thus, you may always control crosstalk interference by launching appropriate optical carrier powers. For this application, a fortuitous property of crosstalk among DWDM optical channels is that the interference decreases with increasing frequency. The forward path frequency range experiences less crosstalk interference than is experienced at 5-42 MHz.

Thus, by shifting the return band higher in frequency as is done in a block-converted system, more optical power may be launched into fiber for the same crosstalk level. Crosstalk degrades as the number of optical carriers increases. The relationships among crosstalk, optical carrier spacing, number of optical carriers and modulating frequency are more complex. Usually, closer optical channel spacing (100 GHz vs. 200 GHz) is preferred for greater than about 12 optical carriers and subcarrier frequencies above about 50 MHz.

Laser selection

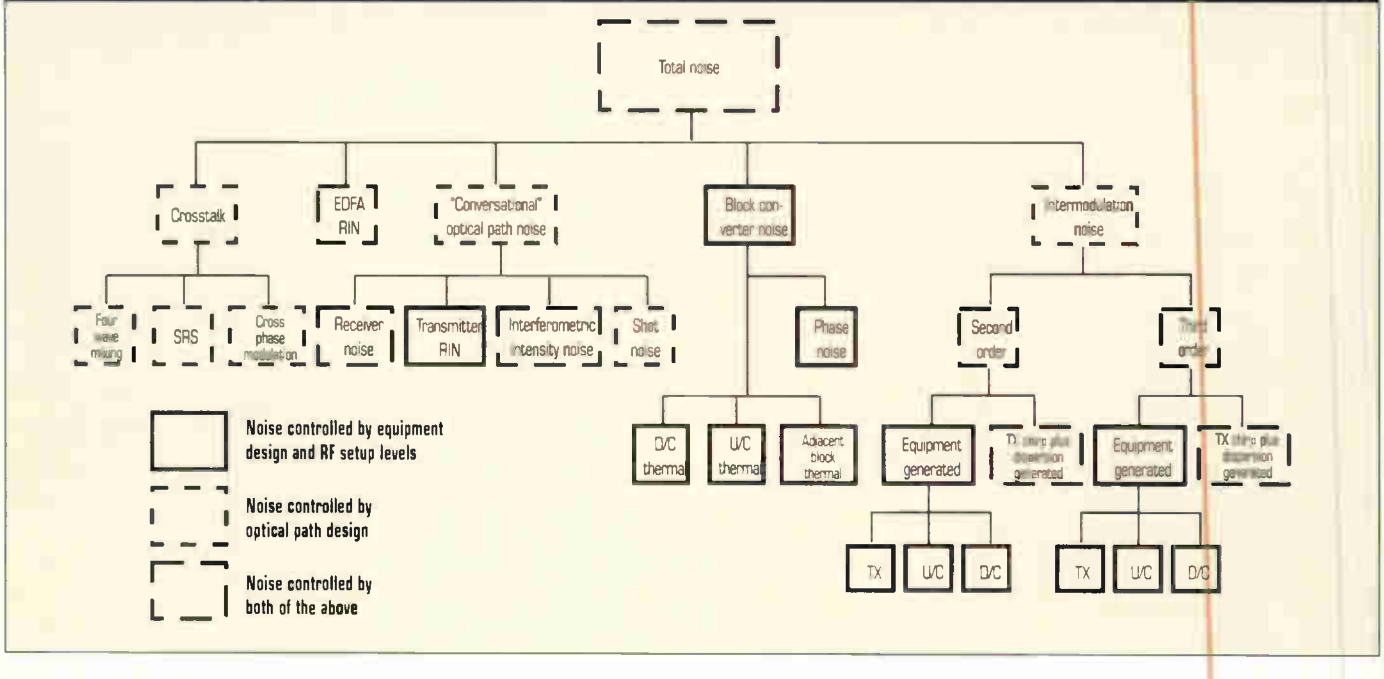
Another design tradeoff is the choice of 1,550 nm DWDM optical transmitter technology. A directly modulated distributed feedback (DFB) laser is significantly less costly than an externally modulated optical transmitter. Because of laser chirp combined with the high chromatic dispersion of standard single-mode fiber at 1,550 nm, the directly modulated optical transmitter's useful frequency range is limited to an octave because of the generation of second order distortion. Therefore, it is limited to carrying nine 5-42 MHz returns.

An externally modulated transmitter permits the use of the entire 45-870 MHz frequency range, and twice as many blocks (18) may be carried per transmitter. The directly modulated transmitter may be operated at a significantly higher optical modulation index per return than an externally modulated transmitter; therefore, the optical path noise performance may be 2-3 dB better than that of an externally modulated transmitter. A case-specific study is required to determine the more cost-effective transmitter type providing the required performance.

Application examples

Crosstalk and other system parameters, as discussed earlier, limit the power per optical carrier launched into the fiber. This might severely limit the optical path length and noise performance, were it not for the use of optical preamplification at the receive end of the optical path. An Erbium-doped fiber-optic amplifier (EDFA) at the headend acting as a preamplifier, as shown in Figure 2 (on page 66), greatly extends the maximum optical path distance from a few kilometers to

FIGURE 1 NOISE IMPAIRMENTS IN A BLOCK CONVERTED DWDM SYSTEM



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The IsoMeter™. Now there is a fast and easy way to test the home cabling for resistance to signal ingress. The RSVP generates a special 28 MHz test signal. The installer uses the IsoMeter to track down leaks in the cabling. Moving in the direction of the leak causes a rise in pitch, quickly pinpointing its location.

The 9580-SST™. The SST headend unit collects balancing and ingress measurement data from one to eight test points, and transmits updated measurements to the SSR field units, the second component of the 9580 system. The SST operates as an ingress monitor, receiving 80 ingress samples per test point, per second.

The 9580-SSR™. Up to six SSR field units can communicate with one SST simultaneously. The SSR displays ingress and reverse sweep information. The 9580 and GUARDIAN products are a complete return path maintenance system designed to test and service the entire return path.

The 9580-TPX™. The 9580-TPX offers a very attractive alternative for monitoring a large number of return test points for ingress at a relatively low cost. The TPX is fully compatible with the 9580-SST, expanding capacity up to 64 test points.

Ingress Management Software. Allows the operator to set up a powerful ingress monitoring system for hundreds of reverse path test points. IngressManagR™ compares the ingress spectra measured at each test point to its own user-settable limits, logs data, sounds alarms, calls pagers and initiates other programmed responses if the ingress exceeds those limits.

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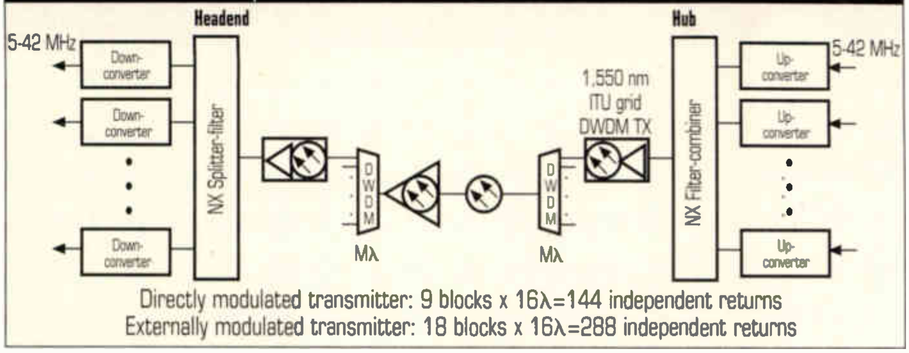
FIGURE 2 SYSTEM DIAGRAM FOR BLOCK CONVERSION WITH DWDM



40 km or more. Intermediate inline amplifiers may be used to further extend that distance.

We have analyzed three examples based on the architecture of Figure 2, using directly modulated DWDM transmitters. The noise-to-power ratio (NPR) performances of eight, 16 and 32 wavelength DWDM systems using nine return blocks on each wavelength are shown in Table 1 (on page 67). The assumed optical path length is 40 km.

In each case, the dynamic range is at least 8 dB based on all nine 5-40 MHz blocks modulating an optical carrier varying in level, or at least 15 dB based on a single 5-40 MHz block varying in level. This level of performance is compatible with the transmission of typical return path signals such as frequency shift keying (FSK), quadrature phase shift keying (QPSK), 16-QAM (quadrature amplitude modulation) or 64-QAM modulated carriers with at least ± 4 dB levels tolerance.

The optical path contributions to NPR dominate over the block converter contributions by 7-8 dB. The variation of NPR with number of wavelengths is relatively small. Two factors contribute to this effect.

One is that optical multiplexer insertion loss increases as the number of wavelengths (optical multiplexer ports) increases. This reduces the optical power launched and results in a crosstalk level that is nearly the same for eight, 16 or 32 wavelengths.

The second factor is that the optical amplifier used for 16 wavelengths is assumed to have 3 dB greater saturated power than the one for eight wavelengths, and the one for 32 wavelengths has 3 dB additional output power. This results in a nearly constant optical power incident on the receiver.

It is possible to trade off dynamic range for normal operating level NPR. For example, greater than 40 dB NPR can be achieved with eight wavelengths and a 2 dB reduction in dynamic range. Alternatively, fewer blocks per optical carrier also can permit higher NPR performance.

Economic comparisons

A major objective in return path design is to eliminate or minimize the size of the secondary hub location, while reducing fiber counts. The physical reduction of the secondary hub location and its conversion into a passive or transparent location is attractive because it reduces associated operating and maintenance costs. In addition, you need to consider the type and extent of test equipment required for system activation and optimization when making decisions regarding equipment alternatives for the return.

We recently designed a return path architecture to for 40 node locations (with each segmented for two return paths) for an equipment deployment in the Midwest. We prepared several alternative scenarios. (See Table 2 on page 67.) They include:

1) Conventional 1,310 nm uncooled DFB return from the node with DWDM 1,550 nm International Telecommunications Union grid DFBs for hub-to-headend transport

Network Management

Headend and Hub Management

Automated Test Systems

RF Distribution Status Monitoring

Unified Network Management Solutions

CHEETAH™ TECHNOLOGIES

A Supplement to Communications Technology

Modern Status Monitoring

By Rex Porter, Editor in Chief
Communications Technology magazine

There has been a lot of discussion and lots written about the question of when the 21st Century actually begins. For me, it began when I stopped writing 19XX in my checkbook and started writing 20XX. In any event, it's time to say goodbye to "cable TV" of the 1900s and to rethink the importance of your "broadband networks." We can reminisce, but we cannot remain! With the dawn of a new century, each broadband network will become part of the backbone for a global broadband network. Such rethinking may not have been as important to community antenna television, but it is crucial for global Internet access and the future of worldwide Internet protocol (IP) telephony.

Clustering of broadband networks among multiple system operators (MSOs) introduced some anxiety within engineering ranks. Since networks from different MSOs use different equipment, both in the system and the headend, network monitoring required easy interface with multiple-vendor equipment.

In the past, we have given little thought to how local broadband networks will soon link with other broadband networks in other U.S. cities. Much of the interface has been through existing telephone systems, but this will change as broadband operators demand their signals remain "secure" from other telecommunications industries (except where absolutely necessary). One has only to study MSO involvement in telephony to realize this change is coming. And we won't wish to communicate only within the U.S. or Canada. How will these signals reach International broadband systems? We have interface with fiber and satellite, so it is doubtful we will allow our signals to be transported by others (except where absolutely necessary).

To become part of a global broadband network, our U.S. broadband networks must become more sophisticated. Status monitoring will concern more than fiber nodes and power supplies. We will have to begin to monitor network loading and server-modem applications. Such monitoring will allow alternative routing and switching before such an overload occurs.

Modern status monitoring can aid engineers in the evaluation of new products used on a trial basis within certain nodes or at select customer premises. That means status monitoring can save recurring losses. One can reminisce that one of our leading engineers spoke recently about how MSO drop cable will be replaced in total about every three to four years. We have more customer drop cable in our broadband networks than any other single product. And when the drop is replaced, so are the connectors. It is now estimated that a truck roll costs more than $100. The only profitable "roll" is one to connect service to the customer.

Superior network monitoring and management must be a part of budget planning each year. Deployment of such monitoring systems will ultimately save money for the operator and owner. These systems will allow the engineering department to identify powering deficiencies, which will create Internet and data failures. A modern broadband network cannot provide telephone service unless power is available on a 24-hour basis. Therefore, monitoring is necessary to assure "constant" customer service.

Planning and implementation of status monitoring and network management systems will result in fewer truck rolls, low failure rates and high customer satisfaction grades. Our broadband system image must be elevated past any competition, be it telephone, utilities or direct broadcast satellite (DBS). ■

A Supplement to
Communications Technology

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Unifying Your Network Management System

By Brett Price, President
Cheetah Technologies

Network management is a technology in transition, expanding beyond simply reporting failures and scheduling maintenance calls. And as the nature of our industry changes, it will be increasingly important to deploy network monitoring and management as a critical competitive element in rolling out new Internet and telephony services.

To achieve this goal, cable operators will need an integrated solution that allows them to correlate fault, signal quality and element status from their headend, hubs and outside plant. In addition, they will need to address the growing numbers and types of components to monitor, link multiple management systems and find rapid solutions to return path problems.

Cheetah's Unified Network Management System reaches across multiple systems and services to provide cable operators with a single management environment for the hybrid fiber/coax (HFC) access network. The entire Cheetah solution is designed to work either as "best of breed" individual systems or as an integrated overall network management solution.

Supporting multi-vendors With open interface

At Cheetah Technologies, we are committed to developing and delivering standards-based products with open interfaces to support multiple vendors. An example is the Phasor™ Return Path Management system. With Phasor's open interface, the system integrates with field meters such as Agilent's Calan 3010R. This combined solution provides cable operators with the ability to remotely troubleshoot return path problems from the field.

With ObjectArchitect™, you can reduce the time and money spent building, debugging and maintaining network communications interfaces. It allows you to integrate devices from many manufacturers, bringing additional headend capacity like datacom and cable telephony under the Cheetah network management umbrella.

Linking multiple Management systems

As a cable operator, you need to protect your investment. Cheetah is uniquely positioned to deliver maximum return on your overall network management investment—a network management solution that leverages information to deliver benefits beyond the capabilities of its individual components. Designed to satisfy immediate network management requirements while providing a platform for integration with emerging technologies, NetMentor™ provides:

- A scaleable and extensible architecture to keep pace with your network's physical growth
- An open systems architecture to integrate easily with higher-order operational support systems (OSSs) as your information management needs evolve.

Solving return path Mysteries

One of the biggest challenges facing cable operators looking to rollout interactive services is managing the return path. With Phasor, signals are captured digitally providing new capabilities for analyzing data and managing your return path. Phasor catches transient signal impairments as they occur to help you identify and locate ingress faster. An added dimension for Phasor is that it is integrated with the NetMentor network management framework, providing a single screen to manage and monitor your entire plant, both forward and return path.

Professional services And training

We don't stop at delivering high quality products and solutions. With Cheetah's professional services, we are there from installation to turn-up, with training and customization of the system to meet your business practices. Our Professional Services Group is dedicated to helping you succeed in maximizing the value of your network management system.

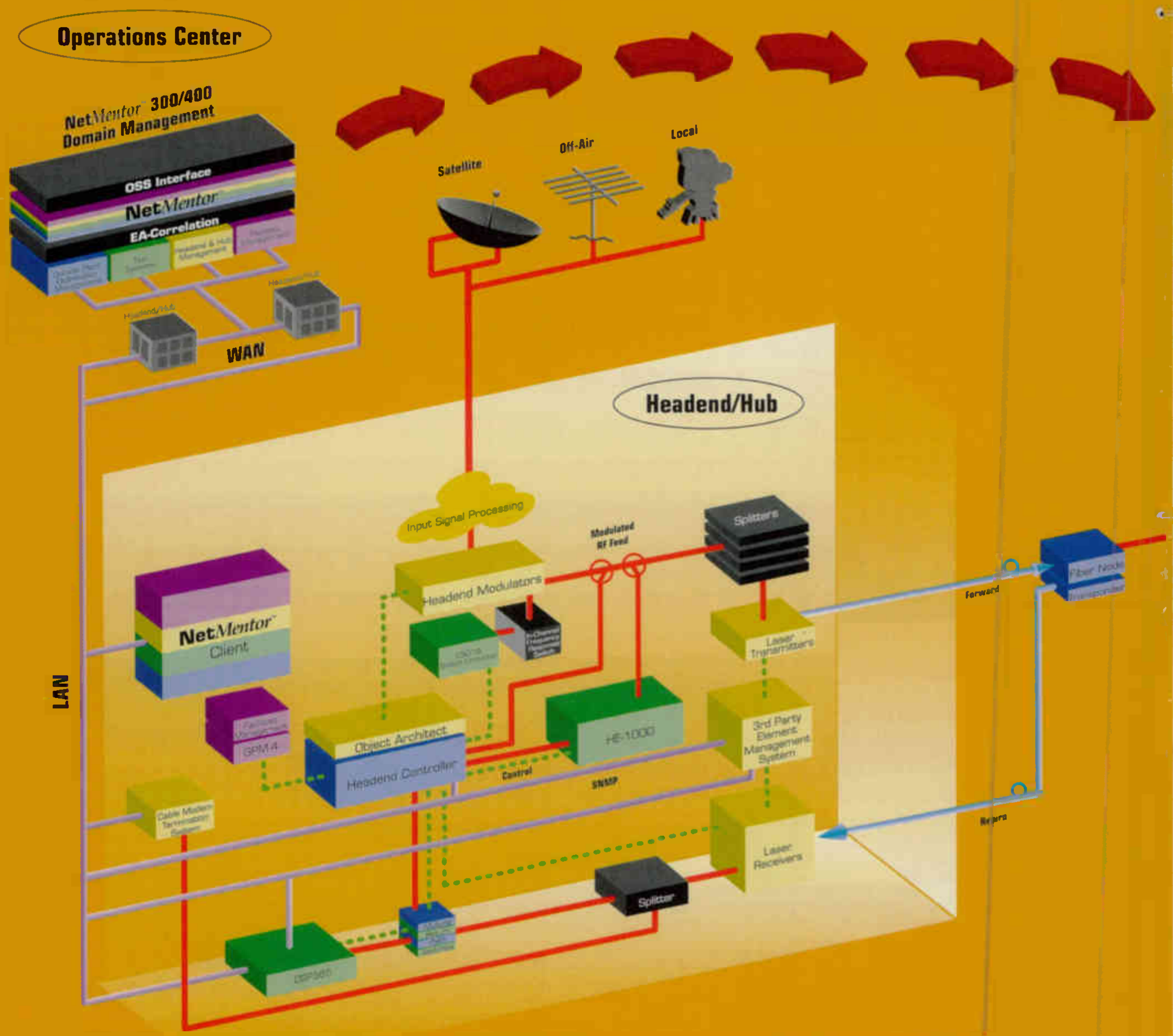
Unified. One system. One solution.

The bottom line? The Cheetah Unified Solution saves you money by leveraging your investment in plant monitoring through the implementation of a full network management solution. This unified, integrated solution enhances the overall value of your network management system by pulling together disparate components onto one screen—reducing overhead, simplifying training and improving efficiency.

Whether you are actively evaluating network management solutions or simply seeking additional information on return path management or status monitoring, I urge you to look into the Cheetah suite of network management solutions. ■

CHEETAH TECHNOLOGIES™

HFC Network D



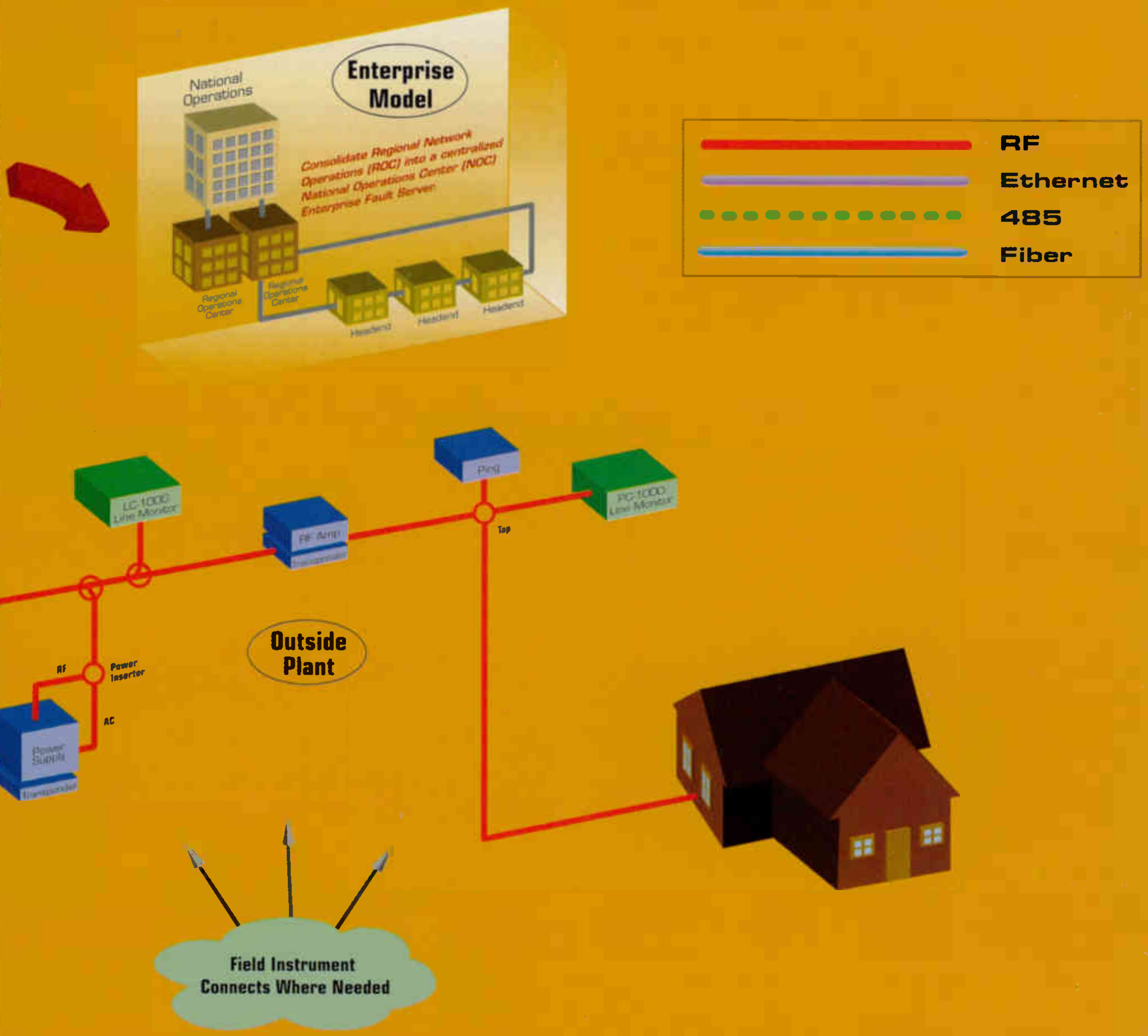
Network Management

NetMentor™ is a HFC management framework that intelligently integrates Distribution System Status Monitoring, Headend/Hub Management and Test Systems.

Automated Test Systems

Managing network performance through forward and return path monitoring. Phasor™ Return Path Management System is best-of-class in standalone and unified configurations.

omain Management System



▲ — **Distribution System Status Monitoring**
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Strong Product, Reliable Network and Happy Customers

Cox Communications Raises the Bar for Broadband Telecommunications Providers

By Doug Larson, Senior Editor, *Communications Technology* magazine

Setting the standard for excellence in the telecommunications industry, Cox Communications has taken the lead on the broadband telecommunications provider playing field. From its highly trained staff to its cutting edge network to the thousands of satisfied customers across the nation, Cox clearly is the example to follow in our industry today.

Says who?

Year-after-year Cox has emerged as a "Best Practices" case study. Don't take our word for it, the list of accolades for Cox is enough to leave any operator salivating at the mouth.

- *Inter@ctive Week's* Interop Infr@structure Award for "Most Innovative Cable Company" at Networld+Interop, 1998 & 1999
- The J.D. Power Award, 1996
- #1 in customer satisfaction among cable multiple system operators (MSOs), 1997 & 1998
- *CT's* "Service in Technology Award," for the year's greatest contributions to the cable engineering community, 1999

Secrets of success

More important than the awards and recognition, Cox has proven to be an industry leader through its consistent success. At the bottom of this success is Cox's unwavering commitment to providing quality services to its customers and communities through growth and innovation. Vendor partner Cheetah Technologies has been there to support Cox's mission with industry-leading products, product support and first-class training. This mission, supported by companies like Cheetah, has been the catalyst for Cox's growth and success over the last couple of years.

Early last year, Cox set a goal to close out the year with between 450,000 and 500,000 new-service revenue generating units (RGUs), which include its local and long distance telephone services, and high-speed Internet access. When all was said and done, Cox wrapped up 1999 with more than 550,000 RGUs—no small feat considering that Cox is going up against the likes of U.S. West on the telephony front.

Cox recognized early on that technology must fully serve its customers' needs. Customers don't understand, nor do they care about, the complexity of the underlying network. They simply want the same level of service they have become accustomed to receiving from their incumbent local telephone provider.

To meet customer expectations, Cox takes a proactive role in monitoring its network. By quickly pinpointing problems in the network, Cox is able to take action quickly to resolve them. Using products like Cheetah's NetMentor, Cox is able to identify and isolate problems such as network outage. In addition, it allows network administrators to select action items that will automatically contact and deploy field technicians for repair, based on reported alarms such as power outage.

Proactive. This is same philosophy Cox has applied in each of its telephony rollouts. Cox serves more than 100,000 customers in nine markets, with an eight-percent average penetration rate across all of its markets.

Proper planning

When Cox launched its Digital Telephone service in Orange County, Calif., in Sept. 1997, it did so with a network design philosophy that the company today still applies in each of its launch markets:

1) Buy all of the reliability insurance it can afford

2) Minimize its exposure to known problem areas through 24/7 surveillance, employee training and development, plant conditioning, backup generators and so forth; and

3) Prepare for the unexpected.

To achieve this goal, Cox established a series of minimum plant upgrade requirements before turning up service. The prerequisites call for a plant upgrade to 750 MHz, an activated and conditioned return path, redundant forward and return fiber-optic paths, four hours of standby power, and reliable status monitoring.

Cheetah's NetMentor™ network management system, which is installed in nine of Cox's clustered markets, plays a critical role in this equation.

"HFC (hybrid fiber/coax) fault management helps us maintain the high network availability that is required to be a successful provider of new services like telephony, high-speed data and digital cable TV," says Ron Zimmerman, corporate status monitoring manager for Cox Communications. "It has provided us remote monitoring of the critical network elements in our telephony systems, and we do that monitoring from our 24/7 NOC (network operations center) here in Atlanta."

Zimmerman adds, "Some of the value that it adds for us is that we monitor the critical network elements, like the power supplies and nodes, to identify potential network faults and report all service-affecting fault conditions to the appropriate field personnel."

Cox also is using Cheetah's Phasor™ software and DSP565 hardware for monitoring and troubleshooting ingress in its return path. The system, which initially was installed in the MSO's San Diego system, uses digital DSP-IF (digital signal processing-intermediate frequency) technology.

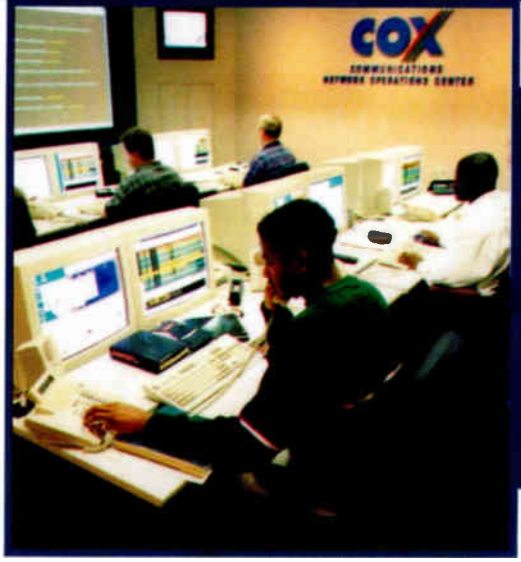
"(We are) planning on performing proactive, real-time return path ingress management and historical trend analysis using the Cheetah Phasor system," says Zimmerman. "The system also provides a remote spectrum analyzer that can be used to assist field technicians with return path troubleshooting."

In addition to the performance monitoring, Cox's Atlanta NOC also handles data collection, which it then makes available to field personnel in all regions via its NOCNET Intranet site. NOCNET can, for example, provide information on upgrades and plant maintenance for any city by fiber node, by hub site or by individual voice port. In fact, the system can even tell a technician how many times a particular voice port or NIU (network interface unit) on the side of a house has been up or down.

Power in partnership

By proactively monitoring the health of these elements, Cox is able to issue trouble tickets and dispatch crews before problems are detected by the customer—and thus prevent customer dissatisfaction.

But Cox doesn't just buy equipment off the shelf and hope for the best. An important element in Cox's corporate strategy has been its vendor partnering activities. "As part of our commitment to deliver quality, we seek strong technology solutions," says Hugh McCarly, director of engineering technology at Cox. "We look to vendors, such as Cheetah, to support our vision and goals by delivering innovative solutions and support."



While being able to monitor the health of its network from day one has enabled Cox to deliver a higher quality product to its customers, managing alarm flow can be labor intensive. To troubleshoot alarms, an NOC operator first must access regional servers and go interactive with regional devices. In an effort to reduce time associated with viewing these regional servers individually, Cheetah met Cox's requirements to centralize all NetMentor alarms from the nine markets into a single Atlanta NOC-managed system through a product called Enterprise Fault Server™.

"This solutions is going to simplify our filtering capabilities by pulling nine markets into one screen," says Dave Fears, Cox's NOC director. "Our next step is to move beyond seeing the alarm to remotely troubelshooting down to the regional devices such as power supplies and nodes from the NOC."

Cheetah also has completed custom integrations for Scientific-Atlanta node transponders, and monitoring of generators that back-up standby power supplies.

Training

Employee training and development also has played a critical role in the success of Cox's new service offerings.

To make sure its NOC personnel understand and get the most out of the system, Cox has worked with Cheetah to send its personnel through Cheetah's NetMentor training within a month of system turn-up. "I took two courses, the Operator and Administrator, down in Sarasota," says Zimmerman. "We actually recommend that our local administrators attend the course as they're deploying the product." The instruction includes lecture, demonstration and performance training, and lab exercises.

In addition to this hands-on training, in 1998 Cox launched Cox University, an online, intranet-based platform designed to develop and educate its employees. The Intranet site includes information about such things as @Home deployments and equipment deployed in the field.

Cheetah works with Cox, for example, to provide up-to-date manufacturer content, including documents, part numbers, performance specs and so forth. This gives technicians in the field real-time access to the information they need to address problems in a timely, proactive manner.

If the past is any indication of things to come, Cox will remain on the bleeding edge of the broadband telecommunications revolution. It will stay there by embracing the same vision and values that have gotten the company where it is today and by continuing to forge strong relationships with its vendor partners. ■

GAIN THE ADVANTAGE

WITH THE UNIFIED NETWORK SOLUTION

One System. One Solution.

More cable operators use the Cheetah Unified Network Management System than all other systems combined. Why? It provides operators with the information they need to better manage their systems. And it saves money. By pulling together individual components onto one screen, this comprehensive system reduces overhead, simplifies training and improves efficiency. Separately, Cheetah products stand out as peak performers. As a total system, they're way out front. **Cheetah. Unifying Your Network.**

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2) 1,550 nm ITU grid return transmitter at the node with DWDM at the hub for hub-to-headend transport [illegible] for

3) Conventional 1 3[illegible]port

[illegible]pare costs of these scenarios, [illegible] consider the capital equipment hat's required at the headend, hub and node locations. Include the total rack space that's required for equipment mounting. This will determine real estate needs at both the headend and hub locations. These real estate costs can add considerably to system upkeep costs over time.

As shown in Table 2, option No. 2 (with ITU grid lasers provisioned in he node) was the most space efficient lternative at the hub location, folowed by option No. 3 and No. 1. However, space efficiency savings need to be weighed against total capital equipment and per link costs.

The combined block conversion and DWDM solution in option No. 3 offered the most cost-effective solution in terms of the initial capital investment and fiber counts. Option No. 3 also was attractive in terms of the total ack units required for deployment, mpared to option No. 1. In addition, it's important to consider power consumption at the headend, hub and node locations and their associated osts over time, as well as the cost of stem maintenance and reliability.

Economic criteria remain at the orefront of any decision-making process regarding architectures for the upstream optical network. Operators must weigh short-term startup costs gainst longer-term maintenance, upkeep and reliability costs when making this decision. Combining DWDM and block conversion offers a possible ost-effective solution. CT

John Kenny is principal engineer at Antec Corp. Emmanuel Vella is vice president of product management, active electronics, at Antec. Kenny can be reached via e-mail at john.kenny@antec.com. Vella can be reached at emmanuel.vella@antec.com.

TABLE 1 NPR PERFORMANCE OF DWDM WITH BLOCK CONVERSION

wavelengths	Noise-to-power ratio (dB)	Total number of 5-42 MHz blocks
8	38.0	72
16	37.5	144
32	37 0	288

TABLE 2 RETURN PATH COST COMPARISON

Return path option	Nodes (2 returns per node)	Headend rack units	Hub rack units	Fibers hub to headend	Cost per link
Conventional DWDM: 1,310 nm node return to hub, ITU grid DFB return TXs multiplexed at hub and transported to headend	40	52	102	5	$7,500
ITU grid return Tx in node 1,550 ITU grid node return to hub, multiplexed via DWDM mux at hub and transported to headend	40	52	22	5	$6,000
Block converter + standard DWDM 1,310 nm node return to hub, nine 1,310 nm returns are RF combined and frequency upconverted for transmission via ITU grid 1,550 nm TXs, which are multiplexed at the hub and transported to headend	40	45	75	1	$4,500

TROUBLE-SHOOTING

Fix PC and Modem Problems Without

a Truck Roll

By Bruce Bahlmann

Troubleshooting cable modem and personal computer (PC) problems generally doesn't receive much attention. It's a buried "action item" in a long list of things each broadband operator worries about when launching an Internet information service.

However, not long after launching high-speed data service, troubleshooting PC and modem problems becomes infinitely more important, and failure to plan for it in system design decisions impedes efforts to add these facilities post-launch.

Cable modem and PC troubleshooting consists of problem-solving and escalation. Through proper implementation of these items, customer problems can be resolved quickly, with optimal use of your subscriber management system, technical support staff and a software application called a troubleshooting tool.

Problem-solving

Problem-solving is an interactive task. During this interaction, you'll need to identify the customer and determine the source of the problem. Depending on the broadband operator, initial contact with the customer, problem discovery and the actual problem resolution may involve several support personnel or third parties. It may span a period of minutes to days, depending on the problem encountered.

Regardless of who is involved, the problem-solving process is relatively the same. Figure 1 (on page 70) describes a typical cable modem and PC troubleshooting process. Through this process, you'll be able to identify and correct a majority of the problems associated with cable modems and PCs. And you'll accomplish most of this during the initial dialogue with the customer.

This process begins with a short discovery period where the broadband service representative (BSR) identifies the customer, accesses the account, reports the problem and opens the trouble ticket. If the problem is technical in nature, BSRs follow the process in Figure 1 beginning with "Start Level 1 support" until they have either identified and corrected the problem or escalated it to the next tier.

The key to this process is to correct all common-sense type problems that can be done easily over the phone. This process is in addition to any standard BSR script. For example, a BSR script might first ask customers if their cable TV reception is OK or whether the customer changed any wiring in the home. If the customer passes these checks, the BSR then guides him or her through the cable modem and PC troubleshooting process.

Troubleshoot the modem

A troubleshooting tool provides BSRs with critical information that allows them to dissect the customer's problem. Because the cable modem precedes the PC in terms of connectivity, it serves as a good place to break down the problem. Here, the goal is to divide the problem in half and continue to divide the problem until its source is found. Typical problems associated with cable modems include:

- Wiring—bad initial install, customer alteration, damage
- Connectors—poorly secured, customer alteration, damage
- Signal—too hot, not enough, filtered, ingress
- Provisioning—removed by mistake, customer exchanged
- Hardware—device failure

The troubleshooting process usually begins by pinging the cable modem. If you cannot successfully ping the modem, the process focuses on probable causes, such as unplugged AC/RF. Any causes that are corrected, such as reconnecting the AC, require the BSR to re-attempt a ping to the cable modem.

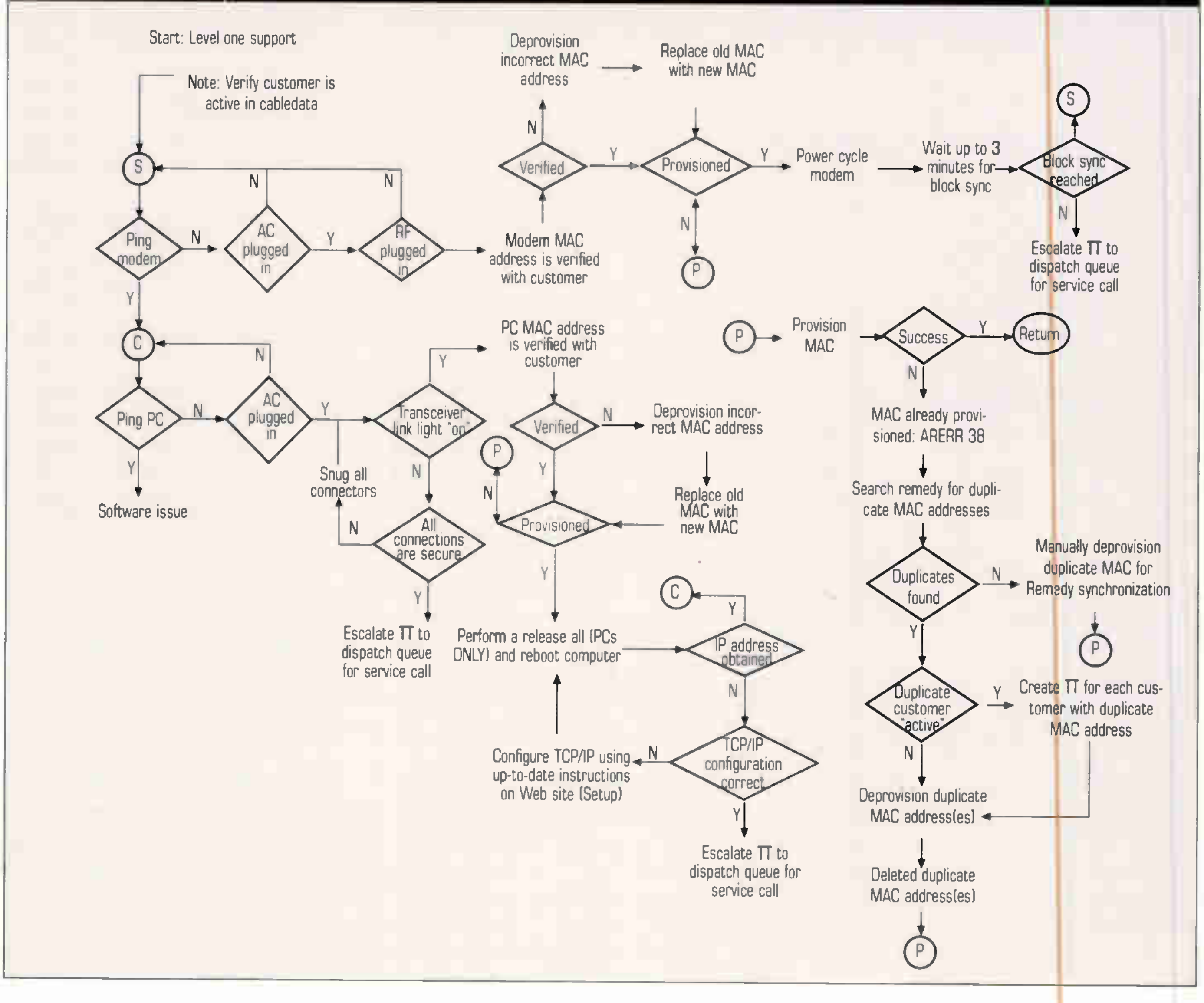
If the cable modem remains "unpingable," problem-solving turns from connectivity to provisioning. Here the BSR will need to verify the cable modem's media access control (MAC) address with the customer and with the troubleshooting tool. If the MAC address is not provisioned or incorrectly provisioned, the BSR will correct the error. If the connection is intermittent or performance is noticeably slow, have the customer examine all connections first and confirm they are snug before proceeding with signal level checks.

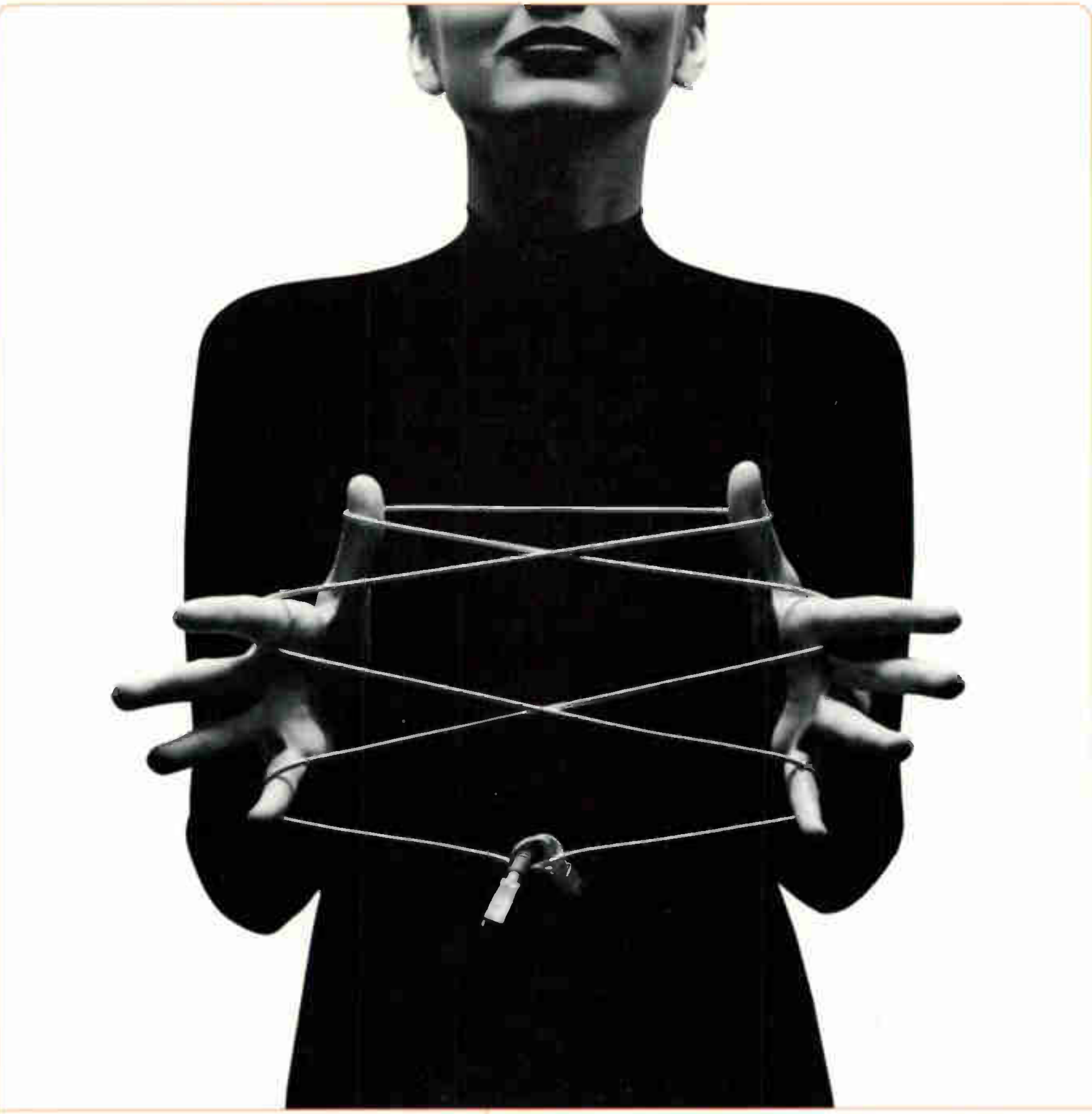
Checks for signal level involve using the troubleshooting tool's "get-health" function. This reads the cable modem's current transmit and receive power levels, which can be compared with the modem's levels at the time of installation. If the newly acquired levels fall out of the normal range or vary greatly from those at the time of installation, the BSR will escalate the trouble ticket to field operations for a service appointment.

Note that troubleshooting applications typically provide a number of functions to help determine signal quality. The specific functionality mentioned here simply enables the troubleshooting process to proceed. I'll explain this functionality further another time.

The success or failure of the signal level check leads to either a verification that the problem is fixed or a

FIGURE 1 CABLE MODEM AND PC TROUBLESHOOTING PROCESS





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BOTTOMLINE

> PC and Modem Troubleshooting

A common misconception is that it's cheaper to solve problems over the phone than with a truck roll, but this is true only when the problems to be solved are "phone friendly." It's critical to find out early on whether the problem can be addressed over the phone.

The most efficient troubleshooting happens when problem-solving and escalation are happily married. You'll need to troubleshoot both the modem and the computer, plus all their associated connections. To increase your efficiency in this area, emphasize ways to ascertain the source of the problem as quickly as possible, such as continually dividing the problem in half. A troubleshooting software application can be a great help, letting the customer service representative (CSR) check a customer's provisioning, connectivity and device health.

Be sure and escalate immediately problems that show a high probability of requiring a service appointment. Once a trouble call is escalated, it's important to move it along in clear and logical steps through the various service tiers, both to solve the problem quickly and to keep chaos from taking over the process. The remaining problems can then be addressed more quickly with a higher probability of solving them over the phone.

service appointment to ensure proper signal levels or to replace the cable modem. If the customer bought the modem at retail, the service call may be as simple as a check for services, after which point the technician corrects the problem or refers the customer to the retailer who sold him or her the modem.

It's important that the service technician know ahead of time whether the customer purchased the cable modem retail or is leasing it through the broadband operator. Without this information, a technician may mistakenly exchange a retail-purchased cable modem with a company-provided spare.

Troubleshoot the PC

Following a successful ping and get-health of the cable modem, the troubleshooting process next focuses on the PC. Typical problems associated with PCs include:

- Wiring—bad initial install, customer alteration, damage
- Connectors—poorly secured, customer alteration, damage
- Configuration—incorrect or missing
- Operating system (OS)—unsupported version, defective, missing proper drivers >

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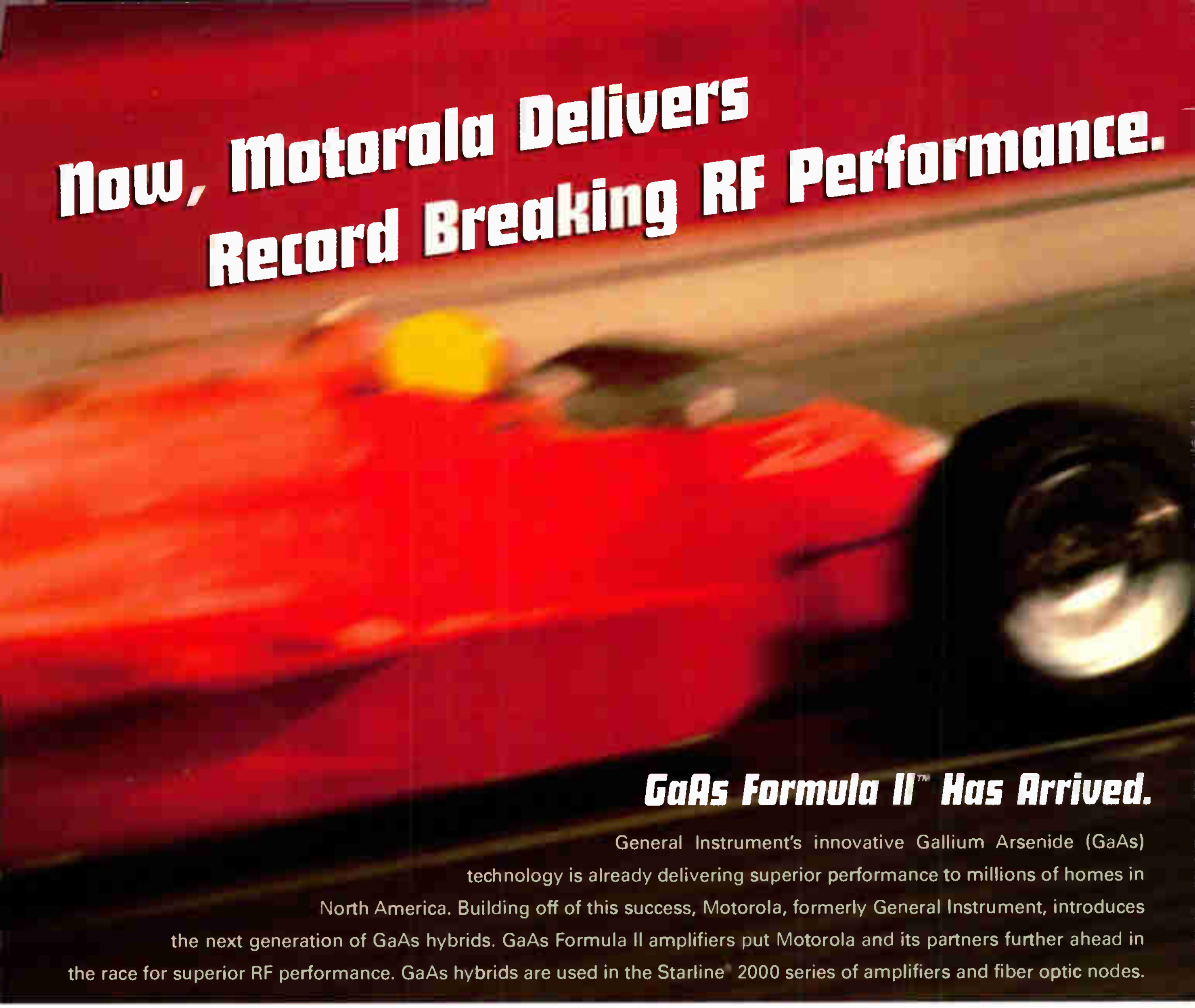

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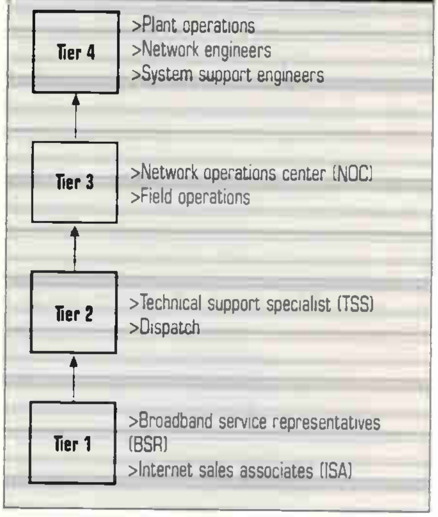
FIGURE 6
TROUBLESHOOTING ESCALATION PROCESS



- Applications—unsupported
- Hardware—device failure or need for reseating

A successful ping and get-health to the cable modem leads to a ping of the customer's PC. If the PC is not "pingable," have the customer check connections between the modem and PC. The easiest way to do this is to look for a link (or transceiver) status light on each end of this connection. Most PC network interface cards (NICs) and cable modems have these link lights for troubleshooting—I strongly recommend that you use NICs equipped with link lights.

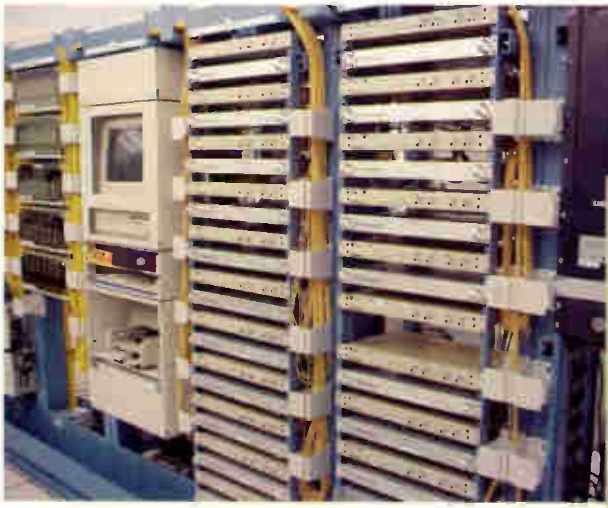
If the link light isn't lit, the problem is a bad connection, damaged wire or failed device. Check the wire between these devices, and also check connectors and connections. If the wire or connections are damaged, the customer can be referred to a customer service site to pick up a free replacement. If both look OK, it's likely that one of the devices has failed, and the BSR needs to escalate this trouble ticket to field services for an on-site appointment.

If good connectivity exists between the customer's PC and modem, the BSR needs to verify the PC's MAC address. If the BSR cannot verify the MAC address—if the customer has changed PCs or NICs since the initial install—the BSR must deprovision the old MAC and provision a new MAC. The BSR then uses the troubleshooting tool to ensure the MAC is correct.

The customer then reboots the PC to attempt to acquire a new IP address. If the PC obtains an IP address, which is visible in the computer's network settings, the troubleshooting tool ought to be able to ping it. If at this point the PC cannot be pinged, the BSR needs to confirm the network settings. The use of dynamic host configuration protocol (DHCP) for PCs speeds the settings of proper network configurations—in fact, most operating systems today default to DHCP when installed.

Note that some PCs' operating systems can acquire an IP address without rebooting; however, this is not a standard function of the variety of operating systems that high-speed data service


MODEL 1205C
MODEL 1205CX
MODEL 1205CXA
MODEL 1205CXA



Left: Fiber racks with reverse receivers

Below: Digital receivers for Pegasus

Images courtesy of Time Warner Cable

interactive features. And when a full commercial system failed to materialize in a timely fashion, much of the world wrote it off as a costly boondoggle. But the story behind the story is that Time Warner learned a number of important lessons during the trial. The most important was that it is possible to build too much flexibility into a digital transport system.

"We came off the FSN using ATM (asynchronous transfer mode) throughout," says Michael Adams, principal network architect at Time Warner. "Although ATM was flexible, we realized that we didn't need all the flexibility that it gave us."

Today's Time Warner digital plant, known as Pegasus, uses Moving Picture Experts Group (MPEG)-2 transport, which provides enough flexibility to meet the needs of the operator and the customer, without having to pay the cost of ATM.

In the headend, ATM continued to provide the link between the server and the quadrature amplitude modulation (QAM) modulators, though this was a complicated arrangement that hampered the introduction of advanced services such as video-on-demand (VOD). In 1997, the company adopted the digital video broadcast (DVB) asynchronous serial interface (ASI) to provide a 216 Mbps link from the server directly to the QAM modulators.

> "More than 90 percent of Time Warner's systems have been upgraded to digital."

"We knew we wanted VOD, and this was a low-cost way of adding it to the broadband infrastructure," Adams said.

Time Warner continues to use ATM for some of its data applications, such as delivering software and Internet protocol (IP) information to the set-tops, while MPEG-2 carries the broadband data, such as VOD.

IP plays a role

The next step was to determine exactly what sort of control and signaling infrastructure would be most suitable. It was clear that the system had to be two-way, and the engineers determined that the best way to get set-tops onto the network was through IP networking.

The protocols that Scientific-Atlanta developed for FSN were introduced to the Digital Audio Video Council (DAVIC) committee and became the DAVIC out-of-band (OOB) spec. It provides narrowband quadrature phase shift keying (QPSK) forward and reverse channels, essentially creating a full duplex 1.5 Mbps local area network (LAN) service.

"We now have set-tops on a giant LAN," Adams says. "We can use the network to send messages for things like premium services, controlling software upgrades for the set-tops, monitoring set-top performance, retrieving buy-rates and statistics from the set-tops, and determining RF input levels, the correction factors that the QAM demodulator is applying,

BOTTOMLINE

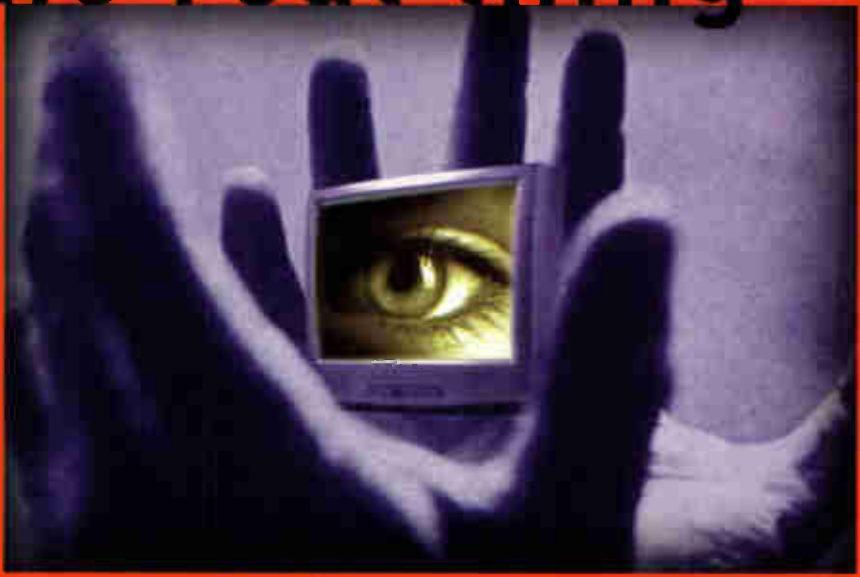
> An Example to Follow

When it comes to digital services, few companies have more experience than Time Warner. From the Full Service Network of days gone by to today's Pegasus platform, Time Warner has been at the forefront of the digital revolution.

To be sure, the company has seen a fair number of bumps along the road, but the result is a digital video delivery system that can act as a model for any cable company looking to upgrade from the analog realm.

Looking back over Time Warner's development program offers a fascinating glimpse into the problems and solutions that most cable operators will encounter as their digital plans get underway. Does asynchronous transfer mode (ATM) have a role to play? Is 64-QAM (quadrature amplitude modulation) enough, or should we go with 256? What will the costs be?

These are all issues that Time Warner's engineers have dealt with. Their answers might help guide you through what likely will be the most difficult project of your career.



and what kind of distortion the cable plant is presenting—all sorts of stuff."

One of the more innovative aspects of the Pegasus design is the use of the QAM MPEG channels to deliver IP data. Adams and other Time Warner engineers determined that the control channel is too narrow to allow every user to pull Web pages, streaming media and all the rest. Instead, the Pegasus QAM channels offer a mix of digital video, audio and IP traffic.

"Some use DOCSIS (Data Over Cable Service Interface Specification) for IP data, but that is targeted for the PC," Adams says. "We have a different way of encapsulating data in the MPEG channel. It's more flexible for our application."

Undertaking the upgrade

When it came time to upgrade each of Time Warner's 40 or so cable systems, any number of unique circumstances had to be dealt with. But by and large, the company tried to follow a set pattern for each upgrade.

The average system is built on a 500-home node. To meet a carrier-to-noise (C/N) ratio of 53 dB, the company tried to keep a limit of four amps and a few line extenders beyond the node. The company uses 7 mW lasers throughout, many of them split to feed two or three nodes. The reverse path uses a single upstream Fabry-Perot (F-P) laser for each 500-home node.

"In order to launch digital programming in the future, we made sure we had a distribution system that we could live with if we wanted to add, say, another 256-QAM or another 200 MHz of bandwidth," says Paul Gemme, vice president of plant engineering at Time Warner. "We built most plants to 750 MHz forward, using 50-550 MHz for analog and 550-750 MHz for digital services."

How much fiber is enough?

The company also decided that running six fibers per node, as opposed to the previous two fibers per node, was the proper balance between cost and future-proofing. Gemme says other systems might decide on eight, 10 or more fibers, but six ought to take Time Warner far enough into the future to recoup the cost of the new glass and then some.

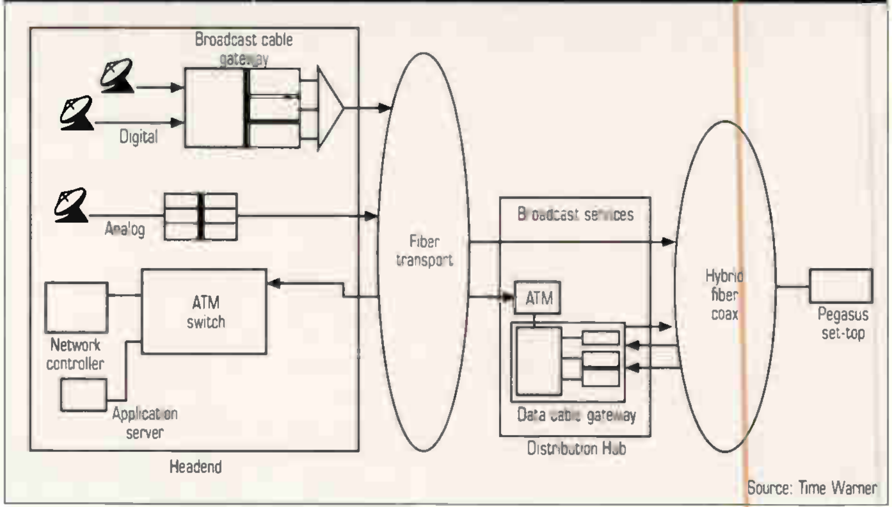
"The biggest cost in laying new fiber is not the fiber itself, but the manpower it takes to put it in," he says. "So adding a few extra strands won't significantly impact costs."

By and large, the cost of upgrading is not in the headend, but in the plant. Gemme says Time Warner spent on average between $16,000 and $17,000 per mile. With 40 divisions and 245,000 miles of plant to consider, Time Warner had quite the costly project on its hands.

"The plant is the most cost-consuming," he says. "It's probably 50/50 between electronics and labor." >

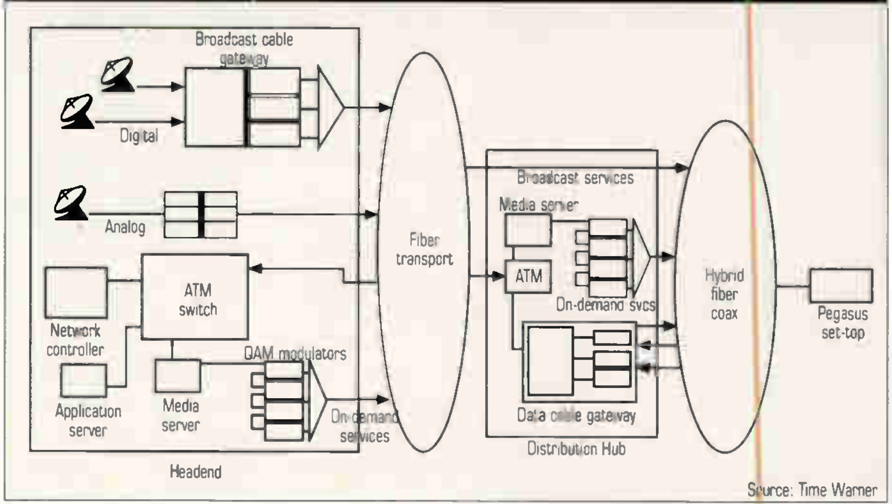
> "The biggest cost in laying new fiber is not the fiber itself, but the manpower it takes to put it in."
> — Paul Gemme, Time Warner Cable

FIGURE 1 PEGASUS PHASE 1: DIGITAL BROADCAST



Source: Time Warner

FIGURE 2 PEGASUS PHASE 2: VIDEO ON DEMAND



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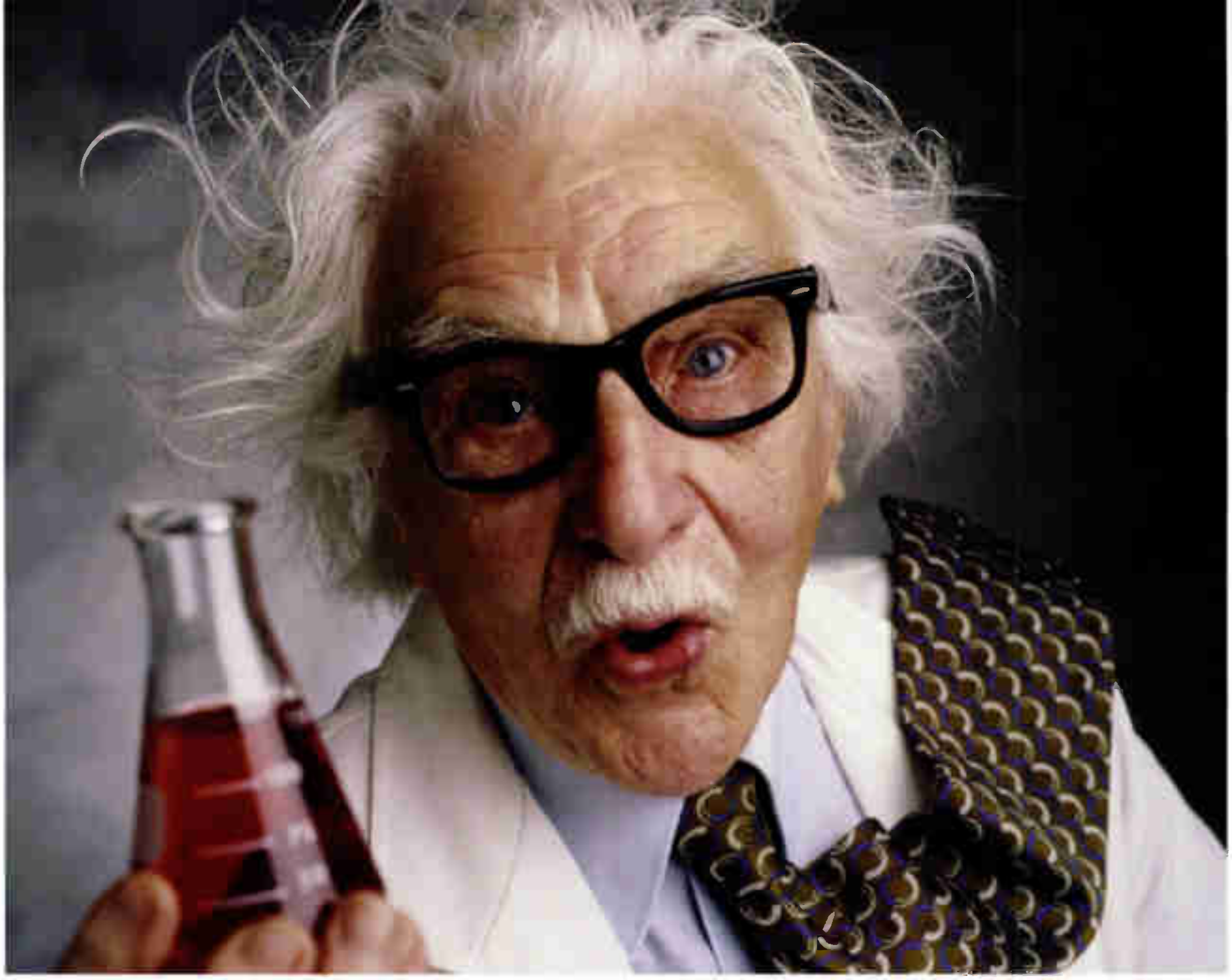

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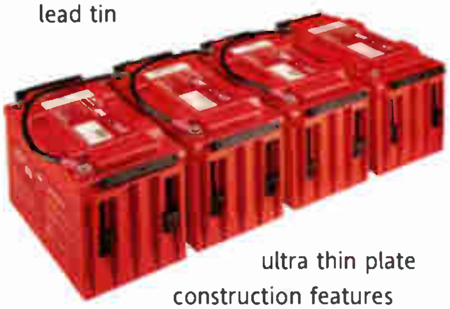

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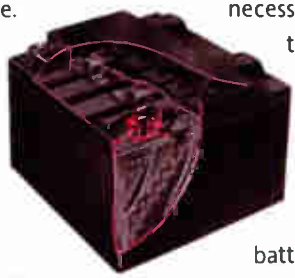

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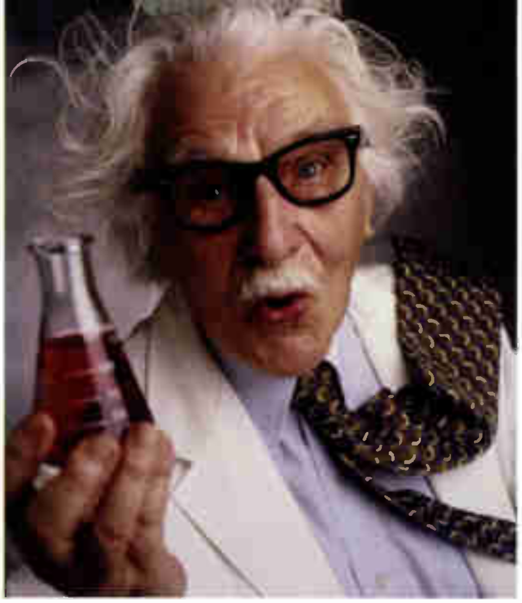

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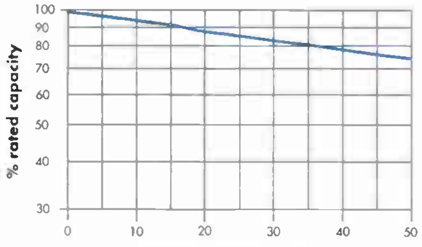

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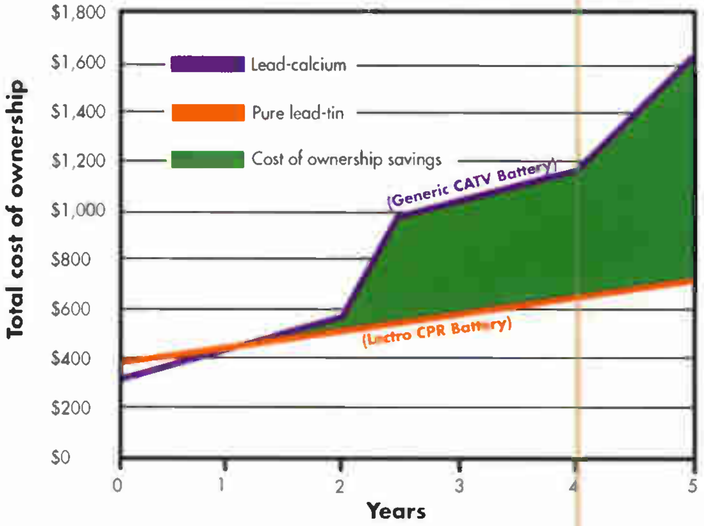
Battery Comparison Cost of Ownership: Lead-calcium vs. Pure lead-tin



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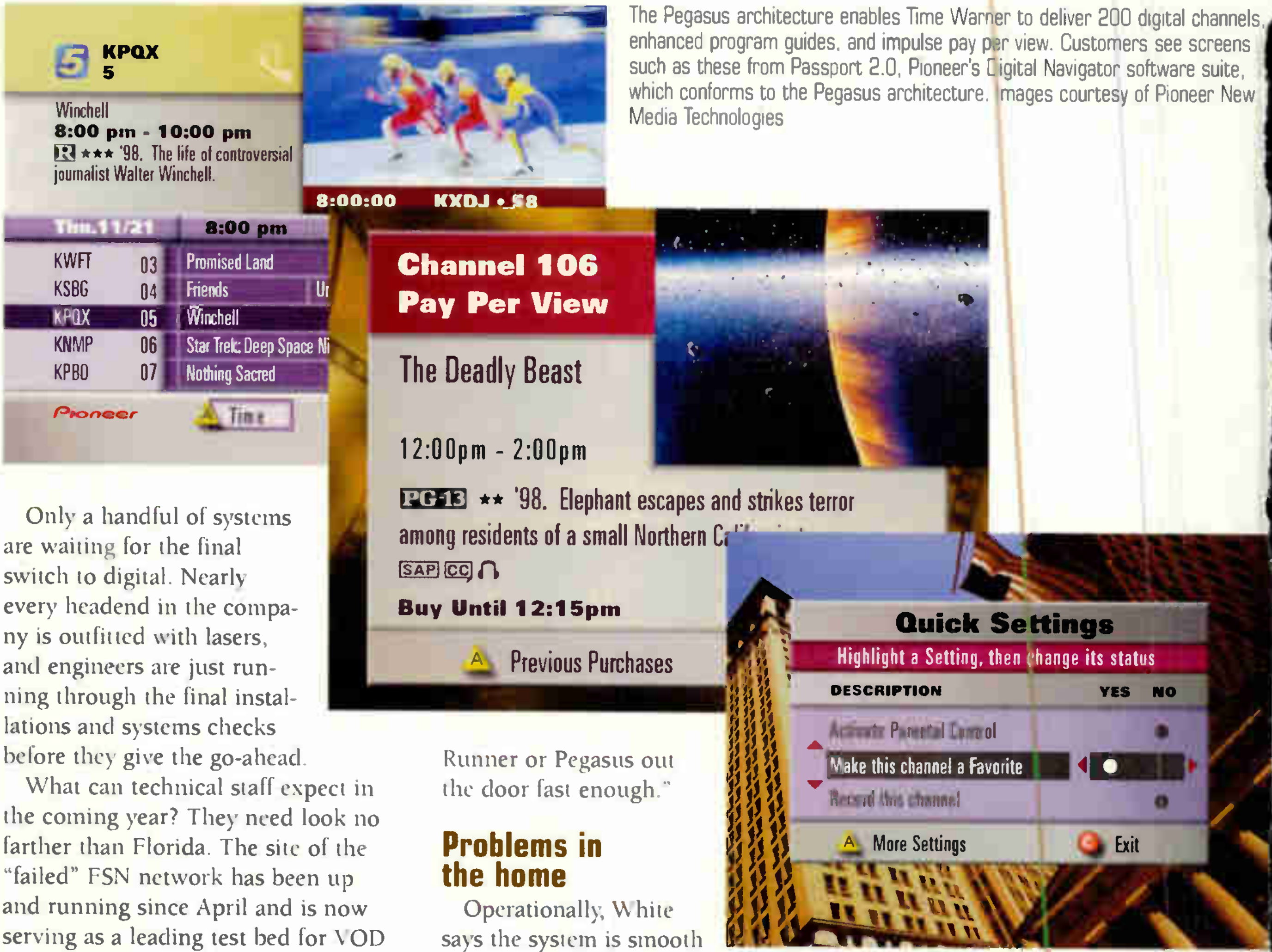

KPQX 5

Winchell

8:00 pm - 10:00 pm

R ★★★ '98. The life of controversial journalist Walter Winchell.

8:00:00 KXDJ • 58

Thu.11/21		8:00 pm
KWFT	03	Promised Land
KSBG	04	Friends
KPQX	05	Winchell
KNMP	06	Star Trek: Deep Space Ni
KPBO	07	Nothing Sacred

Channel 106 Pay Per View

The Deadly Beast

12:00pm - 2:00pm

PG-13 ★★ '98. Elephant escapes and strikes terror among residents of a small Northern Ca

Buy Until 12:15pm

Quick Settings

Highlight a Setting, then change its status

DESCRIPTION	YES	NO
Activate Parental Control		●
Make this channel a Favorite	●	
Record this channel		●

The Pegasus architecture enables Time Warner to deliver 200 digital channels, enhanced program guides, and impulse pay per view. Customers see screens such as these from Passport 2.0, Pioneer's Digital Navigator software suite, which conforms to the Pegasus architecture. Images courtesy of Pioneer New Media Technologies

Only a handful of systems are waiting for the final switch to digital. Nearly every headend in the company is outfitted with lasers, and engineers are just running through the final installations and systems checks before they give the go-ahead.

What can technical staff expect in the coming year? They need look no farther than Florida. The site of the "failed" FSN network has been up and running since April and is now serving as a leading test bed for VOD and other advanced services.

"The customers really love it," says Gene White, vice president of engineering in Tampa. "We can't get Road Runner or Pegasus out the door fast enough."

Problems in the home

Operationally, White says the system is smooth as glass. If there is any one trouble spot he can point to, it's usually inside the home.

"If you think about a cable plant, it's 17,000 miles of hard plant and 22,000 miles of drop plant," he says. "But 3,000 miles are not accessible to

> Pegasus at a Glance

Time Warner is implementing its digital Pegasus architecture in two phases. Phase 1 supports digital broadcast services, while Phase 2 adds the ability to provide video-on-demand (VOD). (See Figures 1 and 2 on page 82.)

"In all of our divisions, we deploy the broadcast system first. That puts in the basic infrastructure for everything," says Michael Adams, principal network architect for Time Warner.

The architecture supports roughly 200 digital channels, enhanced program guides and impulse pay-per-view (IPPV). "It's a competitive response to DirecTV," Adams adds. Pegasus 1 also supports interactive TV services such as Web browsing and e-mail.

Some key elements in the Pegasus architecture are the broadcast cable gateway (BCG), which includes digital satellite receivers and modulators, as well as the data cable gateway (DCG), which performs network signaling. "(Pegasus) has a real-time, two-way communications network built into it that's dedicated to the cable digital set-tops," explains Adams. "It allows us to do impulse pay-per-view, provide entitlements for customers to watch a particular order, and bring back all the orders that people have made. But it's not a polled system. It's a real-time system, and that's one of the big things that we've changed."

Phase 2 of the implementation, which is up and running in Tampa, Austin and Hawaii, includes media servers, operations software and modulators for delivering VOD.

"The media servers and modulators can be placed at either the headend or the distribution hub," says Adams. "If we have a large distribution hub with lots of customers, then we put the service close to the customer. But if we have smaller distribution hubs, then we might pull it back to the headend."

The neat thing about the architecture is its adaptability. "From day one, we built an interactive system. Now, we're adding on the on-demand system," says Adams.

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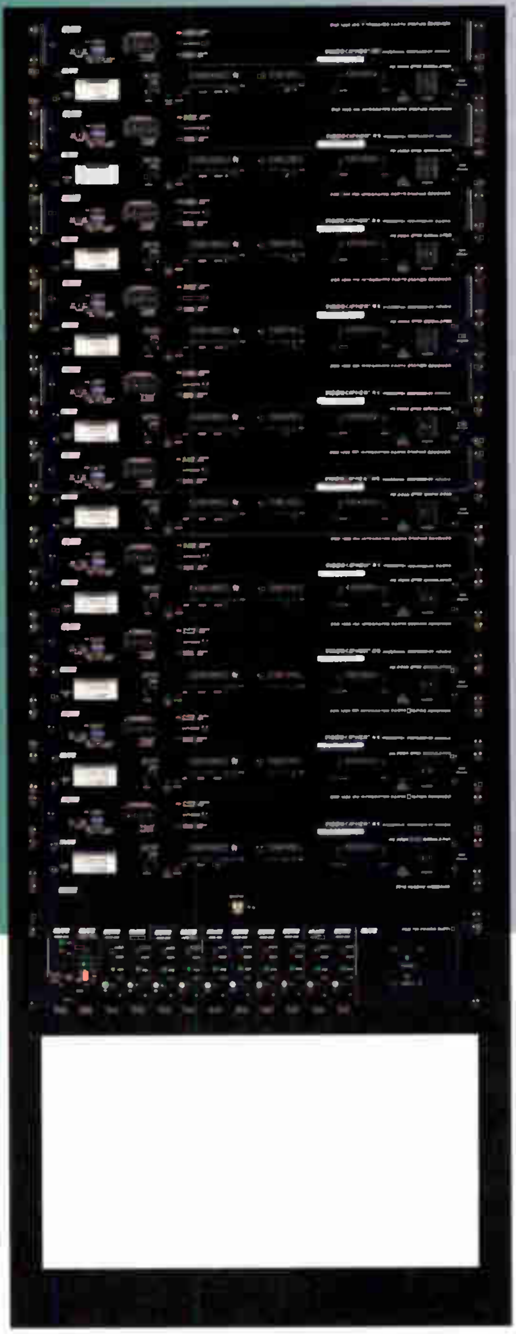

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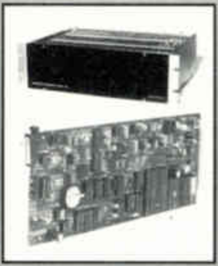
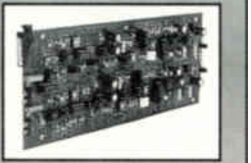




maintenance because they're inside the home. We seem to run about 25 percent of our trouble calls to problems inside the home. Ninety-nine percent of the time it's an old splitter inside the attic, or the customer has purchased marginal parts at a retail store, or the VCR is not two-way capable. We didn't think (home problems) would be that high a percentage."

Right technology, right people

Developing the right technology to deliver a digital service is one problem that cable operators face when the time to upgrade comes. But an even bigger problem is finding the right people to carry the project through.

All systems have people who are very good at their jobs and know how to keep systems and services, even digital ones, running smoothly. But that's a very different matter from building a digital plant from scratch and seeing the project through to a successful outcome, says Gemme.

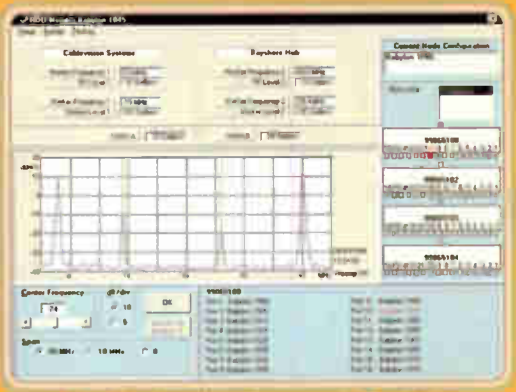
"The single most difficult challenge is to make sure the right people are in place in project management and in each division," he says. "There are a lot of bright engineers and operators out there, but if they haven't been through project management training or haven't completed a project like this before, it could be overwhelming."

Proper planning could save the day, not only to make sure the job goes smoothly, but also to provide management and technical staff an opportunity to view the project from a distance and determine whether additional help or expertise might be needed.

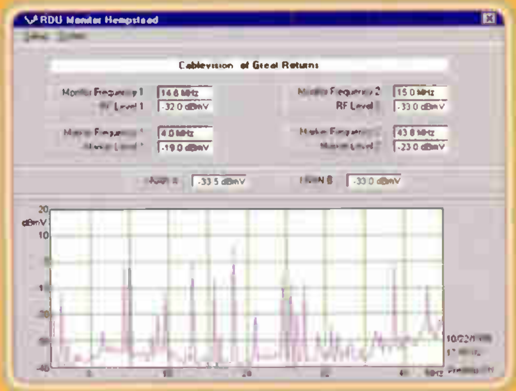
"Make sure they understand the scope of the project and that they can bring it in under budget," Gemme says.

Time Warner's investment in Pegasus has provided the company with a concrete plan preparing its network to meet the digital age head on. Though the project hasn't always turned out as expected, it could very well serve as an example for other operators to emulate in their own systems. CT

Art Cole is a contributing editor to "Communications Technology." He can be reached at acole602@aol.com.



Troubleshooting Screen with Switches



Cablevision of Great Returns

Monitor Frequency 1 14 6 MHz
RF Level 1 -32 0 dBmV
Monitor Frequency 2 15 0 MHz
RF Level 2 -33 0 dBmV
Marker Frequency 1 4 0 MHz
Marker Level 1 -19 0 dBmV
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Marker Level 2 -23 0 dBmV
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Impulse Noise from 85 Mustang Door Buzzer

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I-NAN Status Monitoring

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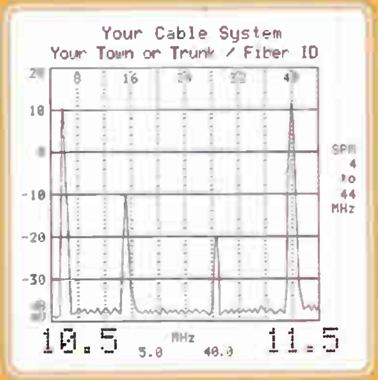
Displays Impulse Noise and CPD

The RDU is a new type of return test system. You "see" the live condition of the return spectrum and RF level in dBmV at the HE, from any subscriber's terminal, amplifier, tap or fiber node.

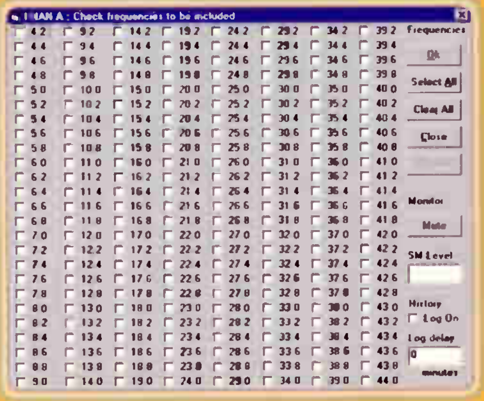
The RDU provides a real time visual display of Carriers, Ingress, Noise, Impulse Noise and Common Path Distortion.



Live Video Screen

With integrated RF switches, the RDU system allows you to select and monitor a single node, a group of nodes or all the nodes in the Hub. Node configurations are created and named by you insuring an intuitive, easy to implement Return Management System.

RDU's Status Monitor the noise floor, where you designate, by frequency. The RDU averages the energy and displays your benchmark *I-NAN*® number. You gauge the noise floor's condition from a trackable number!



I-NAN A : Check frequencies to be included

☐ 4 2	☐ 9 2	☐ 14 2	☐ 19 2	☐ 24 2	☐ 29 2	☐ 34 2	☐ 39 2
☐ 4 4	☐ 9 4	☐ 14 4	☐ 19 4	☐ 24 4	☐ 29 4	☐ 34 4	☐ 39 4
☐ 4 6	☐ 9 6	☐ 14 6	☐ 19 6	☐ 24 6	☐ 29 6	☐ 34 6	☐ 39 6
☐ 4 8	☐ 9 8	☐ 14 8	☐ 19 8	☐ 24 8	☐ 29 8	☐ 34 8	☐ 39 8
☐ 5 0	☐ 10 0	☐ 15 0	☐ 20 0	☐ 25 0	☐ 30 0	☐ 35 0	☐ 40 0
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☐ 9 0	☐ 14 0	☐ 19 0	☐ 24 0	☐ 29 0	☐ 34 0	☐ 39 0	☐ 44 0

I-NAN Status Monitoring Set Up Screen

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Real Power's NOT PRETTY

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Disturbances Can Toast Your System

By Ed Spears

Power quality is perhaps the largest threat to the goal of 99.99 percent uptime in cable networks. Today's higher operating frequencies (750 MHz to 1 GHz) pose new challenges for the typical cable plant.

Providing critical services such as digital data transmission and lifeline telephony make reliable networks a necessity, not just a desirable luxury.

Few studies exist that describe the type and severity of the day-to-day power anomalies in coaxial cable networks. Some of these are harmful, and almost all are invisible to the personnel who maintain and monitor the system. Yet these same technicians are required to repair the results and determine the cause of network failures.

It pays to know the enemy, so let's define, display and analyze power-related events in a real, operating cable TV network. Certainly, a more thorough understanding of real-world powering conditions will enable the design of more effective power protection solutions to meet the need for increased ruggedness and reliability.

Types of disturbances

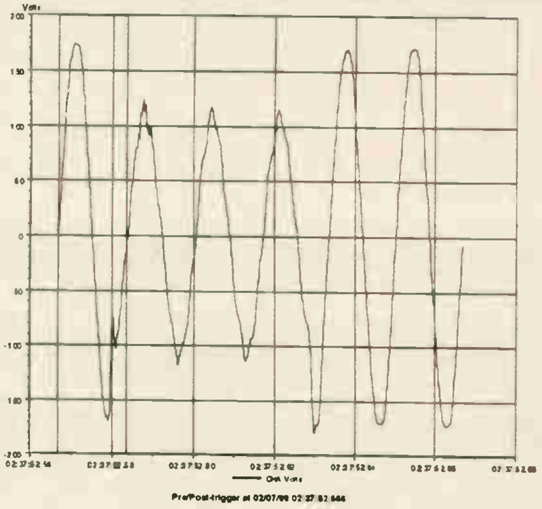
To those familiar with uninterruptible power supplies (UPSs), definitions of power problems usually are directed toward disturbances that exist deep inside an office building or factory. The sensitive telecommunications and computer equipment protected by a conventional UPS usually is located far from the source of many external power disturbances, so it is automatically protected from many of the most dramatic power events.

The cable TV network, along with its associated power supplies, is installed directly on or near the utility pole, in the worst possible location for susceptibility to power grid variations.

Therefore, the cable TV power supply, and the devices it protects are subject to disturbances of a significantly greater magnitude and frequency than the typical indoor computer networking system that a conventional UPS is intended to protect. In other words, the same types of power problems exist in the broadband network; they're just bigger, longer lasting and more frequent. Some of the types are described in this article and illustrated with waveform graphics.

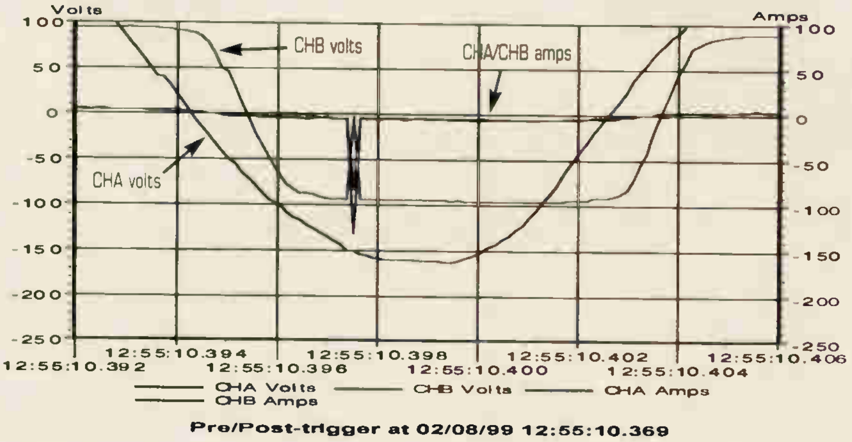
Note that the figures here consist of line disturbance monitor data taken from several cable TV power supplies operating at 87 VAC in various locations in an actual broadband network. None of these disturbances was "simulated" or artificially induced. Warning: Some of what you are about to see is not pretty. (You may want to send the kids to their rooms.) These

FIGURE 1 | VOLTAGE SAG



This is a severe sag, about 30 percent reduction in voltage. Many power supplies would go out of regulation and pass at least some of this low voltage out onto the network. Note that it lasts for only about three cycles and was likely caused by a large motor such as a refrigeration compressor starting.

FIGURE 2 | CURRENT SPIKE



pictures depict real-world conditions and power events that are much more severe than those that could be simulated in a typical lab environment.

It took only a few weeks (cumulative) of monitoring to collect this data, yet we had no shortage of power disturbance events to analyze. The power supplies were installed in standard enclosures, and we fitted them with monitoring equipment to detect abnormalities in the input and output of the UPS. We monitored voltage and current and recorded significant aberrations. When the monitor stored an event, it simultaneously recorded the voltage and current on all of the other terminals of the UPS. We conducted the monitoring during the winter, so there was no thunderstorm activity. (Lightning-related disturbances are dramatic, but well-documented in other readily available publications.) Our intent was to document and describe the everyday power anomalies seen in a typical network.

Voltage sags

A sag is any voltage decrease that exceeds +/-10 percent of nominal for more than one cycle (one cycle at 60 Hz is 16.6 msec) and may last for many cycles. These are by far the most commonly occurring events on any power grid. Even lightning strikes can cause a sag, as protective devices act to divert the energy of the strike to ground. Traditionally, regulating power supplies have been utilized to counteract the effects of voltage sags.

A severe sag (>20 percent) may overcome the power supply's ability to regulate and pass a temporary undervoltage into the coax network. (See Figure 1.) This could cause active devices near the end of the cascade to drop offline because of low AC voltage. Obviously, power supplies with wide input voltage tolerance are desirable; they reduce the likelihood of this signal loss.

Voltage surges and spikes

A voltage surge is an unwanted increase in AC voltage. A surge may last for several cycles, and spikes are very short duration surges, often lasting for only microseconds. The "ringwave" is the most common variation of surge and is caused by protection fuses clearing (and interacting with system inductance) or power factor switching in the utility grid. These may not be

BOTTOM LINE

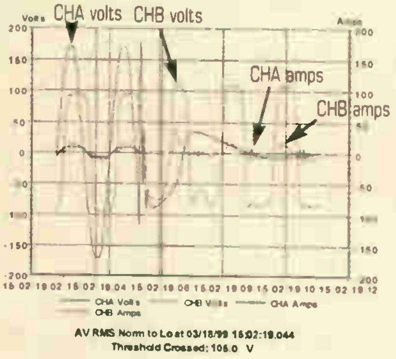
> Definition and Analysis of Common Power Anomalies

Common, everyday power disturbances exist in every broadband network. These are not necessarily catastrophic events, but they are an insidious source of cable plant problems and intermittent failures.

Certain types of power supplies attenuate some of these disturbances (sometimes). Other disturbances, such as common mode noise and severe sags, can negatively affect the network in spite of the presence of a properly installed powering system.

The vigilant technician needs to be aware of the potential for subtle power-related anomalies and, armed with proper monitoring equipment, will be able to identify the source of the trouble. In addition, the ongoing monitoring of cable TV network power conditions will provide a valuable insight into performance requirements for the design of next-generation power supplies and surge suppression equipment.

FIGURE 3 AC OUTAGE



This AC outage was caused by a technician opening the AC disconnect to test the operation of the inverter and batteries. Note the large spike caused by just opening the disconnect breaker.

The output voltage and current waveforms are slightly distorted for the first few cycles of inverter operation. There is a slight DC offset to the output voltage as well. This is normal and lasts for about 10 cycles.

large voltages, but energy, not voltage, is the problem here: the lower the frequency of the ringwave, the greater the available energy.

Figure 2 (on page 90) shows a current spike that occurs simultaneously on the output and the input. It is severe enough that the output voltage drops briefly to zero. This probably stemmed from a disturbance on the coax sheath (neutral). It may not last long enough to affect the actives, but if it did, loss of data or a dropped phone call could result. Properly rated surge suppression on the AC input and coax output of the power supply can eliminate most surges and spikes.

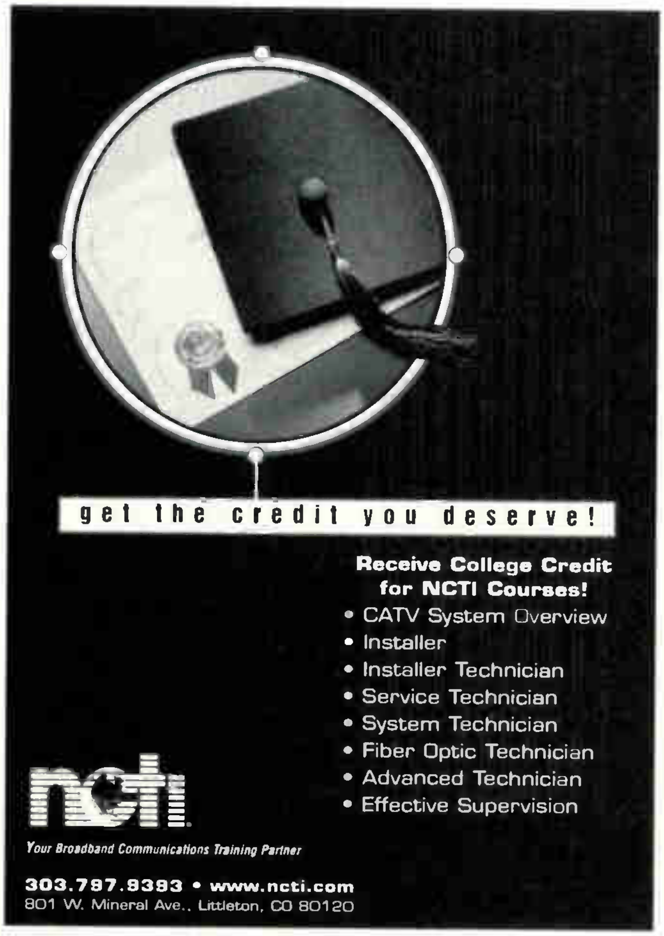
Voltage transients

A voltage transient is a severe spike, often hundreds or thousands of volts. Large transients often are associated with lightning events, and the closest strikes can conduct 100,000 amperes and have the voltage potential to jump 30,000 feet from a cloud to the ground. Heavy-duty surge suppressors are the best defense and need to be installed on the input of the power supply and at the power inserter. In about 5 percent of lightning strikes, the current carried by the vertical ground wire on the nearest power supply can be nearly 40,000 amperes as the energy seeks ground. This is a good argument for low-resistance grounds.

Most transients, however, come from less obvious occurrences such as industrial load switching and utility fault clearing, especially in construction zones. Transients occurred frequently in our data, even without thunderstorms during the period.

Blinks and blackouts

Blinks (lasting less than one second) occur much more frequently than blackouts, and they can cause a



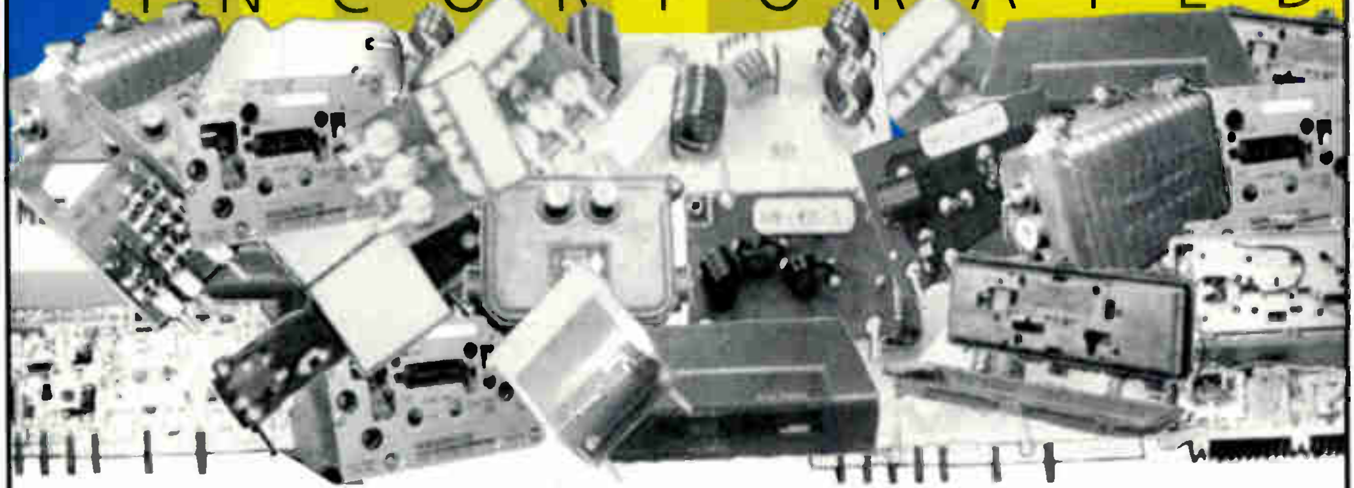
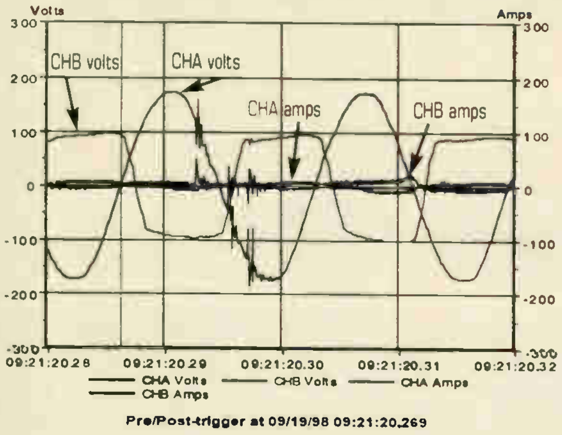


FIGURE 4 LINE NOISE



Here, line noise is visible on both the input voltage and current. Fortunately, there is little disturbance on the output of the supply.

problem for a nonstandby power supply. A UPS with batteries will simply "ride through" the event on its batteries and resume drawing utility power when AC input returns. The network never sees an interruption.

But a nonstandby power supply drops the network, however briefly, when a blink occurs. (See Figure 3 on page 92.) This leaves the network starving for power so that when the blink is over, the power supply has to provide extra current to charge the capacitors in the DC power packs in all the amplifiers. This "inrush" of power happens after every blink of the utility and can cause a power supply to go into foldback current limit, or get stuck in a mode where it does not produce full output voltage.

Either way, the network does not come back on properly and usually needs to be turned on in segments manually. This problem can be avoided at the network design stage by specifying amplifiers that have "walk-in" power input circuitry. Most newer amplifiers now include this walk-in feature. Otherwise, the only remedies for this symptom are reducing load on the power supply, deploying a larger capacity supply or switching to a UPS.

Line noise (electrical noise)

Line noise refers to low level unwanted signals, usually higher frequency (compared to 60 Hz), which can be observed with an oscilloscope "riding" along on the utility sine wave. It's common, but not often noticed by maintenance personnel unless they routinely use oscilloscopes. It can cause intermittent and confusing problems if the noise gets through the

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power supply and onto the coax.

One type of electrical noise, called humbars, can be quite obvious because they are visible in the TV picture. These can result if the line noise is constant and if the DC power packs in the actives do not filter out the offending harmonic frequencies. We found many examples of line noise in our data. One example is shown in Figure 4 (on page 94). When faced with line noise, technicians need to hunt down and isolate the source of the noise and either repair or remove the source. But don't try to troubleshoot problems related to incoming power service. Leave this to a qualified electrician or the power company.

Maintenance events such as changing power supplies or testing battery/inverter operation also can cause power aberrations. Devices such as bypass switches and service power inserters let maintenance take place with minimal disturbance.

Power supply grounding

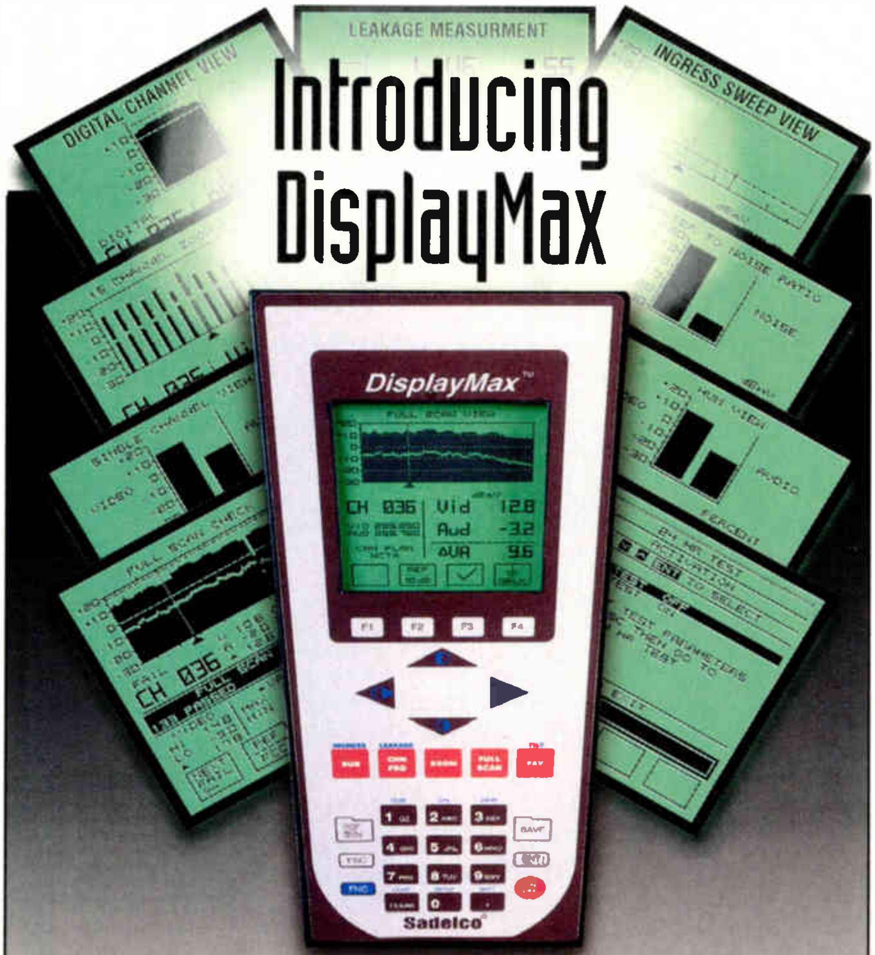
Many of the previously mentioned power problems can be alleviated or eliminated simply by using proper grounding and bonding procedures. Here are the key things to remember:

1) Connect utility neutral and ground together in the AC disconnect box.
2) Drive a ground rod (typically 8 ft., depending on soil and climate conditions) at every power supply installation. Ground impedance must be less than 25 ohms, and 2-5 ohms is desirable.
3) Connect the green ground wire from the power supply to cabinet ground.
4) Connect the ground to the receptacle in the power supply cabinet.
5) Ensure the coax fitting on the power supply cabinet is tight.
6) Bond sheath, cabinet and vertical.
7) Use the proper gauge soft drawn copper ground wire per the National Electrical Code (NEC).
8) Remember, according to the following rules from NEC Article 250-51, "Effective Grounding Path," the grounding path must:
   - Be permanent and continuous, NO splicing
   - Have the lowest impedance (shortest path) to earth
   - Have proper ampacity for expected fault currents

Don't get burnt

Though real utility power isn't pretty, modern UPS technology, coupled with proper grounding and bonding procedures, can help keep power anomalies from frying your system. If you've got strange things going on in your network that you just can't figure out, it's entirely possible that power disturbances are responsible. CT

Ed Spears is senior applications engineer for Raleigh, N.C.-based Lectro Products Inc. He can be reached via e-mail at spears@powerware.com.



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Video Compression 2:

Digitizing the Picture

By Jim Farmer

With digital TV (DTV) a critical weapon in the fight against competitive satellite offerings, it's essential that you understand how digital service differs from your old analog favorite. This month, we continue our series on digital compression by examining analog-to-digital conversion.

If you missed the first part of our series, see the February 2000 issue, ("Digital Video Compression, Beyond Nuts and Bolts," page 66). We discussed breaking a picture into "pixels," or picture elements, in both the vertical and the horizontal directions.

Picking up where we left off last time, in analog TV, the picture is naturally broken into pixels vertically by the scanning process. Horizontally, the picture is not naturally broken into pixels, but for DTV, we can define horizontal pixels by taking adjacent minute pieces of a given scan line and treating each as a simple element that has brightness and color, but no defined shape.

Analog-to-digital conversion

The first step in the process of converting to a digital signal is to apply the analog signal to an analog-to-digital converter (A/D). What do we get when we go through the A/D process? The accompanying figure (on page 100) illustrates a line of analog video, with the video going from black on the left side of the screen to white about three-quarters of the way across the screen.

Note the smooth transition from one level to the next of the analog signal, which would cause the screen to show a continuous lightening of the picture from the left to the right. We also show the digital signal, assuming we had only a four-bit digital conversion process. Of course, what we really are showing is the digital signal converted back to analog, which is where we would eventually have to get to at the receiver.

This smooth transition has been damaged by the A/D and D/A processes. What we would see on the screen after digitization would be a series of steps in gray scale from black to white. We say that we have introduced an "artifact" into the picture. An artifact, according to my dictionary, is "any object made by human work." In this context, we mean anything artificial in the picture: something not real.

In the figure, we used only four bits to represent all possible signal levels. If I use "n" bits to represent the video level, I can divide the picture into 2n different levels. So with only four bits, I have only 16 levels with which I can represent the video level. If I were to use 8 bits, I could divide the picture into 256 levels, and so on. If I use 8 bits, I say that I use 8 bit quantization. As a practical matter, we would want

BOTTOMLINE

> Digitizing the Picture

This month we talked about digitizing the picture, which entails sampling the picture in time and converting each sample to digital. Of course, it is not enough just to digitize the picture: The resultant transmission bandwidth would be impossibly wide. So we must compress the picture, using a number of tricks. First, we remove as much spatial redundancy as practical by using a technique called the discrete cosine transform, or DCT. We then use techniques to reduce temporal redundancy, the characteristic that most pictures are pretty much the same as the picture before and the picture after. Finally, we use coding techniques to reduce the length of codes required to send the data.

to use better than 8 bit quantization for high quality.

Notice that the figure shows the color burst. We did this in order to provide an easy way to identify the picture. While it is possible to start the encoding process with a composite NTSC signal, this is not preferred. The process of encoding a signal into composite analog NTSC involves a lot of compression itself (though it was not necessarily thought of as compression at the time), and the NTSC compression artifacts can unnecessarily damage the digital compression.

It is better to start with either the native red-green-blue (RGB) signals from the camera, or with the luminance and two color difference signals, which is what is usually done.

Now what?

OK, we have digitized the picture, so now we transmit it to the subscriber and reap the benefits of digital transmission, right? Not at all! The problem is in the numbers, so let's see what it would take to transmit the digitized signal.

In the February article, we said a so-called standard definition picture, equal in resolution to NTSC, had 480 pixels vertically and 640 horizontally. Multiplying, this gives us 307,200 pixels in one picture. We also assumed that we were working in black-and-white, but we will need to transmit color information. We'll talk later about how the eye is less sensitive to resolution, or "sharpness," in colors than in black-and-white.

This allows us to transmit less color information, but we must transmit two additional pieces of information to allow the receiver to reconstruct a picture in three primary colors. This is the old idea of three equations to find three unknowns: Eventually, I'll have to "light" red, green and blue electron guns on the picture tube, so I need three independent pieces of information to drive the three guns. To take this need for color into account, double the number of pixels we transmit to 614,400 per frame.

We transmit about 30 frames per second in NTSC, so we have to transmit the value of each of 614,400 pixels 30 times a second, or we must transmit 18.43 Mp/s (megapixels per second). But we cannot encode each pixel with just one bit; to achieve good quality video, we might have to encode each pixel to 12 bits, so the bit rate is 12 times the pixel rate, or 221.2 Mbps (megabits per second).

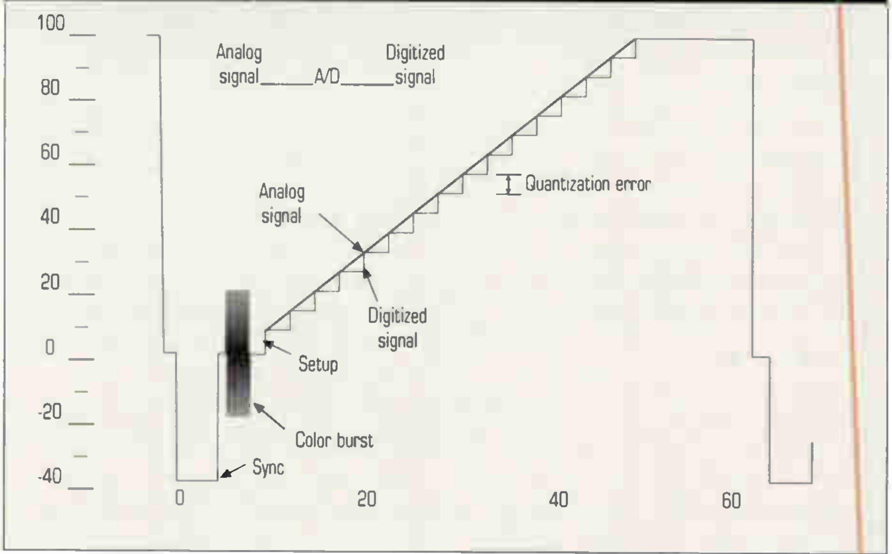
At this, we still have not allowed anything for synchronization or audio, nor have we allowed for ancillary services such as closed captioning and electronic program guides (EPGs). Furthermore, we have not transmitted a picture that is materially higher in resolution than what we have in NTSC today. Obviously, if we are going to make digital video a real service, we must compress the signal.

Elements of compression

You hear of one picture being transmitted in maybe 1-5 Mbps, but we just saw that we start at maybe 221.2 Mbps without audio or control. It is a tall order to compress the signal this far. Fortunately, there are a lot of tricks available, and we use just about every one of them to do the compression.

The compression standard upon which current DTV systems is based is called MPEG-2. This is the second standard developed by the Moving Picture Experts Group, sponsored by the International Telecommunications Union. This compression standard has been extended for use in North America and other countries that choose the same standard, by an ad hoc group called the Advanced Television Systems Committee, usually just called the ATSC. A different standard is being used in Europe, called DVB, for digital video broadcast. It serves the same functions but is not compatible with ATSC. Both are based on MPEG-2 compression. >

FIGURE 1 RESULTS OF ANALOG-TO-DIGITAL CONVERSION



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Spatial redundancy

The first trick is that most pictures contain a lot of redundancy. We commonly assume that every pixel is totally unrelated to those around it, but if you look at almost any real picture, you will see that large areas of the picture consist of identical video. A large patch of blue sky consists of a large group of identical pixels. Someone's face consists of several regions of identical pixels. Even a picture of a highway has large "patches" (pun intended) of identical pixels.

So if we can identify these regions of a picture that are identical, we would have to transmit the pixel value (in three color components) only once, plus transmit something that tells the receiver where to apply those identical pixels. This can reduce the number of bits transmitted.

The problem is to come up with a practical way of processing the signal such that we efficiently identify the regions of identical pixels. We might go farther and identify regions of "almost" identical pixels and treat them identically, so long as we can fool the eye and brain into not noticing those artifacts. Of the many ways to achieve this result, the one chosen for our DTV system is called the discrete cosine transform, or DCT. We'll talk about the DCT more next time.

Temporal redundancy

Besides so-called "spatial redundancy," which the DCT is designed to remove, most pictures have "temporal redundancy," meaning that the scene changes little from one frame to another. Though we transmit about 30 frames, or complete pictures, per second (phase alteration line, or PAL, systems transmit 25) to avoid flicker, little information changes from one frame to the next.

A good method of compression is to transmit only the changes in information from one frame to the next. Because most of the picture is not changed from one frame to the next, we usually can realize a significant reduction this way. Several techniques are used to reduce temporal redundancy.

One is to use motion compensation: The encoder compares two frames and seeks blocks of the picture that are the same from one to the other. It then can tell the decoder to "take this set of blocks and move it to here for the next picture." This works quite well, for example, when the camera is panning across a scene. Most of a frame is simply the previous frame moved over. It is necessary to transmit only the new location of the video, plus the video that changes.

A powerful way to reduce the bit rate is to use interframe coding, in which we transmit only the difference between frames. In MPEG-2, three types of frames are transmitted.

The so-called I-frame (intraframe) pictures are constructed without


0.9%
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reference to any other frames. Typically, about two I-frames are transmitted each second. It is necessary to transmit I-frames to allow a TV set just tuning to a program to get started decoding. I-frames are larger than other types of frames because they must contain all the information needed to reconstruct a picture.

P (predicted) pictures are predicted from past frames. Only the difference between the last picture and the P-frame is transmitted. Because only relatively small changes take place between frames (with the exception of a scene change), P-frames contain much less data than do I-frames.

Finally, the system uses B-frames, bidirectional frames. These frames contain only information that cannot be derived from both previous and future frames. B-frames contain the smallest information of any frame types; you can do a pretty good job of deciding what is in one frame if you have both the frame that came before and the frame that came after.

Code redundancy

A final trick is to shorten the resulting bit stream by searching for common bit sequences and transmitting a shorter "code word" for common bit sequences. Obviously, if you do this, then when you encounter a rarely-used bit sequence, you will have to transmit something longer, but you don't have to do this very often. The technique is called Huffman coding. I like to explain Huffman coding by reverting to some of my early training as a ham radio operator.

Those of you familiar with Morse code know that common letters use short sequences of "dits" and "dahs," and less common letters use longer combinations. The most common letter in the English language is "e," which has the code representation "dit." Another common letter is "t," which is "dah." On the other hand, "q" is not common, and it has the code representation "dah-dah-dit-dah." Because a dah is three times the length of a dit, it takes about 12 times as long to send a "q" as it does an "e," but you don't send "q" nearly as often.

Similarly, the Huffman codes look for common bit sequences and replace them with shorter sequences.

Coming up next

In the June issue, we'll continue this series by examining the DCT in more detail. This is a great place to get into some deep mathematics, but we shall content ourselves with a more intuitive approach and refer you to other places where you can learn the gory details.

References

"On the Road to DTV: Understanding the ATSC DTV Standard," M. Isnardi and C. Seagrave, tutorial presented at the IEEE International Conference on Consumer Electronics, 1998.

The Video Compression Book, Panasonic Technology. CT

Jim Farmer is chief technical officer for Antec. He can be reached via e-mail at jofarmer@mindspring.com.

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TRAINING
By the NCTI

Using Powers of Numbers, Part 4

This month's installment continues a mathematics refresher series. The material is adapted from a lesson in NCTI's Installer Technician Course. © NCTI.

Last month's installment introduced using powers of 10 for problems involving addition and subtraction. This installment continues with using powers of 10 (also referred to as scientific notation) for basic multiplication and division, and it also covers understanding metric prefixes. It then offers a practical application using these powers of 10 and metric prefixes as could be encountered in a cable system.

Applying rules for multiplying

Observe the following rules for multiplying numbers in powers of 10:

1) Multiply the numbers directly to get their product.
2) Add the power of 10 algebraically. (The powers do not have to be the same.)

Example:
Multiply 4 X 10^{12} and 3 X 10^{-6}

$$(4 \times 10^{12})\ (3 \times 10^{-6})$$
$$= 12 \times 10^{(+12\ +\ [-6])}$$
$$= 12 \times 10^{+6}$$

Applying rules for dividing

Observe the following rules for dividing numbers in powers of 10:

1) Divide the numbers directly to get their quotient.
2) Subtract the power of 10 in the denominator from the power of 10 in the numerator.

Example:
Divide 75 × 10^6 by 15 × 10^3

$$\frac{75 \times 10^6}{15 \times 10^3} = 5 \times 10^{(6\,-\,3)}$$
$$= 5 \times 10^3$$

Understanding Metric prefixes

The powers of 10 most commonly used in electronics and electrical work are 10^9, 10^6, 10^3, 10^{-3}, 10^{-6}, 10^{-9} and 10^{-12}. Because these values are used frequently, metric prefixes have been assigned to represent each of them. That is, rather than writing 2,000 watts or 2 × 10^3 watts (W), this same value is expressed as 2 kW. Again, 0.000036 amperes is expressed as 36 µA.

The metric prefixes listed in the accompanying table are included primarily for decimal point orientation. When using Ohm's law, powers of 10 and metric prefixes are utilized in practical applications.

TABLE 1 Metric Prefixes and Their Symbols

Power of 10	Value	Metric prefix	Metric symbol
10^9	One billion	giga	G
10^6	One million	mega	M
10^3	One thousand	kilo	k
10^{-3}	One-thousandth	milli	m
10^{-6}	One-millionth	micro	µ
10^{-9}	One-billionth	nano	n
10^{-12}	One-trillionth	pico	p

Practical application

For instance, power supply consumption rate can be calculated using powers of 10. In this example, our hypothetical system has 150 power supplies that each pull an average of 10 amps at 60 VAC. Assume that the system's power supplies run 24 hours a day.

To calculate the power supplies' total power consumption in a month (P_{total}), you begin with the Ohms law formula P = IE and then factor in the time (T) to give P × T. Finally, multiply that sum by the number of power supplies to get P_{total}.
(I × E × T × # of PS = P_{total}).

P (in watts) = (10 amps × 60 volts)
= 600 W

T (hours) = 24 hrs × 30 days/month
= 720 hrs

P_{total} = 600 × 720 × 150 power supplies

P_{total} = 64,800,000 watt-hours (Wh)

or

P_{total} = 64.8 × 10^6 Wh

or

P_{total} = 64.8 megawatt-hours (MWh)

or

P_{total} = 64,800 kilowatt-hours (kWh)

CT

CALENDAR

April

2-4: **Canadian Cable Show**, Toronto. Call (613) 232-2361.

3-5: **SCTE regional seminar**, "Train the Trainer," Los Angeles. Contact Jessica Dattis in the SCTE National Conferences Department at (800) 542-5040, ext. 239, or jdattis@scte.org.

4: **Great Lakes and Lake Michigan SCTE Chapters' Vendor Show**. Contact Paul Hales at prhales@digitrace.com.

8: **Llano Estacado SCTE Chapter technical seminar and testing session**, Cox Communications, Lubbock, Texas. Topic: Category VI Tutorial, Terminal Devices, hosted by Lee Skinnell. Contact Bob Baker at (505) 763-4411.

10-13: **NAB 2000**, "The Convergence Marketplace," Las Vegas. Contact NAB at (888) 740-4622 or register online at www.nab.org/conventions.

10-11: **Mid-South SCTE Chapter Vendor Show**, Grand Hotel, Tunica, Miss. Contact Bob Allen at bob.allen@twcable.com.

11: **SCTE regional seminar**, "DOCSIS Deployment," San Diego. Contact Jessica Dattis in the SCTE National Conferences Department at (800) 542-5040, ext. 239, or jdattis@scte.org.

17-18: **Cable Television Law 2000**, San Francisco. Contact PLI at (800) 260-4754 or register online at www.pli.edu.

19: **Delaware Valley SCTE Chapter Vendor Show**, Horsham, Pa. Contact Chuck Tolton at (215) 961-3882.

20: **Wheat State SCTE Chapter Cable-Tec Games and Vendor Show**, Red Coach Inn, Wichita, Kan. Contact Joe Cvetnich at (316) 262-4270, ext. 139.

25: **SCTE regional seminar**, "Cable 101," Philadelphia. Contact Jessica Dattis in the SCTE National Conferences Department at (800) 542-5040, ext. 239, or jdattis@scte.org.

PLANNING AHEAD

> **May 7-10:** C2K, National Cable Television Association Cable 2000, New Orleans. Call (202) 755-3669.

> **June 5-8:** SCTE Cable-Tec Expo 2000, Las Vegas. Call (610) 363-3822 or go to www.scte.org.

> **July 12-15:** New England Cable Show, Newport, R.I. Call (781) 843-3418.

INTRODUCING

Communications Technology's Readers' Choice Awards 2000

Communications Technology's Readers' Choice is an annual awards program that honors the industry's most exceptional new products. *CT* readers will select the winners during the SCTE Cable-Tec Expo held June 5–8 in Las Vegas, NV.

Entries from companies who will be exhibitors at this year's SCTE Cable-Tec Expo are being accepted in the following categories:

- **Best New Headend Product**
- **Best New Distribution/Line and Transmission Product**
- **Best New Customer Premise Product**
- **Best New Network Diagnosis Product**

Nomination criteria will include the product's technological innovation, feature set, interoperability and adherence to recognized industry standards, and contribution to broadband telecommunications' growth and advancement.

Qualifications

To be considered for a ***Readers' Choice*** award, the product must be on display at the SCTE Cable-Tec Expo. The product must have been announced no earlier than May 1, 2000 with a product release/ship date no later than September 1, 2000. SCTE Cable-Tec Expo exhibitors must fill out and submit the entry form (provided on next page) and product press release via Certified Mail to *CT* by May 15, 2000.

Communications Technology's Readers' Choice Awards 2000

Entry Form

To nominate your product, send the following information via Certified Mail to:
Jennifer Whalen, Editor, *Communications Technology*, 1201 Seven Locks Road, Potomac, MD 20854.

Contact Information

Entries due May 15, 2000

Vendor contact person

Phone #

Mobile/Show Phone #

Email

Booth # at Expo

Award Category *(check only one)*

- ☐ Headend
- ☐ Distribution/Line and Transmission
- ☐ Customer Premise
- ☐ Network Diagnosis

Product Information *(Attach responses on additional sheets)*

- ● Name of product:
- ● Announcement date:
- ● Name of company:
- ● Availability date:
- ● Description of product (200 words or less)
- ● What is the key distinguishing feature that makes this product stand out in its category?
- ● How does the product advance the state of the art of broadband telecommunications?
- ● What is the business and technology case for this product?
- ● What makes this product a significant improvement on your existing offering?
- ● List two or three competing products and indicate what makes this product significantly better.

Readers' Choice Award Categories

Headend: Processors, modulators, satellite receivers, lasers, receivers, RF grooming, combiners, antennas, towers, microwave equipment, lightning protection, headend cables, racks, surge suppression equipment, video and audio equipment, monitors, commercial insertion gear, cable modem termination system (CMTS), routers, Ethernet switchers, servers, caching engines, backup generators, air conditioners, HVAC (heating, ventilating and cooling gear), servers, firewalls, routers, local area networks (LANs), telephony gear, uninterruptible power supplies (UPSs), backup generators.

Distribution/Line and Transmission: Coaxial cable, fiber, nodes, passives, actives, amplifiers, strand, hardware, taps, addressable taps, line splitters, directional couplers, power inserters, connectors, utility enclosures, power supplies, standby power supplies, batteries, pedestals, vaults, controlled environmental vaults (CEVs), duct, pipe, conduit, tools.

Customer Premises: drop cable, drop passives, drop hardware, converter, set-tops, cable modems, network interface units (NIUs), network interface devices (NIDs), interdiction units, TV sets, VCRs, traps, filters, tools.

Network Diagnosis: test equipment, OTDRs, TDRs, fault locators, status monitoring equipment, network management systems, transponders, operations support systems (OSSs).

SPECTRUM ANALYZER

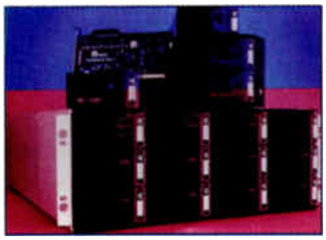
The FTB-5240 from EXFO Electro-Optical Engineering is a portable optical spectrum analyzer (OSA) that tests dense wavelength division multiplexing (DWDM) networks. It delivers a spectral window of 1,250 to 1,650 nm and power and wavelength accuracy of +/- 0.3 dB and +/-0.02 nm, respectively. The software can characterize any DWDM system or any building block of a system (passive and active components) and can be used at several stages: manufacturing, precommissioning, commissioning and maintenance.

For more information, contact EXFO at (418) 683-0211 or on the Web at www.exfo.com.

DIGITAL MEDIA STORAGE

Hammer Storage's latest storage area network (SAN) product is the SLPRO12-FC/FC-FT Fiber Channel random array of inexpensive disks (RAID) subsystem. The SLPRO12-FC/FC-FT supports up to 12 fiber channel-arbitrated loop (FCAL) disk drives per enclosure with storage capacity of 600 GB, expandable up to 25 TB. Its integrated, hardware-based RAID controller with optical or copper interface makes it suitable for digital media applications. When configured with active/active controllers, the RAID engines deliver up to 190 MBps sustained throughput and are hot pluggable and hot swappable.

For more information, contact Hammer Storage at (510) 608-4000 or on the Web at www.hammerstorage.com.



POWER SUPPLY TRANSPONDER

The Tollgrade 135PSM1 transponder is designed to provide power supply monitoring and control over a hybrid fiber/coax (HFC) network. Part of Tollgrade's Lighthouse Cable Status Monitoring System product suite, the unit is dynamically frequency agile in both directions, from 5-15 MHz for the return path transmitter, and from 50-135 MHz for the forward path receiver. The transponder monitors individual battery voltages and can control and detect power supply standby events. A decentralized intelligence architecture enables it to make alarm decisions that limit network traffic.

For more information, contact Tollgrade at (412) 820-1355 or on the Web at www.tollgrade.com.

NETWORK AND INTERFERENCE EMULATOR

The Telecom Analysis Systems 8250 emulates hybrid fiber/coax (HFC) cable network impairments in a controllable laboratory instrument. This cable network and interference emulator is designed to evaluate the transmission performance of cable modems, cable modem termination systems (CMTSs), set-top boxes, high definition TV (HDTV) equipment, and Internet protocol (IP) telephony products. Impairments emulated include amplitude tilt, intermodulation distortion, group delay distortion, noise and interference. A built-in diplex filter combines upstream and downstream channels from the CMTS into a single interface.

For more information, contact TAS at (732) 544-8347 or on the Web at www.taskit.com.

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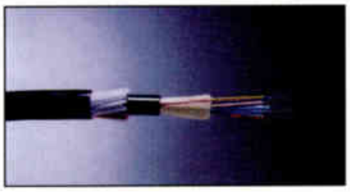

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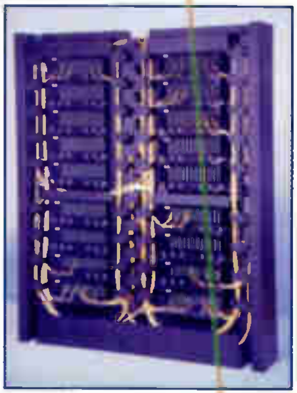
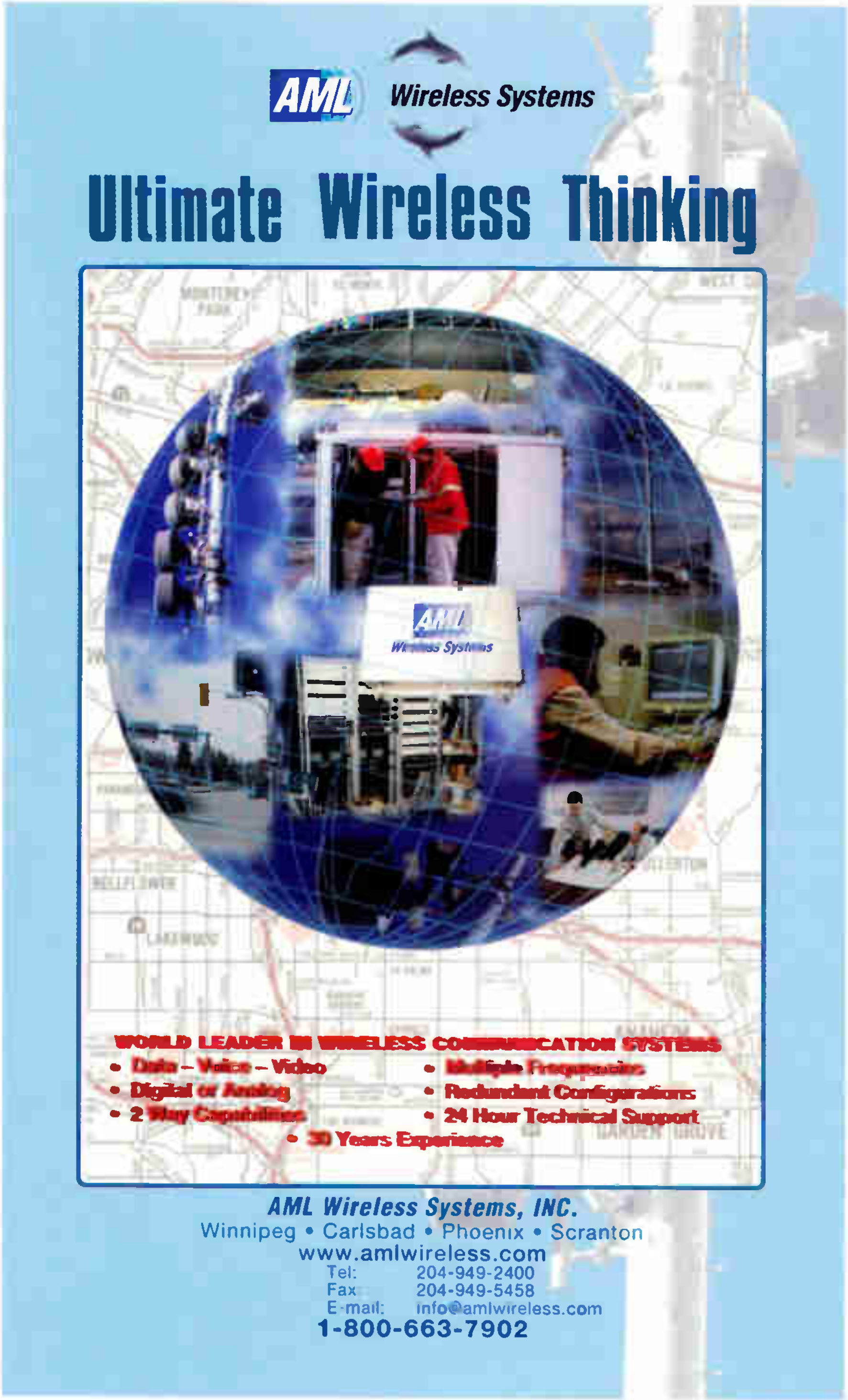
For more information, contact Optical Cable at (800) 622-7711 or on the Web at www.occfiber.com.

OPEN BAY FRAME SYSTEM

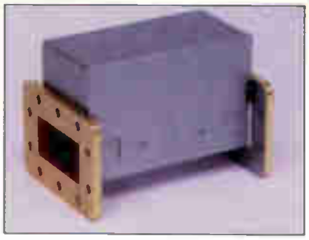
The LX-4000 from FONS Corp. optimizes fiber capacity while providing tools for fiber management and cable protection. This high-density open bay frame system accommodates up to 44 units of 1.75-inch Electronic Industries Association standard rack space, providing capacity for more than 1,200 terminations in a single bay. This rack system combines heavy-duty steel construction, a 7-foot base frame, modular fiber management spools, front-to-rear access slots, and integrated cable management troughs. The base frame is available in two sizes (19 and 23 inches wide).

For more information, contact FONS at (800) 366-7995 or on the Web at www.fons.com.





BANDPASS FILTER



Microwave Filter Company's model 7892D waveguide bandpass filter suppresses strong out-of-band (OOB) interference caused by marine or airport radar systems. The filter has a typical insertion loss of 0.5 dB at the center frequency and 1.25 dB maximum (1.0 dB typical) at 3.7 GHz and 4.2 GHz. Suppression is 25 dB minimum at 3.65 GHz and 4.25 GHz and 50 dB minimum below 3.55 GHz and above 4.35 GHz. Group delay variation typically is less than 8 ns.

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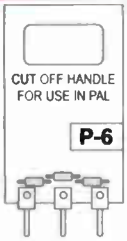

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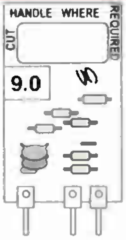

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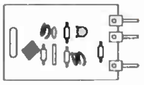

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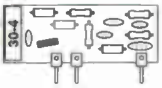

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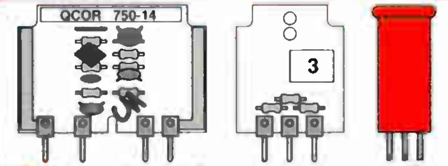

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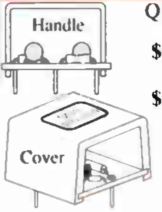

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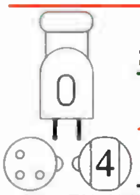

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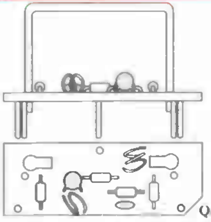

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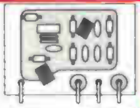
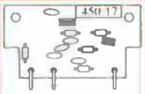
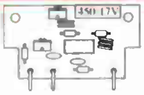
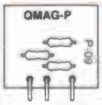
QRF has the full line of pads for Augat.

For Philips/Magnavox

	 	
QMAG-6 for 62E Series **$10.00** Fixed EQ's 330, 400, 450, 500, 550, and 600 MHz!	**QMAG for 5EE Series** **$10.00** Fixed EQ's 330, 400, 450 and 500 MHz!	**QMAGV for 5CE Series** **$14.00** Variable EQ's 330 MHz 450 MHz & 500 MHz!

NEW Reverse EQs for GNA & TNA!
QMAG-6-42-** values 1 to 12 dB, **$10.00 ea.**

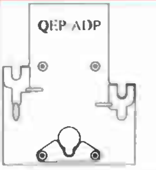


Use our QMAG-P for 4-A Pads
4-A Pad (0, 3, 6, 9, 12 dB) **$4.50**
All pads below in 1 dB Steps
6-A Pad (for reverse path) . $1.75
7-A Pad (equivalent, 550 MHz). $2.90
9-A Pad (equivalent, 860 MHz). $2.45

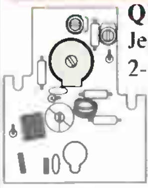
QLX EQ's for Jerrold

Equalizer for Jerrold JLX
(Replaces EQ & SEA)
ALL in 2 dB increments.
ONLY 1 dB insertion loss for all models!
(330, 350, 400, 450, 500 and 550 MHz)
330-450 - 0-30 dB 500 MHz - 2-24 dB
550 MHz - 0-24 dB **$6.75 each**
600 MHz $7.50 **750 MHz $8.75**
600 & 750 MHz in 2 dB steps, 0-24 dB

QEP-ADP for SJ



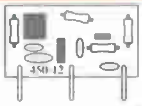
Fixed value equalizer adapter allows **QLX** to replace SEP-*. NO alignment! Lower Cost! Lower Insertion Losses! ***EASY*** installation!
QEP-ADP $7.00 each
Plus QLX - **$6.75** Total is only **$13.75**



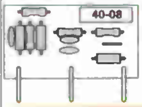
QEP Variable trunk equalizer for Jerrold SEP. Available in 1- and 2-way models ... 4's, 5's **$17.50**
TL - 5 thru 11 dB
L - 10 thru 16 dB
H - 16 thru 22 dB
ST - 20 thru 25 db
(300 through 450 MHz Bandwidths)

QCF-* AGC pilot filters for SJAS modules!
Low-band: **$12.00** High-band: **$20.50**

QEE & *New* QER

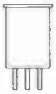


Line Extender Equalizers
(Replaces SEE by Jerrold)
270, 300, 330 & 400 MHz
All values **$5.00** each!
450 MHz - **$6.00** 550 MHz - **$7.00**
QEE values: 6, 12, 18 & 24 dB
QEE-40 MHz ***Reverse*** **EQ - $6.00**
Reverse values 2, 4, 6, 8, 10 & 12 dB
(Matched to cable only, lower insertion loss.)

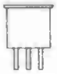


NEW **QER-40** same as **SEE-40** matches **JLX-SS-40** diplex filter plus cable values 2, 4, 6, 8, 10 & 12 dB. **In stock at $7.00 each!**

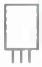
Jerrold pads, 0 to 20 dB in 1 dB Steps



JXP-* to 550 MHz **$2.90**



JXP-A-* 750 MHz **$2.45**



SXP-* **$1.75**

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DIGITAL TESTERS

Two bit error ratio testers (BERTs) from Agilent Technologies simplify a wide range of test applications. Both are designed to characterize, verify and test optoelectronic and high-speed digital components, multiplexer and demultiplexer integrated circuits (ICs). Agilent's 86130A BitAlyzer is a general-purpose, serial 3.6 Gbs BERT, and the 81250 ParBERT is a modular, parallel 2.6 Gbs BERT. They can perform multiplexer and demultiplexer testing for telecommunications and system area network (SAN) ICs, multiple transmitter and receiver testing in manufacturing, forward error correction (FEC) device testing, and compliance testing of optical components.

For more information, contact Agilent at (800) 452-4844 or on the Web at www.agilent.com.

SERVER CABINET

X-Mart/CDT's Ultra Server houses all brands of colocated servers in bayed or stand-alone configuration. Key features include: locking and reversible doors with tempered bronze safety glass, fully vented rear doors, quick lift-off side panels, grommetted cable access top and rear for dust protection, adjustable slide rails and uprights, built-in cable management with 6 mm hardware for Velcro or cable ties, registration marks every 30 slots for easy installation, built-in grounding, anti-tip device, and retractable or swivel shelves that conform to the Electronic Industries Association standard for 19-inch racks.

For more information, contact X-Mark/CDT at (800) 793-2954 or on the Web at www.metalenclosures.com.

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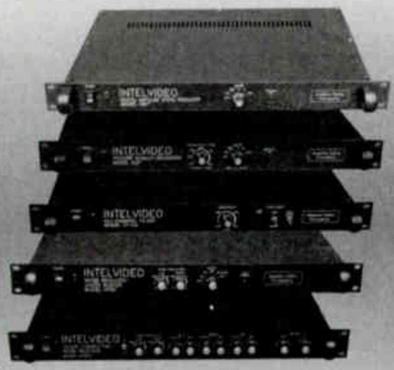

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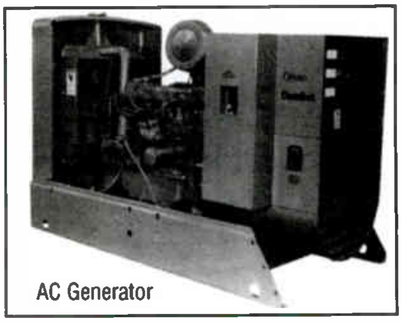

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TERMINATOR TOOLS

Ripley's Locking Terminator Tools (LTTs) are used to install and remove locking terminators from tap ports in cable TV distribution networks. The tools are offered in two lengths: one with a longer, larger handle and another with a smaller handle for easier access between trap shields. The solid filled shaft is designed to keep out debris that could interfere with proper tool operation.

For more information, contact Ripley at (800) 528-8665 or on the Web at www.ripley-tools.com.

MDU OPTICAL NODE

The Blonder Tongue FILN is an L-band, cable TV hybrid fiber/coax (HFC) optical node designed for signal distribution in multiple dwelling units (MDUs). The self-contained optical node comes in three models (8-, 16- and 24-output), which provide various signal levels. The unit is cable TV line powered, exceeds Federal Communication Commission distortion specs and is two-way capable with an integrated active return path at 5-40 MHz. Its range of cable TV input levels allows for design flexibility.

For more information, contact Blonder Tongue at (732) 679-4000 or on the Web at www.blondertongue.com.

VIDEO SERVER SYSTEM

The 1230 Broadcast Media Cluster (BMC) line of video server systems from SeaChange increases bandwidth and performance capabilities. The 1230 BMS is a clusterable unit with up to six channels at 30 Mbps per channel and 360 GB of random array of inexpensive disks (RAID)-5 storage using 36 GB disk drives. Interconnected with up to six other 1230 BMC units in the RAID2 Media Cluster configuration, it provides up to 42 input/output (I/O) channels and over 2 TB of fault-resilient storage.

For more information, contact SeaChange at (800) 661-7274 or on the Web at www.seachange.com.

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Videotek's new high-performance 8VSB DDM-500 demodulator and DDM-510 demodulator/decoder represent years of research and experience in precision demodulation of TV broadcast signals.

With its quality frequency-agile tuner, 8VSB demodulator, and MPEG-2 decoder, the DDM-510 is clearly the industry benchmark by which all other 8VSB demodulators will be judged. Within its solid 2RU construction, the DDM-510 advanced circuitry demodulates any ATSC-compliant signal from 54 MHz to 806 MHz (Ch. 2 to 69), displays the transport stream information, and decodes video and audio from the ATSC MPEG-2 data.

For applications requiring only SMPTE 310M, DVB-ASI or DVB-SP transport streams, or for CATV rebroadcast and translation, the compact DDM-500 is the ideal choice. This 1RU package, designed for demodulation of off-air 8VSB transmissions for bit stream analysis, includes a compact 8VSB demodulator with an uncompromising frequency-agile tuner.

For more information on the DDM-500 or DDM-510, call one of our sales engineers at 800-800-5719, or visit our web site at **www.videotek.com.**

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MARKETPLACE

MULTIMEDIA TAPS

Full Profile Multimedia Taps from Scientific-Atlanta increase operators' flexibility in network construction and upgrades. The taps feature 2-, 4- and 8-port versions that use an identical housing, which gives operators the ability to change the number of ports by simply changing the faceplate. The taps also feature S-A's Connection Beam technology with 12 amps of current and integrate with S-A's Power Distribution Unit, which provides power dropping. They contain an AC/RF bypass switch that provides uninterrupted service to downstream subscribers when the faceplate is removed for servicing.

For more information, contact S-A at (777) 236-7871 or on the Web at www.sciatl.com.

CABLE MODEMS

Two cable modems under 3Com's HomeConnect brand come with self-installation kits. The 3Com HomeConnect Cable Modem External is interoperable and can be deployed in Data Over Cable Service Interface Specification (DOCSIS) systems. It features differentiated tiers of service, real-time audio/video streaming and concurrent voice transmission. The 3Com HomeConnect Cable Modem TMI is a Protocol Control Information (PCI)-based telco-return cable modem. It integrates into a variety of systems, including Windows-based personal computers (PCs), and its low-cost internal design recommends itself to original equipment manufacturers (OEMs).

For more information, contact 3Com at (800) 638-3266 or on the Web at www.3com.com.

DSX SYSTEM

Telect has redesigned its digital system cross-connect frame (DSX) to save space. The DSX-3 packs up to 32 DS-3 terminations in four inches of vertical rack space. A smaller model holds 24 terminations. Standard prewireable backplane allows cabling of applications before module installation. Users can select from a range of applications, including 6-, 4-, and 3-port modules, extension repeaters, intra-office repeaters and digital network interconnects. Active and passive modules can be deployed side-by-side in the same chassis to streamline equipment configurations.

For more information, contact Telect at (800) 926-6000 or on the Web at www.telect.com.

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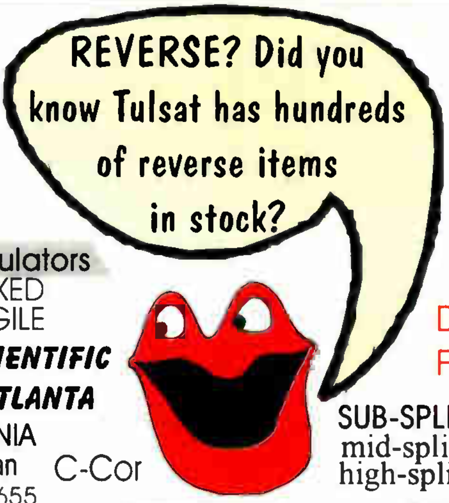

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SCTE's Cable-Tec Expo® 2000

If you are a **technology professional** in the cable **telecommunications** industry, you'll want to join more than **12,000 technologists** and **400 industry vendors** to secure your position on the **cutting edge of today's technology**.

You'll receive hands-on experience with the tools of the trade in the **Exhibit Hall**, and you'll advance your working knowledge in the practitioner-led **preconference tutorials**, **technical workshops** and **Engineering Conference**.

Sunday through Thursday

June 4–8

Las Vegas

Attendee Registration

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A Message from the SCTE President

Like many broadband industry professionals, you rely on learning the application of new technologies to keep your skills sharp. Cable-Tec Expo 2000, to be held June 4–8 in Las Vegas, will emphasize technical training opportunities to help you stay abreast of current industry trends.

The direct interaction between hardware buyers and vendors, in a focused, professional environment without distractions, is a unique niche that Expo 2000 offers. Cable-Tec Expo 2000 will serve many useful purposes, such as education, certification, transacting business, networking and recognition.

At Cable-Tec Expo 2000, you can:

- Hear industry leaders discuss technological issues and proposed solutions on how to address them at the Engineering Conference.
- Learn about the latest technical developments in the technical workshops.
- Receive hands-on instruction from product manufacturers on how to use new tools and address troubleshooting issues.
- Network with leading professionals and companies in the industry.

Cable-Tec Expo 2000 promises to be our best-attended show yet, with total attendance of approximately 11,000 and more than 460 exhibiting companies expected. I hope you will join SCTE for Cable-Tec Expo 2000, Sunday through Thursday, June 4–8 in Las Vegas, and take advantage of what this technically comprehensive show has to offer.

Sincerely,
John Clark

CABLE-TEC EXPO® 2000 PROGRAM SUBCOMMITTEE

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4. **Network** with more than 11,000 leading cable telecommunications professionals from around the globe.

5. Earn your **certification** and validate your expertise at the SCT Testing Center.

6. Review the latest **training an educational resources** at the SCTE Bookstore.

7. **Share your ideas and suggestions** with the SCTE Boa of Directors and staff at the Annu Membership Meeting.

8. **Celebrate excellence** as you peers are honored at the Awards Luncheon.

9. Enjoy what is always a highlight event: **Expo Evening with Cable-Tec Games**.

10. **Recharge your energy** for the **challenges** of the months ahead with a change of scenery.

	Registration	Training	Exhibits and Demonstrations	Testing	Special Events
Sunday, June 4	**Attendee Registration** 1–6 p.m.	**Preconference Tutorials** 2–4:30 p.m.			**House of Delegates and Membership Meeting** 4:30–6 p.m. **Arrival Night Reception** 6–8 p.m.
Monday, June 5	**Attendee Registration** 7:30 a.m.–5 p.m.	**Annual Engineering Conference** 8:30 a.m.–noon	**Exhibit Hall Open** 2–6 p.m.		**Awards Luncheon** Noon–2 p.m. **Expo Evening with Cable-Tec Games** 6:30–8:30 p.m.
Tuesday, June 6	**Attendee Registration** 7:30 a.m.–5 p.m.	**Expo Workshops** 8 a.m.–12:30 p.m. **Reverse Path Workshop** 8:30 a.m.–5:30 p.m.	**Exhibit Hall Open** 11 a.m.–6 p.m.	**Certification Testing** 10:30 a.m.–3:30 p.m.	**Individual Hospitality Events**
Wednesday, June 7	**Attendee Registration** 7:30 a.m.–noon	**Expo Workshops** Noon–4 p.m.	**Exhibit Hall Open** 9 a.m.–1 p.m.	**Certification Testing** 1–4 p.m.	**Closing Night Receptions:** ▪ **Loyal Order of 704** ▪ **Ham Radio Operators** ▪ **SCTE-List** 6–8 p.m.
Thursday, June 8				**Certification Testing** 8 a.m.–noon	**Golf Tournament** 7 a.m.–2:30 p.m.

Engineering Conference/Workshops

Engineering Conference
Monday, June 5
8:30 a.m. to noon

The broadband industry faces dual challenges. First, consumers anticipate, and consumer electronic product makers promise, new and exciting products, services and applications. The consumer demand for the benefits of technology is increasing. Second, broadband network operators have to build and maintain the networks that will enable these products, applications and services work seamlessly - all to benefit the customers and meet their expectations. Will the network be reliable? Will it be able to carry all of the communications, entertainment and data services that are anticipated? What engineering and operational opportunities exist to provide the fully capable broadband network of the future?

The plug-and-play future brings high expectations.

After the Engineering Conference, get the details at seven different workshops and a daylong session on the reverse network. Spend time with exhibitors learning about new and upgraded products. Visit the Expo-exclusive demonstration areas for real-world real-time learning.

Cable-Tec Expo® 2000 Workshops

Right Sizing the Network

This workshop will offer discussions and solutions concerning the planning, designing and building of a broadband network capable of handling the multitude of services offered today. Telephony, Internet access, digital video, video-on-demand and other services must share bandwidth with traditional analog video entertainment services in a complex network. Planning for future additions is critical. Consideration will be given to headend rack space, floor space, frequency allocations and monitoring functions.

Network Operations Centers

The deployment of lifeline services requires operators to recognize potential problems. Many operators are installing their own network operation centers (NOC), which are designed to monitor network performance and manage planned maintenance and on-demand maintenance. How should a NOC be set up? What functionality should it have? What skills do the people who operate it need? What software and hardware solutions are available to provide the required information? Get the answers to these pressing questions.

Headend/Hub Transport and Design

Today's headend incorporates Ethernets, optical fibers, digital signal processing, Internet gateways, Terabyte servers and other intrusions. This session will discuss the skills and techniques needed to design and deploy flexible RF, data and optical networks to provide adequate and flexible routing of signals and bandwidth to maximize resources.

Telecommunications Test Equipment

New services, especially those based in digital technologies, require new, practical and affordable tools and techniques for characterizing, testing and troubleshooting two-way broadband networks. You will learn of techniques and equipment that can be used to characterize many of the network's operational parameters to assure quality delivery of signals to the customer's home.

Telephony Ready?

An increasing number of cable operators are now deploying or planning to deploy telephony services. Some are providing traditional circuit-switched telephony via the HFC network, while others are testing or planning to deploy IP telephony. What have the early implementers learned, and what can you do now to prepare for the addition of telephony to your network? You will learn of implementation strategies and issues related to the deployment of both circuit-switched and packet-switched telephony services.

Video-On-Demand

Now that the economic hurdles have been largely overcome, many networks are facing the technical issues related to the deployment of video-on-demand (VOD) services. You will greatly benefit from this presentation of the technical "how-to's" of VOD deployment.

Reliability

Improving network reliability involves many aspects of the headend, physical plant and operational procedures. You will be able to look at a wide variety of topics centering on the topic of reliability.

The Reverse Network

The 5 to 42 MHz spectrum is expected to provide a highly reliable pipeline for the completion of two-way communications. New techniques are being implemented that maximize the capabilities of the 5 to 42 MHz spectrum through management, maintenance, planning and technology. Here, you will learn about some of those techniques.

A full day of training will be provided on **Reverse System Operations and Testing**. You will benefit from this workshop's substantive structure, as it will be provided in four parts, allowing you to participate in one or all parts as your schedule allows and your needs require. Topics covered through the day will include:

- Set-up of the reverse plant
- Characterization of the reverse spectrum
- Monitoring of the reverse spectrum
- Testing the reverse spectrum
- Repair of the reverse spectrum

Networking Events

Once a year Cable-Tec Expo provides you with the opportunity to interact with your technical peers from around the globe in both educational and informal settings.

Arrival Night Reception	June 4	6–8 p.m.
Expo Evening	June 5	6:30–8:30 p.m.
Cable-Tec Games	June 5	6:30–8:30 p.m.
Hospitality Suites Hosted by exhibiting companies	June 6	
Closing Night Reception	June 7	4–6 p.m.
SCTE's Annual Golf Tournament	June 8	7:30 a.m.–2:30 p.m.

SCTE Bookstore at Expo!

The SCTE Bookstore will be located in the Expo 2000 registration area and will offer a wide variety of SCTE technical publications and training materials, as well as book signings by noted industry authors.

Internet Stations and Online Show Daily

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New this year! Check your e-mail, surf the Web, locate exhibitors, read up-to-the-minute cable news and more... without leaving the show floor! You'll find ***Cable-Tec Expo Internet Stations*** located throughout the exhibit hall. Each station will feature computers with FREE high-speed connections to the 'Net, plus instant access to ***BIGPIPE.com's Online Show Daily***. Brought to you by BIGPIPE.com and *Communications Technology* magazine. Contact Allan Rubin at 301-340-7788, ext. 4253, or at arubin@phillips.com, for online advertising or *Internet Station* sponsorship opportunities.

Conference and Hotel

Touch the Technology!
SCTE's Cable-Tec Expo 2000
Sunday, June 4 to Thursday, June 8, 2000
Las Vegas Convention Center

Registration

Complete and return the official Attendee Registration Form. Use a separate form for each attendee. Photocopies are acceptable. SCTE will not accept registrations by phone. Payment must accompany forms in order to be processed.

Reservations

Hotel reservations will be accepted only with paid attendee registration forms. Reservations will not be accepted by phone.

Hotels are assigned first come, first served based on availability. However, every effort is made to honor hotel requests.

Failure to complete the housing form and credit card information will delay the processing of reservations.

SCTE reserves the right to place reservations where rooms are available.

Hotel Reservation Deadline: April 28

Deposits

One night's credit card deposit is required to guarantee room.

SCTE cannot process housing forms without complete credit card information.

SCTE is not responsible for hotel cancellations that result from the failure to follow hotel deposit procedures.

Confirmations

Hotels will send you a written confirmation of your reservations. Please call your hotel directly for your hotel confirmation numbers.

Cancellations and Changes

Hotel cancellations or changes must be received in writing by SCTE prior to April 28. After April 28, changes or cancellations must be made directly through the hotel.

Transportation

SCTE has selected **Conventions in America (CIA)** as the official travel agency for this event. Call 1-800-929-4242 and ask for Group #661 to receive the following discounts or the lowest available fares on any other carrier:

American Airlines and **America West Airlines**—Save 5 percent to 10 percent on the lowest applicable fares. Take an additional 5 percent off with minimum 60-day advance purchase. Travel between June 1–13, 2000.

Southwest Airlines—10 percent off lowest everyday fares. All rules apply. Travel between June 1–13, 2000.

Alamo Rent A Car—Rates start as low as $30/day for economy models or $130/week with unlimited free mileage.

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fax 619-232-6497.
Reservation hours: M–F 6:30 a.m. to 5 p.m. Pacific time
E-mail: flycia@stellaraccess.com

If you call direct or use your own agency, please refer to these codes:

American	1-800-433-1790	Starfile #1960UE
Southwest	1-800-433-5368	File #G0250
America West	1-800-548-7575	File #9267
Alamo	1-800-732-3232	ID #609661GR

Registration Options

Complete Registration: Includes Preconference Sessions, Engineering Conference, Technical Workshops, Exhibit Hall, Annual Awards Luncheon and Expo Evening.

Expo Only: Admittance to Technical Workshops and Exhibit Hall.

Spouse Registration: Includes Preconference Sessions, Engineering Conference, Technical Workshops, Exhibit Hall, Annual Awards Luncheon, and Expo Evening.

Preregistration Deadline April 28

Register by April 28 and save $$!
Forms received after April 28 will be returned.
Registrations received after April 28 will not be processed and individuals must register on-site in Las Vegas at the on-site rate.

Missed the deadline? Register on-site!

Cancellations and Substitutions

Requests for cancellation or substitutions must be received in writing on or before April 28. All requests for cancellation will be subject to a $75 cancellation fee. No refunds will be given after April 28. After April 28, substitutions will be processed on-site at the Registration Assistance Booth; written company authorization and a $5 processing fee are required to process substitutions.

Fees

Member-Advantage Rate	Non-Member Rate
Complete Registration	
Before April 28: $345	Before April 28: $445
After April 28: $395	After April 28: $495
Expo Only	
Before April 28: $295	Before April 28: $355
After April 28: $355	After April 28: $455
Spouse Registration	$95
SCTE Membership	$48 North America $72 International

Return completed registration and housing forms with appropriate fees to:
Society of Cable
Telecommunications Engineers Inc.
P.O. Box 13540
Philadelphia, PA 19101-3540

Or fax to: 610-363-5834

Not a member? Join today and save $100 on your Expo registration!

Dress Code

Please dress in a manner that is comfortable and conducive to learning. Business casual attire is recommended.

Badges

Admission to all events is granted based on color-coded badges. Pick up your badges at the registration desk upon

Cable-Tec Expo® 2000 Exhibitors as of Feb. 1, 2000

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ACT Communications
Adams Global Communications Inc.
ADC
Advanced Communications
Agilent Technologies Inc.
Alcoa Fujikura Ltd.
Alpha Industries
Alpha Technologies
Altec Industries
American Allsafe Co.
American Digital Cartography
American Polywater Corp.
Americon International
Amherst International
AML Wireless Systems
Antronix
Applied Instruments
Arcom Labs/Northern CATV
Arena Services
Arguss Communications Group Inc.
Arnco Corp.
Atlanta Graphic Solutions
Aurora Instruments
Avantron Technologies
B.G.I. Technology
Bekaert Corp.
Belden Wire and Cable
Ben Hughes/Cable Prep
Bigband Networks
Blonder Tongue Laboratories
Brazen Software
Broadband Access Systems Inc.
Broadband Innovations Inc.
Broadband International
Broadband Products Inc.
Budco Inc.
Cable AML
Cable Constructors/KES
Cable Innovations
Cable Leakage Technologies
Cable Link Inc.
Cable Resources Inc.
Cable Shoppe
Cable Source International
Cable Spinning Equipment
Cable Technologies
Cable Yellow Pages
CableNetwork Associates Inc.
CableServ Electronics
Cabletek Wiring Products
Cabletron Systems
California Eastern Labs
Canal+/US Technologies
Can-Am Services Inc.
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Carson Industries
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Champion Products Inc.
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Chatsworth Products
Cheetah Technologies
Chromatis Networks
Coast CATV Supply Inc.
Com21 Inc.
CommScope Inc. of North Carolina
Communication Services Co.
Communications Associates
Compass Communications Inc.
ComSonics
Comtech Services
Concurrent Computer Corp.
Condux International Inc.
CONTEC L.P
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DX Communications
Eagle Comtronics Inc.
Earthvision Systems Ltd.
Electroline Equipment Inc.
Equipment Technology Inc.
Ericsson Inc.
ETI Software Solutions
Exfo E.O. Engineering
Fiber Instrument Sales Inc.
Fiber Optic Network Solutions
Fiber Solutions Inc.
Fiber Trucks and Trailers Inc.
Fiberdyne Labs Inc.
Fitel Lucent Technologies
Flight Trac Inc.
FM Systems
Force Inc.
FOXCOM Ltd.
Frontline/Vela Broadcast
GAD Line Ltd.
GLA International/Design Extender
GMP
GN Nettest
Gold Communications Inc.
Goldcom Inc.
Golden State Engineering
Gould Fiber Optics
Graybar Electric Co. Inc.
Hal-Tec Corp.
Harmonic Inc.
Heart Interface Corp.
HellermannTyton Corp.
Holland Electronics
Hukk Engineering
I.C.M. Corp.
ICS Network Solutions
ICTV
IMMCO Inc.
INCAD Inc.
Intergraph Corp.
International Metal Corp.
IRIS Technologies
ISC Datacom Inc.
Itronix Corp.
Jackmoon USA Inc.
Jameson Corp.
JDS Uniphase
JM Consulting Group Inc.
John Weeks Enterprises
Jones Broadband International
Klein Tools
Knaack Manufacturing Co.
Leaming Industries
Lectro Products–Invensys Energy Systems
Lemco Tool Corp.
Lindsay Electronics
Lode Data Corp.
Lucent Technologies
Lyn-Ladder and Scaffolding Group
MacLean Power Systems
Mainline Equipment Inc.
Marconi Communications
Maspro USA
MasTec Broadband
Masterack
MCR Group Inc.
MDSI Mobile Data Solutions
Medley and Co.
Mega Hertz
Methode Electronics Inc.
Microcast Technologies Corp.
Midtronics Inc.
Midwest Cable Services Inc.
Midwest Tower Service
Mintek Barcode Technologies
MK Battery
Mobile Tool International Inc.
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MoreCom Inc.
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NetGame Cable Ltd.
New Elite Technologies Inc.
Nickless Schirmer & Co Inc.
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NOISE COM Inc.
Non-Stop CATV Services Inc.
Nortel Networks
Northern Technologies Inc.
Oldcastle Precast
Ortel Corp.
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Panduit Corp.
Passive Devices Inc.
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PCT International Inc.
Pelsue Co.
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PenMetrics Inc.
Peregrine Communications Inc.
Performance Power Technologies
Philips Broadband Networks
Pioneer New Media Technologies
Pirelli Cable and Systems
Plastic Techniques Inc.
Plexco
Power & Telephone Supply
Power Battery Co.
PPC
Precision Valley Communication
Preferred Technologies
Preformed Line Products
Primedia Intertec
Protel Industries Inc.
P-T Technologies Inc.
Quality Cable and Electronics
Quality RF Services Inc.
Radiant Communications
RDL Inc.
Reliable High Performance Products Inc.
RF Networks Inc.
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  Division of Reef Industries Inc.
The Siemon Co.
The Weather Channel
Thomas & Betts Corp.
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Tollgrade Communications Inc.
Toner Cable Equipment Inc.
Toshiba America Information Systems
Traces Inc.
Transtector Systems Inc.
Trilithic Inc.
Trilogy Communications Inc.
Trinet Communications Inc.
Triple Crown Electronics
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Tulsat
Tulsat/Lee Enterprises
TVC Communications
Tyco Electronics
Universal Electronics
Uraseal Inc.
US Electronics
USTec
Vanner Power Group
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Videotek Inc.
Viewsonics Inc.
Virtek Cable Contractors Inc.
Vision Specialties Inc.
Wade Antenna Ltd./Taco Antenna
WaveCom Electronics Inc.
Wavetek Wandel Goltermann
West 1 CATV Supplies Inc.
William Frick & Co.
World Wide Cable Inc.
YC Cable USA Inc.
Zenith Electronics

Cable-Tec Expo® 2000
Attendee Registration Form

Badge Information

Complete a separate form for each registrant. Photocopies are accepted. Do not use this form to register exhibitor personnel.

Please Print or Type.

Name: ______________________ Nickname: ______________________

Title: ______________________ Company: ______________________

Street Address: ______________________

City: ______________________ State: __________ Zip: __________

Phone: (   ) ______________________ Fax:(   )______________________

E-mail (PLEASE TYPE): ______________________

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☐ YES! I wish to receive/continue to receive *Communications Technology* magazine. ☐ No, thank you.

Signature: ______________________ Date: __________

Occasionally, *Communications Technology* makes its lists available for special offers from qualified, relevant businesses and organizations. If you would not like to receive this information, check this box. ☐

Is housing required? ☐ Yes ☐ No If "yes," please complete and enclose the Official Cable-Tec Expo 2000 Housing Form.

Registration Fees

	Pre-Registration Until April 28, 2000		On-Site (no need to submit this form prior to arrival) After April 28, 2000		
	Member	Non-Member	Member	Non-Member	
Engineering Conference and Expo	$345	$445	$395	$495	$________
Expo Only	$295	$395	$355	$455	$________
Spouse Registration	$95	$95	$95	$95	$________
Spouses Name (First, Last): ______________________					
Additional Luncheon Tickets @ $40 each					$________
Additional Expo Evening Tickets @ $60 each					$________
SCTE Membership (Join/Renew)	$48 North American		$72 International		$________
			TOTAL ENCLOSED:		$________

Method of Payment

Fees are payable to SCTE by check (in U.S. dollars), Visa, MasterCard or American Express. Registration fees or credit card information must accompany this form in order to process registration. Please do not include hotel deposit with payment.

☐ Check ☐ Visa ☐ MasterCard ☐ American Express

Credit Card Number: ______________________ Exp. Date: ______________________

Cardholder Signature: ______________________ PRINT Cardholder Name: ______________________

Contributions or gifts to the Society of Cable Telecommunications Engineers Inc. are not tax deductible as charitable contributions. However, they may be tax deductible as ordinary and necessary business expenses.

Registration Policies

- SCTE will accept registrations by fax *only* when paid by credit card. Please *do not* mail original if already faxed.
- Registrations received after April 28 will not be processed. After April 28, attendees must register on-site at the on-site rate.
- Name substitutions must be received in writing at SCTE prior to May 5. After that date, substitutions must be processed on-site at the Registration Assistance Booth accompanied by a $5 processing fee and written company authorization.
- Registration forms accompanied by a completed SCTE membership application and dues payment are eligible for the member rate.
- Sustaining membership qualifies only the individual named on the membership to register at the member rate.
- SCTE will send written confirmation of your attendee registration.
- No refunds will be given after May 5. All cancellations must be received in writing on or before May 5 and are subject to a $75 cancellation fee.

Return completed registration and housing forms with appropriate fees to:

SCTE Inc.▪P.O. Box 13540▪Philadelphia, PA 19101-3540
or fax to: 610-363-5834

CT400

For SCTE Use Only

Date Received: __________ Date Processed: __________ Amount Received: __________

SCTE Member: ☐ Yes ☐ No Membership fee included: ☐ Yes ☐ No

Batch #: __________ Check #: __________ ☐ Visa ☐ MC ☐ AmEx

Cable-Tec Expo® 2000
Attendee Housing Form

Housing Instructions

- The Official Cable-Tec Expo Hotel is the Las Vegas Hilton, with a room rate of $109 per night. Overflow hotels may be added as needed.
- Housing reservations are accepted only with paid Expo registrations. Registration forms with payment and hotel reservation requests must be received by SCTE Headquarters by April 28, 2000. Hotels are assigned first come, first served based on availability.
- A credit card deposit of one night's rate must accompany reservation requests. Rooms must be guaranteed by credit card ONLY. Please fill out complete credit card information below.
- Hotel cancellations or changes must be received in writing by SCTE Headquarters prior to May 5. After May 5, changes or cancellations must be made directly through the hotel.

Attendee Information

Complete a separate form for each reservation. Photocopies are accepted. DO NOT use this form to request an exhibitor room block.
Please TYPE.

Name: ______________________________ Nickname: ______________
Title: ______________________ Company: ______________________
Address: ____
Street/P.O. Box City State Zip
Phone: ( ) ____________________ Fax: ( ) ______________
E-mail (PLEASE TYPE): ______________________ SCTE Member # __________

Attendee Accommodation Information for the Las Vegas Hilton

Arrival Day: __________ Date: __________ Time: __________ Departure Day: __________ Date: __________
Time: ____
Room Type Requested: ☐ Two Double Beds ☐ King Size Bed ☐ Smoking ☐ Non-Smoking
Number of Persons Sharing Room: ________ Name(s): ______________________
Special Requests (honored when possible): ______________________________

Payment Instructions

You must guarantee your room reservation by providing credit card information and signature below.

☐ Visa ☐ MasterCard ☐ American Express

Credit Card Number: ______________________________ Exp. Date: __________
Cardholder Signature: ____________________ PRINT Cardholder Name: ______________

Return completed registration and housing forms with appropriate fees to:
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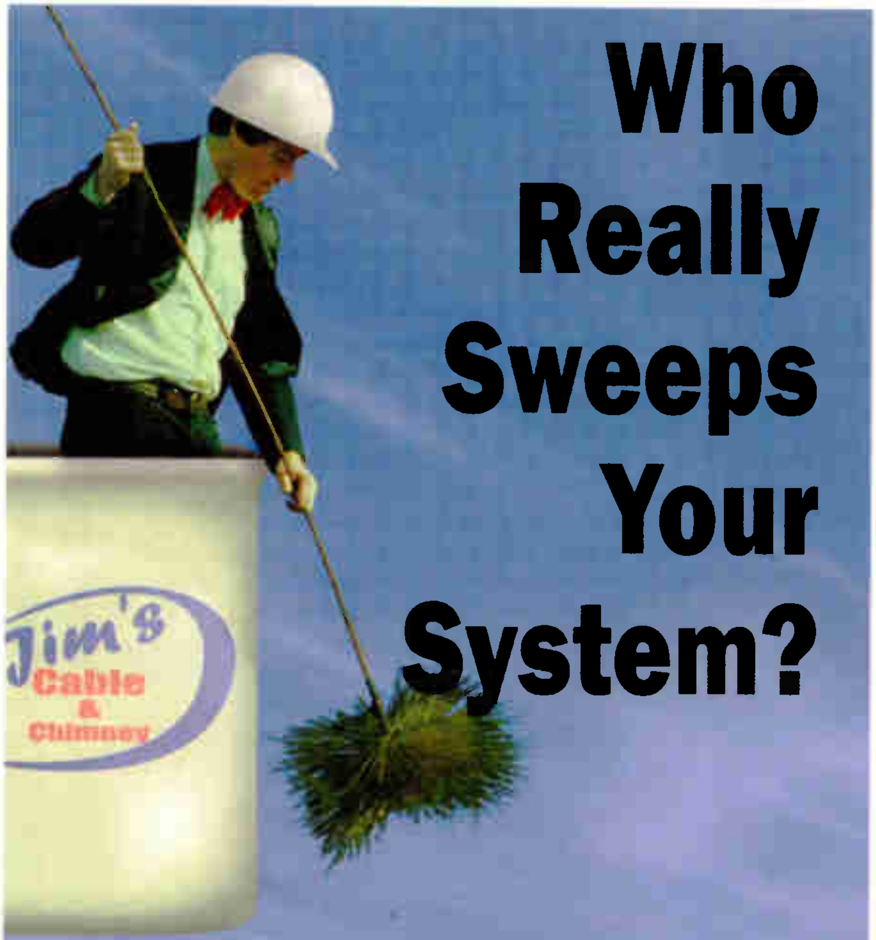

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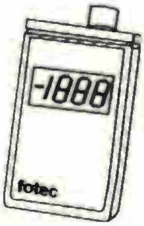

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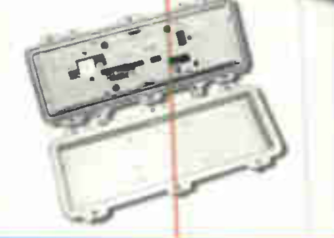

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Cable-Tec Expo has long been the premier hardware show for our industry. It provides an opportunity for attendees with a wide array of experience and backgrounds to gain insight into the challenges facing the industry. Training opportunities abound at Expo, with the centerpiece being the multitude of workshops offered on a wide variety of topics. The Cable Tec Expo 2000 Program Subcommittee has selected topics to provide you with top-notch learning opportunities. Here's a glimpse of what's ahead.

Right-sizing the network

This workshop will offer discussions and solutions concerning the planning, designing and building of a broadband network capable of handling the multitude of services offered today. Planning for future additions is critical. Consideration will be given to headend rack space, floor space, frequency allocations and monitoring functions.

Network operations centers

Many operators are installing network operations centers (NOCs), which monitor network performance and manage both planned and on-demand maintenance activities. Come by and learn how a NOC is set up, the functionality it needs, the hardware and software necessary to provide the proper information, and the skills needed to run one.

Headend/hub design

Today's headend incorporates Ethernets, optical fibers, digital signal processing (DSP), Internet gateways, Terabyte servers and other intrusions. To keep pace with the changes, join the discussion on skills and techniques needed for designing and deploying flexible RF, data and optical networks to provide adequate and flexible routing of signals and bandwidth to maximize resources.

Test equipment

Presenters of this session will demonstrate techniques and equipment to characterize many of the operational parameters of a network to assure the quality delivery of signals to the customer's home.

Telephony ready?

More and more cable operators are now deploying or planning to deploy telephony services. Don't miss this one if you're interested in implementation strategies and future issues related to deploying both circuit-switched and packet-switched telephony services.

Video-on-demand

Now that the economic hurdles largely have been overcome, many networks are facing the technical issues related to the deployment of video-on-demand (VOD) services. Join us for a technical "how-to" look at VOD deployment.

Reliability

Improving reliability of a network involves many aspects of the headend, physical plant and operational procedures. This workshop will examine a variety of topics centering on the issue of reliability.

The reverse network

The 5-42 MHz spectrum is expected to provide a highly reliable pipeline for the completion of two-way communications. New techniques are being implemented that maximize the capabilities of the return through management, maintenance, planning and technology. Drop by to hear the latest on these techniques.

SCTE also is offering a full day of training on reverse system operations and testing. This session will be provided in four parts, and attendees can attend one or all parts as their schedules and needs require. Topics covered through the day will include:

- Set-up of the reverse plant
- Characterization of the reverse spectrum
- Monitoring of the reverse spectrum
- Testing the reverse spectrum
- Repair of the reverse spectrum

Of course, Cable-Tec Expo will offer an exhibit floor featuring more than 460 industry hardware and service vendors. Cable-Tec Expo truly will provide an opportunity for all attendees to "touch the technology" that is shaping the broadband telecommunications industry. CT

Alex Best is senior vice president of engineering for Cox Communications and chairman of SCTE's Cable-Tec Expo Program Subcommittee. He can be reached at (404) 835-5500.


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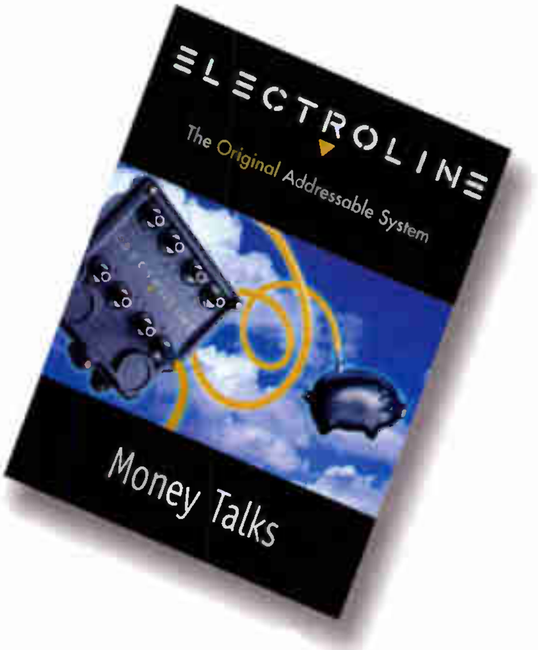
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MULTIPOWER: Reliability Is Key

CableNews Jan.11/00 - Cable engineers in Latin America and Asia are relieved to report that power supply reliability is on the increase. Plagued by "dirty" power from unreliable utilities, typical "standby power supplies" are seldom up to the task.

Typical users report that standby units are so challenged by constant dropouts, transient "spikes" and low-line conditions, that they "transfer" virtually continuously. This is hard on batteries, transfer relays, inverters and logic circu

Recent installations of Multipower's new "True UPS" supplies, however, have shown that powering indeed can be the most reliable ingredient in a system's outside plant.

Multipower engineers report that "it's simple; true UPS architecture has always been superior in reliability to standby approaches; it's just that no one has been able to put UPS like this in a high efficiency, price-competitive package before. That's what we've done.."

Apparently, in th

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power supply technology Multipower landed three patents. When pressed Multipower would admit to one patent recently issued, which accounted for the breakthrough design leading to the high powering efficiency the company's designers sought. The other two patents are actually still in the application phase, but relate to power factor correction and battery testing.

A typical scenario played out recently i a system in Sao Pa Soa

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