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Planning 2002, Part 2

Communications Technology

Official Trade Journal of the
Society of Cable Telecommunications Engineers

August 2001

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 Communications Technology™ (ISSN 0884-2272) is published monthly by PBI Media, LLC, 1201 Seven Locks Road, Suite 300, Potomac, MD 20854, USA. Editorial and sales offices located at 5655 S. Yosemite, Suite 200, Englewood, CO 80111 USA, (303) 889-1565. August 2001, Volume 18 Number 8. Periodicals postage paid at Rockville, MD, and additional mailing offices. POSTMASTER: Send address changes to *Communications Technology*, P.O. Box 3230, Northbrook, IL 60065-3230. Change of address two to eight weeks notice requested. Send to the above address or call (847)559-7314. Email: CT@omeda.com. Subscriptions: Free to qualified individuals directly involved in the cable industry. All other prepaid subscriptions, US: one year $89; two years $178. Canada: one year $99; two years $198. Foreign: one year $129, two years $258.

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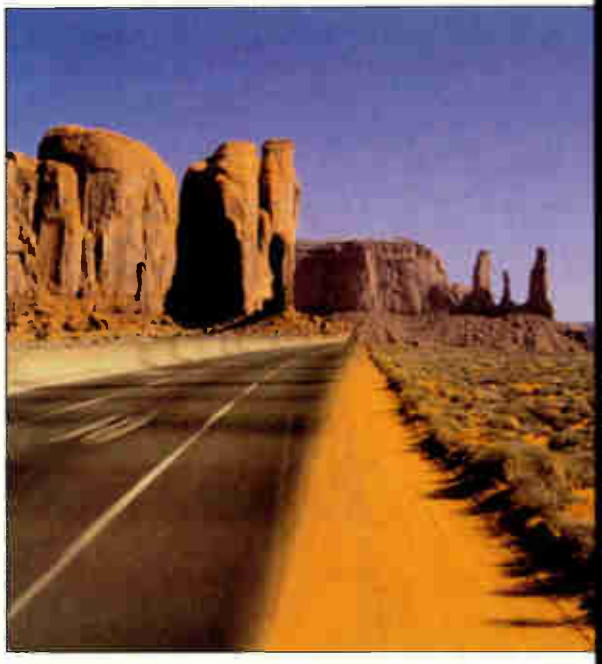

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Cut Your Ties to Sears?

A lime green envelope arrived in my mailbox this week. On its face it read in giant print, "Cut Your Ties to Cable TV." I opened it thinking it was junk mail from **DishTV** or one of the other satellite companies. It was from **Sears**!

"Suppose everyone in cable decided to stop buying from Sears."

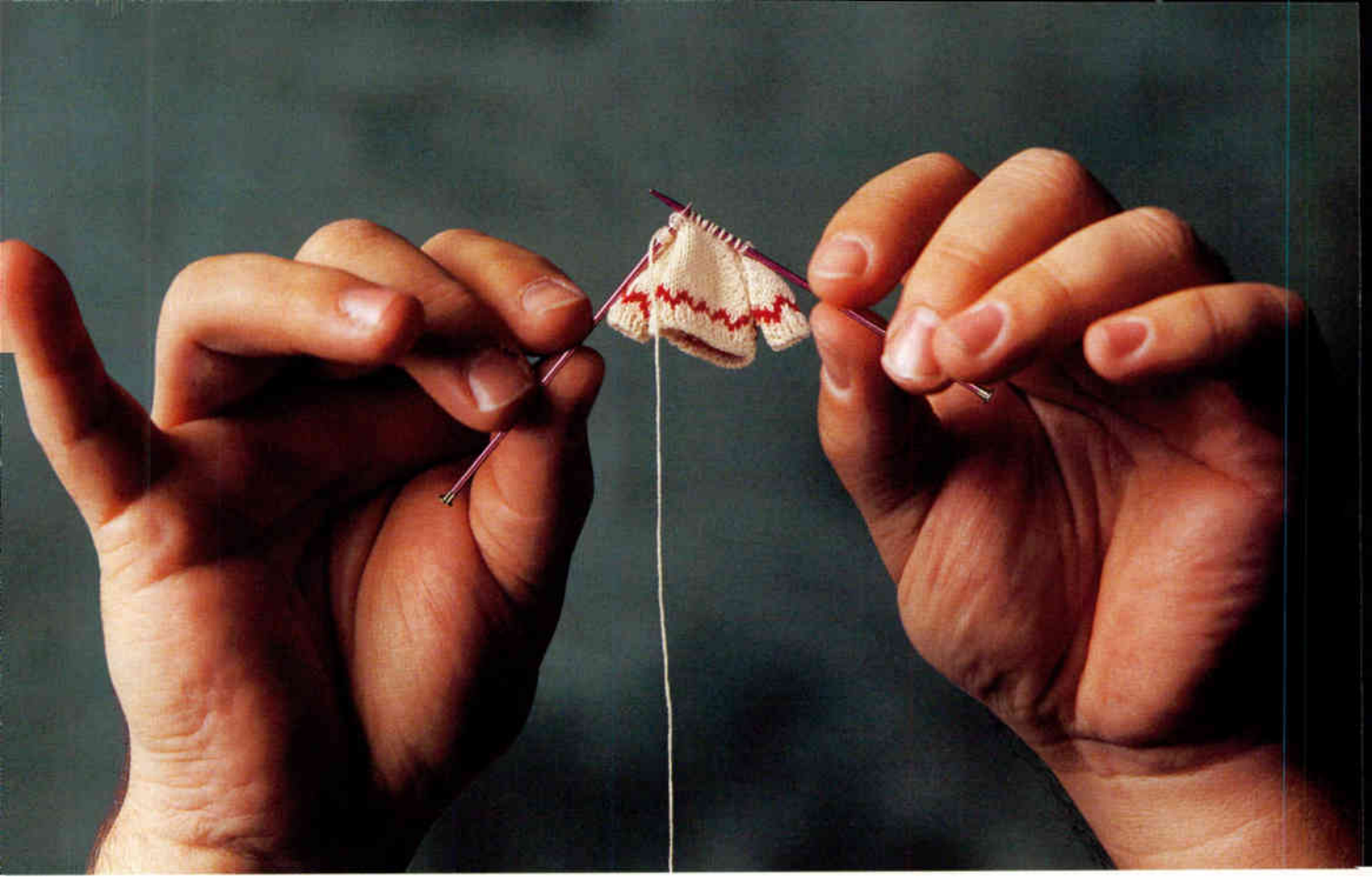
Of course, it did announce that Sears had teamed up with Dish Network "to bring you the latest in TV technology." But I thought the cable TV industry did that back in the 1980s when we introduced programming by satellite?

I wouldn't mind Sears getting into the business of satellite TV. That's their prerogative. But I am more than a little disturbed when they have mass mailings asking cable customers to discontinue their cable service. I take it personal because I have used Sears to furnish more than a dozen homes, including mine and those of my relatives.

As one of their earliest credit card customers, I've spent hundreds of thousands of dollars for their sofas, stoves, refrigerators, washers and dryers. I don't remember them ever hesitating to accept my hard-earned money because it was from an industry such as cable television. As a matter of fact, white-collar workers consider both cable TV and Sears hometown businesses.

Greed does weird things to corporate thinkers, and apparently it affects those at Sears. Sometimes they forget that millions of people work in the cable business. Every major city, suburb, small town and village has large numbers of people employed by our industry. Suppose everyone involved in cable decided to stop buying anything from Sears. After all, Sears is asking everyone to stop using our service. Sears would jeopardize major business just to get into the satellite TV business, something they know absolutely nothing about?

I am forwarding the letter on to the **National Cable & Telecommunications Association** (NCTA), hoping they will meet with someone at Sears' headquarters and try to set them straight. In the letter, Sears touts their excellent customer service, but think how I feel after being a loyal Sears customer for half a century and now Sears publicly denounces my industry. Cut my ties to the cable industry? At this point in my life, it's a much easier decision to cut my ties to Sears! CT



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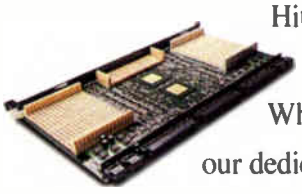

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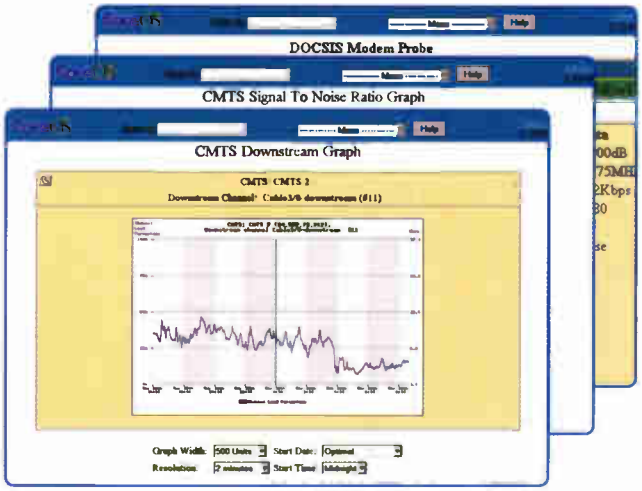

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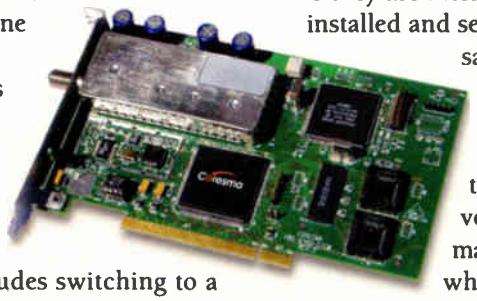
Host-Based Modems Shift Landscape

By Monta Monaco Hernon,
Contributing Editor

At the NCTA Cable 2001 show, **Coresma**, Inc., formerly **NetGame**, was armed with the reference design for a host-based internal cable modem, the CICM 6001RD-A.

The CICM is based on the Coresma 6100 MAC (media access control) chip which has a dual-pipeline construction and four 32-bit reduced instruction set computing (RISC) processors that each operate at 100 million instructions per second (MIPs). The chips are programmable.

"You can actually write to the chip," says Mark Adams, Coresma's CEO.



A software modification could be done in three to five months, whereas changes to the firmware or hardware could take 12 to 18 months, he explains. This includes switching to a different version of Data Over Cable Service Interface Specification (DOCSIS).

Claiming to be physical layer (PHY)-agnostic, Adams says Coresma wants to "offer host-based to as many semiconductor companies as possible."

Host-based modems, because they feed off the memory and the central processing unit of a host, such as a personal computer, are expected to cost less than regular modems.

Adams wouldn't comment specifically on what the price of the CICM will be, but says Coresma is trying to get it "way below" the $100 mark on launch for the end user. He is aiming for it to be a sub-$50 product within the next 12 to 18 months.

Coresma changed its name from NetGame last October to reflect its evolution from an Internet gaming company to one that focuses on "system-on-chip" technology. In another shift, Coresma has decided to sell not only to multiple system operators (MSOs) but also to original equipment manufacturers (OEMs).

"I don't think [MSOs] care much anymore about making small margins on cable modems," Adams says.

Keith Kennebeck, an analyst with the **Strategis Group** agrees that the concept of a host-based modem should be attractive to MSOs.

"The main advantage of (computer controlled cable modems (CCCMs) in general) is that they will be super cheap—$50 and less—and in the case they are internal, will already be installed and set up on the PC," says Kennebeck. "However, CCCMs require interaction between the modem vendors and PC manufacturers, which could be challenging," he adds.

Mike Paxton, senior analyst with **Cahners In-Stat Group**, says the popularity of CCCMs will depend on the business plan of the MSO and into what type of device the modem is integrated.

"[It] might be less efficient or cost-effective, or more cost-effective, depending on how it is used," he explains.

Adams says a retail model is in Coresma's future and notes that the company will add a USB version to its product line.

As for certification, Kennebeck says certification for DOCSIS 1.1 modems is supposed to begin by the end of the year. CCCM certifications are not expected until late 2002, he adds. CT

NEWSBYTES

> ***Pacific Broadband Qualifies***
> **Pacific Broadband Communications** received Data Over Cable Service Interface Specification (DOCSIS) 1.0 qualification from CableLabs for its cable modem termination system (CMTS), which has custom-built silicon.

> ***OpenTV, BigBand Team Up***
> **BigBand Networks** and **OpenTV** are collaborating to enable the insertion of interactive TV content at master or local headends. The companies say the product will help operators better manage their transmission bandwidth requirements.

> ***MSN Grows***
> **MSN** had the largest growth rate among major Internet service providers (ISPs) over the past year, but ranks below average in customer satisfaction, a **Solomon Wolff Associates** report says. MSN accounts for 10 percent of U.S. Internet users, making it the second largest ISP behind **AOL**.

> ***WorldGate Targets Ad Sales***
> **WorldGate's** Local Interactive Ad Sales Guide is a tool designed to provide local cable ad sales teams with the information needed to sell and involve local advertisers in their interactive TV offerings.

> ***N2 Broadband Speeds VOD***
> Digital asset distribution and management provider **N2 Broadband** says that **Warner Brothers Technical Operations** and **iN DEMAND** have signed agreements to use N2 Broadband's MediaPath system to transmit digital content securely to headends to support video-on-demand (VOD) services.

Open Access Trials Still Rolling

By Ruth Suarez Zane
Contributing Editor

While cable heavy hitters **AT&T Broadband** and **Time Warner** are falling under scrutiny for what some are calling lengthy open access trials, other cable providers are jumping into the fray.

"Cable providers have been reluctant to nail down commercial open access launch dates."

Comcast began technical field trials in Philadelphia earlier this year with **Juno Online Services** and **Earthlink**.

Cox Communications, **America Online** and **Earthlink** are participating in a six-month technical trial in which the companies are testing the delivery of the high-speed AOL PLUS Internet service over Cox's broadband network in El Dorado, Ark.

Time Warner's cable division began an open access trial last September with AOL, **Road Runner** and Juno in Columbus, Ohio.

AT&T began its $20 million technical trial in Boulder last November, and plans to open its cable network to Internet service providers (ISPs) in the middle of next year. For the next two months, it will continue to test billing and customer care operations for the 300 users and four ISPs participating in the technical assessment.

Meanwhile, AT&T will be at work in Boston this fall with its commercial trial of Broadband Choice. The trial will include several thousand cable modem subscribers and will prime the carrier for a broader 2002 rollout, once AT&T's exclusive **Excite@Home** agreement expires.

Paying customers

AT&T spokeswoman, Sarah Eder, says customers will be paying for the service this time around. Eder would not disclose which ISPs would be involved in the upcoming Boston trial.

"We won't be discussing the technology prior to launching," Eder said. "We haven't targeted a specific community, nor have we named who will be participating."

With one ISP, cable operators could manage data services more loosely, says Veenod Kurup, director of data operations, support systems, for Cox. Now that's changing, with a somewhat counter-intuitive result.

"You need to have better control of your network, even as you open it up," Kurup says.

Opening up cable networks involves technical feats such as allow-

DEALS

> ***C-COR.net Buys ADC Assets***
C-COR.net is acquiring the DV 6000/6400 line of uncompressed digital video products and Optiworx line of modular headend and node equipment from **ADC**. The $32 million cash deal includes ADC assets in Meriden, Ct., Argentina and Austria.

> ***CAIS Gets Funds***
CAIS, the B2B broadband and bundled service provider, got a $19.5 million injection from **CII ventures II LLC**, an affiliate of **Kohlberg Kravis Roberts & Co.**, and two major shareholders. Pending shareholder approval, CAIS will become **Ardent Communications.**

> ***Luminous Completes Round***
Luminous Networks completed an $80 million equity financing round, which gives Luminous working capital to produce its PacketWave products. Strategic investor **Scientific-Atlanta** has a development and original equipment manufacturer (OEM) relationship with the optical Ethernet platform provider.

> ***Firm Targets Cable***
Investment firm **Friedman, Billings, Ramsey & Co.** issued a report on growth trends in the cable industry, including the demand for broadband connectivity and emerging interactive services, and initiated coverage of **Charter**, **Comcast**, and **Cox.**

> ***S-A Taps Tulsat***
Tulsat Inc. agreed to distribute **Scientific-Atlanta's** Continuum headend and tap/passives products, which support a variety of video, voice and data services. Tulsat will also become an outlet for factory re-manufactured and surplus S-A products.

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ing users to change ISPs, vary speeds, and troubleshoot problems, and enabling the cable operator to manage customer care, monitor

"You need to have better control of your network, even as you open it up."

—Veenod Kurup, Cox Communications

traffic, ensure quality of service (QoS) and close complicated customer transactions.

Billing looms as an especially strong challenge to open access. Earlier this year, Time Warner licensed **Portal Software's** Infranet customer management and billing platform. Another billing player, **AP Engines**, announced its AP InterLink at the NCTA show as a way for MSOs to automate provisioning across multiple operations support systems (OSS).

> New Standards Section of SCTE Web Site

The new section of the SCTE's Web site devoted to standards features an inventory of officially approved standards, describes each SCTE Standards subcommittee, lists SCE Standards staff, and includes a calendar of upcoming meetings and activities. Visitors to the site can download forms used in the standards process and purchase complete SCTE and American National Standards Institute (ANSI)-approved standards.

Cable providers have been reluctant to nail down commercial open access launch dates for fear of being unable to meet those goals. Could such protective measures backfire?

"The task is more difficult than anyone anticipated," says Frank Dzubeck, president of **Dzubeck & Associates**, a Washington-based telecom consultancy. "It's not for lack of trying. The systems are not as robust and as sophisticated as in other segments of the communications industry, but they never had to be, so why would they have spent the money before?" CT

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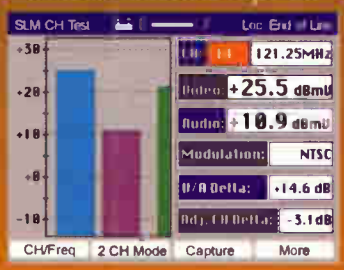

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SCTE and Comcast Push Safety

By Michael Robuck, Associate Editor

From climbing poles and ladders to driving while distracted or fatigued, cable technicians have plenty of opportunities to get hurt on the job.

Driving and lifting are the top two concerns, says Dennis Sullivan, director of safety at **Prince Telecom**, a contractor that specializes in the installation of advanced services. Another problem, he notes, is the tendency of 20- to 30-year-olds to regard themselves as "invincible and all-powerful."

To honor operators that have overcome these challenges, the **SCTE** presents Gold and Silver Safety Awards at the annual Cable-Tec Expo. By this metric, **Comcast** has become a safety powerhouse.

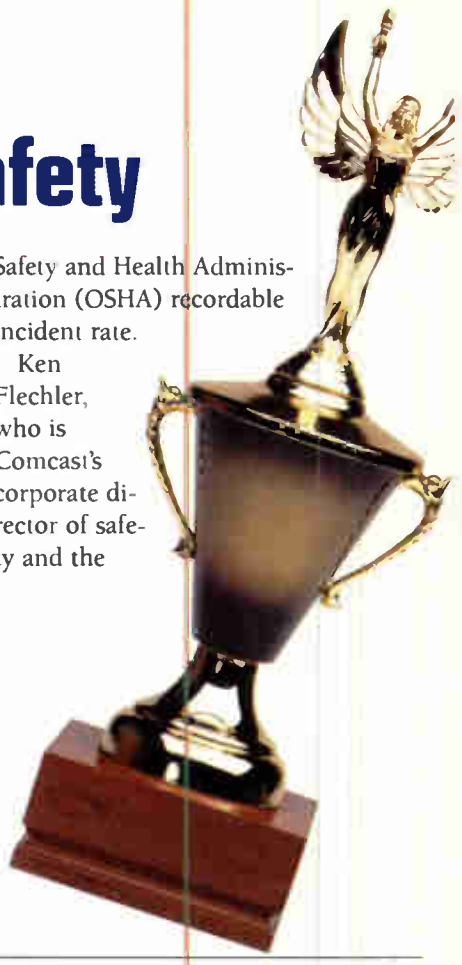
At this year's show in Orlando, Fla., Comcast hauled in 11 of the 14 gold awards and five of the seven silver awards. The Philadelphia-based operator took home five gold awards and four out of four silver awards in Las Vegas a year ago.

"I believe the success Comcast had last year really fueled interest throughout their company and led to them achieving even more awards this year," says Melissa Hicks, SCTE's director of membership services and industry relations.

This year, **Cox Communications** and **Time Warner Cable** picked up one and two Gold Awards, respectively.

Winning a gold or silver award is pretty cut-and-dried because they are based upon an organization's U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) recordable incident rate.

Ken Flechler, who is Comcast's corporate director of safety and the



chairman of the SCTE's Environmental, Health and Safety Committee, said Gold Award winners have to maintain an incident at or less than 50 percent of the industry's national OSHA rate. Silver Award winners maintain a rate at or below 25 percent of the industry's national rate. To establish the incident rate, OSHA uses Standard Industrial Classification (SIC) codes.

The cable systems submit a form to the SCTE committee, and then Flechler calculates their self-reported incident rates to see if they achieve gold or silver status.

"We have over 100 cable systems and we're really focused on safety, so I was actually expecting to win more," Flechler says. Comcast's decentralized structure is a challenge. "We have to get our new systems into our safety culture and get everyone walking in the same direction," he says.

"We have an overall philosophy on safety, but the big thing is to empower our people and let them do what they need to in order to accomplish their goals," Flechler says.

Aside from the cost savings from implementing a successful safety program, Flechler says the awards serve to improve company morale. He also threw down the gauntlet for next year's award ceremony.

"I definitely see us winning more and more every year," Flechler says. "Georgetown, Delaware, has won gold the past three years and I would like to see some of our other systems win year after year as well." CT

> Gold & Silver Safety Award Winners

This year's Gold Safety Award winners are: Comcast, Albuquerque, N.M.; Comcast, Burlington, N.J.; Comcast, Clinton, Conn.; Comcast, Dothan/Marianna, Ala.; Comcast, Florence, Ala.; Comcast, Georgetown, Del.;Comcast, Groton, Conn.; Comcast, Manitowoc, Wis.; Comcast, Montgomery County, Md.; Comcast, Salisbury, Md.; Comcast, Shoals, Ala.; Cox Communications, Middle Georgia, Ga.; Time Warner Cable, Barstow, Ca.; and Time Warner Cable, Coronado, Calif.

SCTE presented Silver Safety Awards to Comcast, Sacramento, Calif.; Comcast, Alexandria/Arlington, Va.; Comcast, Prince William, Va.; Comcast, Washington, D.C.; Comcast, Pima, Ariz.; and Cox Communications, Orange County, Calif.

FROM THE PIPE — CT's PIPELINE

"Time Machine" Helps Modem Subs

By Laura Hamilton
Editor, *CT's Pipeline*

John Q. Subscriber's network settings become corrupted when he installs some nifty new software. So, he needs to reset or reconfigure them, and has two options. One, he can try to figure it out through the user guide, or, two, he can call your system for help. Either way, if he gets a number wrong as he enters the settings, you might have to roll a truck.

Saving operators money

Want to save the money on that truck roll? Need to lower the number of trouble calls coming into your system? Want to increase customers' satisfaction and empower them at the same time? Of course you do. And one operator, **Rogers@Home** says it is doing all that by dabbling in the time/space continuum. Sort of.

"An analysis of calls received in the first few months of 2001 indicated that almost 50 percent of calls were customer hardware- or software-related," Alek Krstajic, a Rogers@Home senior vice president of interactive services, says. "Rogers' investment in [iToolbox] will allow our customers to resolve many of those issues themselves, making it easier and more convenient for them."

All Rogers@Home customers have received a free copy of iToolbox, a CD-ROM that helps customers using Windows-based computers to troubleshoot their particular problems.

Along with information that allows customers to optimize their use of high-speed access, iToolbox contains troubleshooting tips and software tools including Connect Wizard, which automatically helps resolve potential connection and e-mail quandaries.

"The program literally takes the computer back in time to the last time it was connected to the network, thereby eliminating any connection problems caused by incorrect computer or e-mail settings," the company reports. "Rogers is the only Internet service provider to offer this service."

The program installs with a "Healing Agent." Periodically—usually twice a week—it checks subs' network settings and backs them up. If these settings suffer alteration or corruption, the Connect Wizard uses the Healing Agent to restore connection.

"I'm still a rookie, but this was a snap," Rogers customer Sylvia Mauti gushes. Another sub, Michael Vathilakis, says, "It is nice to know that I can check my own connectivity and e-mail problems without having to make a phone call."

Rogers spokesperson Taanta Gupta tells *CT's Pipeline* that the op is enjoying "good results" so far with the CD-ROM and its test phase will continue for the next couple months. Watch for detailed info on the trial in an upcoming issue of *CT's Pipeline*. CT

This story was adapted from info that originally ran in "CT's Pipeline," a weekly HTML newsletter delivered exclusively to SCTE members via e-mail. For more information on this and other member benefits, contact (610) 363-6888, or visit www.scte.org.

Clarification: In the July issue of CT, the cover photography and photographs used in the SCTE Expo story on page 38 were taken by David Dell'Olio, Foto Inc.

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The new **DSM-220** Wideband Modulator from DX sets the pattern for the next generation of headend modulators. In keeping with the tradition of performance and innovation, the DSM-220 incorporates DX's unique BandPass filtering system delivering outstanding C/N performance in high capacity channel environments. Additional features include a digital channel display, dual inputs with automatic video sensing and switching and a frequency range to 858MHz.

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Alliance Rallies Around Linux

By Arthur Cole, Contributing Editor

A new alliance of cable set-top manufacturers and software providers has formed to bring the Linux operating system to the digital cable marketplace.

The **TV Linux Alliance** counts among its members 24 leading vendors, including **Motorola**, **Pace Micro Technology**, **Liberate**, **OpenTV**, **TiVo** and **Excite@Home**. Notably missing, however, is cable mainstay **Scientific-Atlanta**.

The alliance intends to define a standard application programming interface (API) as a means to improve development time for new digital cable applications. A basic-level spec is expected out by the end of the year.

Alliance representatives said that the decision to support Linux as a set-top operating system (OS) came down to one criteria: open standards. Unlike a proprietary OS such as Windows CE, the Linux source code is available to everyone. That allows applications developers to fix bugs and make improvements to the software without having to wait for input from the owners of the source code.

"For set-tops, the biggest challenge is coordinating all the technologies that are coming together on the advanced boxes," says Fran Helms, director of Liberate's PopTV partner program and chairperson of the alliance. "Linux allows all developers to work on the OS source code, in addition to their own technology."

For the set-top manufacturers, Linux has the appeal of offering another alternative in an increasingly networked industry.

"As more and more systems move into thick-client technology, there will be a need for more networking support," says Carl McGrath, vice president and general manager of Motorola's DigiCable line. "And with

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the growth of home networking, we see a need for more support for (universal serial bus) USB, 1394 and the various wireless interfaces."

To be sure, other OSs will likely provide support for these things as well, but it's that open source code that give Linux an edge with developers.

The alliance also breathes new life into the Linux application market. Once hailed as the seachange technology that would topple the **Microsoft** hegemony, Linux has seen a tepid response from desktop users who continue to flock to the familiarity of Windows.

"The embedded space is where Linux will win."
—Cathleen Collett, Lineo

"The embedded space is where Linux will win," says Cathleen Collett, senior product marketing manager at **Lineo Inc.**, a Utah-based Linux application developer, which is also part of the alliance. "We determined a need to create a standard because there are so many varying versions of Linux."

On the surface, the lack of support from Scientific-Atlanta would seem to be a major setback for the alliance. However, Liberate's Helms said it is not necessary for Linux to dominate the set-top market in order to be successful.

"The purpose of the alliance is to ensure that where Linux has been chosen as the set-top OS, we can avoid having the middleware developer or chipset manufacturer having to support 10 different flavors of Linux," she says. "Network operators like to have a choice of vendors and solutions. We are putting forth a standard Linux set where there is some standardization, but there are still other choices out there." CT

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Is Your Network Data-Ready?
Part One

Time and time again, I'm asked if any special requirements are needed for a cable system to carry high-speed data. My answer is, "It depends." The dialogue usually continues something like this: "What do you mean 'it depends'? We've never had any major problems providing regular cable service on our network."

"Yes, but..."

"But what?"

"Data can be deployed in a classic tree-and-branch network."

Read on to find out. There is no secret formula, no rocket science, no magic. Really! Your network's architecture doesn't necessarily have to be hybrid fiber/coax (HFC), although it helps. Okay, it helps a lot, but data can be deployed in a classic tree-and-branch network. Your system doesn't have to incorporate the latest, state-of-the art 750 MHz or 860 MHz bandwidth technology. Two-way isn't mandatory, either. You can deploy telco-return cable modems in a one-way network, but a two-way network offers a bunch more flexibility, greater throughput and the ability to migrate to more advanced services such as voice.

The bottom line (and the "it depends" part) is this: Data can in most cases be successfully deployed on a cable network if the *entire* network—headend, distribution network, and subscriber drops—complies with certain minimum technical performance specifications. Those performance specifications include relevant government technical regulations applicable to cable systems and the recommended parameters in the Data Over Cable Service Interface Specification (DOCSIS).

The first requirement is pretty straightforward. With few exceptions, most cable systems are required by law to comply with applicable government technical regulations. Part 76 of the Federal Communications Commission's (FCC's) rules includes cable TV technical performance requirements for US cable systems. Those rules, which you're supposed to have on file in your system, can be found online at: www.access.gpo.gov/nara/cfr/waisidx_99/47cfr76_99.html

So, the first step is to make certain that your entire network complies with relevant government technical rules. If it doesn't, let me make it very clear that non-compliance may impact the ability of the network to reliably transport data signals.

What about DOCSIS? Isn't that just a standard for interoperability among cable modem termination systems (CMTSs) and cable modems? It's that and much more.

One part of DOCSIS, known as the Data-Over-Cable Service Interface Specifications Radio Frequency Interface Specification, includes minimum recommended technical performance parameters to carry data on cable networks. An overview of some of those parameters appeared in the June 2001 issue of *Communications Technology* ("Cable Modem 102: More Nuts and Bolts," page 68). The entire DOCSIS 1.0 RFI Spec is available online at www.cablemodem.com/SP_RFI_105_991105.pdf. The DOCSIS 1.1 RFI Spec, which is similar to the 1.0 RFI Spec, can be found at www.cablemodem.com/RFI-I06-001215.pdf.

Before you get too ambitious about downloading either of these files using your computer's dial-up modem, consider yourself forewarned that the documents are, uh, fairly good-sized. For instance, the DOCSIS 1.0 RFI Spec is 214 pages (a little under 1 MB), and the 1.1 RFI Spec is 450 pages (about 3.5 MB).

I want to talk a bit about some of the DOCSIS RFI Spec recommendations, but before I do it's important that you understand one more piece of advice. Data doesn't like misaligned cable networks. For the sake of this discussion, I'm going to assume that your entire network—headend and hubs, downstream and upstream optical links and downstream and upstream coaxial distribution plant—is properly aligned. Improper alignment absolutely will impact the ability of the network to reliably transport data signals.

Where was I? Oh, yes. DOCSIS recommended technical parameters for the carriage of data on cable systems.

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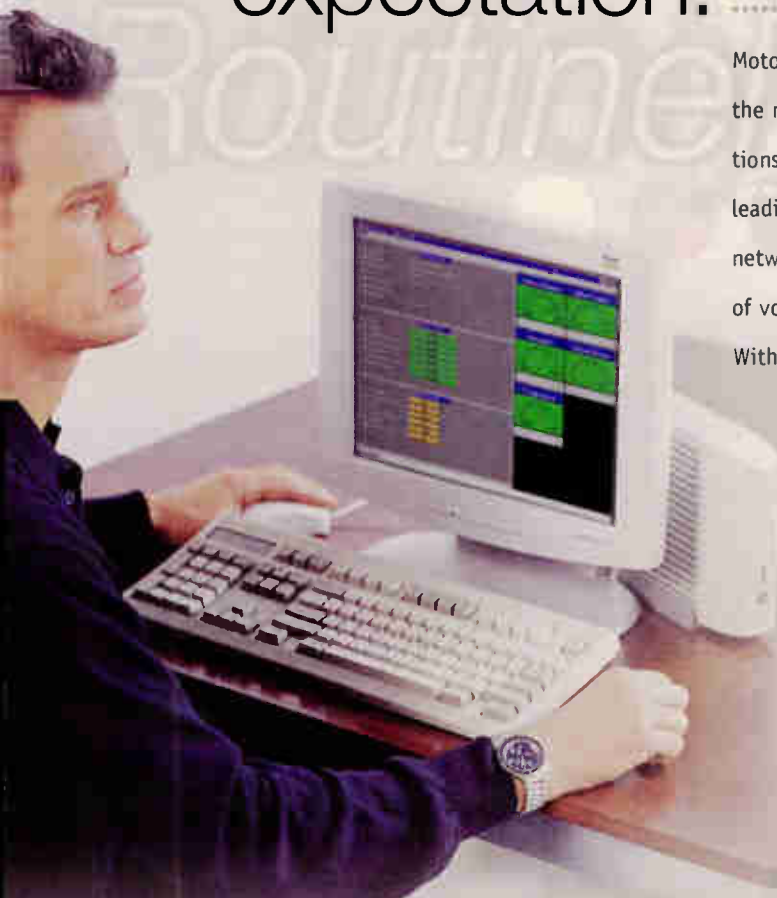

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your downstream and upstream digitally modulated carriers. Another way to think of the parameters is in-channel specifications, much like some of the FCC's in-channel performance requirements for analog TV signals. For the most part, none of what's recommended in DOCSIS is what I'd consider to be particularly onerous, although some of the measurement techniques required for their verification are a bit different from your run-of-the-mill analog TV channel measurements.

Let's look at the key specs:

- *Downstream digitally modulated carrier amplitude relative to analog visual carrier levels:* -10 decibel-carrier (dBc) to -6 dBc. This is pretty straightforward, but the most common mistake I see is incorrect measurement of the digitally modulated carrier's amplitude. See "Downstream Power Measurements: Watts Up Doc?" in the September 2000 issue of *CT*. That article also is available online at www.cabletoday.com/ct2/archives/0900/0900fea08.htm
- *Downstream carrier-to-junk ratio:* Okay, DOCSIS doesn't actually use the term "junk," but I'm taking a few editorial liberties. Carrier-to-noise (C/N) and carrier-to-interference: 35 dB; carrier-to-composite triple beat and composite second order: 50 dB; carrier-to-cross modulation: 40 dB; hum modulation: 5 percent. Nothing tricky here. If your system meets FCC or equivalent rules, you should do fine.
- *Amplitude ripple:* 0.5 dB. This is in-channel frequency response. I'll admit 0.5 dB is a tough spec, especially considering that the FCC rule for analog TV channel frequency response is +/-2 dB. Interestingly, DOCSIS 1.1 relaxed this spec to 3 dB.
- *Group delay ripple:* 75 nanoseconds (ns). This is quite a bit tighter than the FCC's chrominance-to-luminance delay inequality spec of 170 ns for analog TV channels, but data doesn't get along well with excessive group delay. Too much group delay and the bit error rate (BER) suffers.
- *Signal levels and other such things:* Seasonal and diurnal signal level variation: 8 dB. Same as the FCC's rule in §76.605(a)(4). Signal level slope, 50 MHz to 750 MHz: 16 dB. Maximum analog visual carrier level at the cable modem input: +17 dBmV. Lowest analog visual carrier level at the cable modem input: -5 dBmV. Level range of the downstream digitally modulated carrier at the cable modem input: -15 dBmV to +15 dBmV. Total RF input power at the cable modem (40 MHz to 900 MHz): less than +30 dBmV.
- *Bit error rate.* DOCSIS says the cable modem's post-forward error correction (FEC) BER is to be 10^{-8} or less. For 64-QAM (quadrature amplitude modulation), this BER spec must be met at a C/N ratio (E_S/N_0) of 23.5 dB or greater. For 256-QAM, the post-FEC BER spec must be met when operating at a C/N ratio (E_S/N_0) of 30 dB or greater when the cable modem input signal level is -6 dBmV to +15 dBmV, and at a C/N ratio of 33 dB or greater when the cable modem input level is -6 dBmV down to -15 dBmV.

Next month, I'll wrap up the downstream specs, and take a look at DOCSIS recommendations for the upstream plant. CT

Ron Hranac is a consulting systems engineer for Cisco Systems, and senior technology editor for Communications Technology. You may reach him at rhranac@aol.com.

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Convergence, Divergence at SuperComm

SuperComm—telephony's biggest annual trade show, held this year June 3-7 in Atlanta—proved that the telecom industry has developed a split personality. Convergence remains the norm when the focus is on technology and economics, but a divergence in markets has developed.

The show was a good opportunity to get a reading on telecom prospects over the next year. One session hosted by **Marconi** presented opinions that typified those on the floor and in other panels. The Marconi session included NYU and Stanford University economist Nicholas Economides, analyst Jeff Kagan, **Bell South** Executive Director of Advanced Technology Systems Engineering Hank Kafka and **Delta Airlines** Telecommunications Manager Alan Rubin, in addition to Marconi Deputy CEO John Mayo.

"Supercomm attendees needed to look long and hard for solutions aimed at MSOs."

The consensus was that although the industry's economic slump is deep, it should end within six to eight months.

Kagan's comments typified the prevailing industry attitude about growth in the next year. He noted that "telecommunications will not have the 'go-go' mentality of the past, and we can expect a normal growth curve." The results of a survey of decision-makers at 91 communications service providers and 112 enterprises—presented by Mayo—gave some indication of what 'normal' will be. The majority of the respondents indicated their network spending will increase about 10 percent over the next year.

Traditional target

Most vendors at Supercomm were targeting traditional telecommunications carriers. The floor gave an indication of the relative importance of market segments and their position on a technology introduction curve.

SuperComm typically provides interest zones for exhibitors, grouping products addressing similar concerns. The zones typically correlate well with solutions that are emerging as primary concerns in the next year. This year, information technology (IT) was the largest zone, followed by the carrier/service provider zone. Wireless was the only access technology given its own zone.

The lack of a zone does not necessarily indicate dismissal of a technology, but may be an indication that a technology is becoming more mature. As products become more mature, they tend to be integrated into vendor displays of solutions.

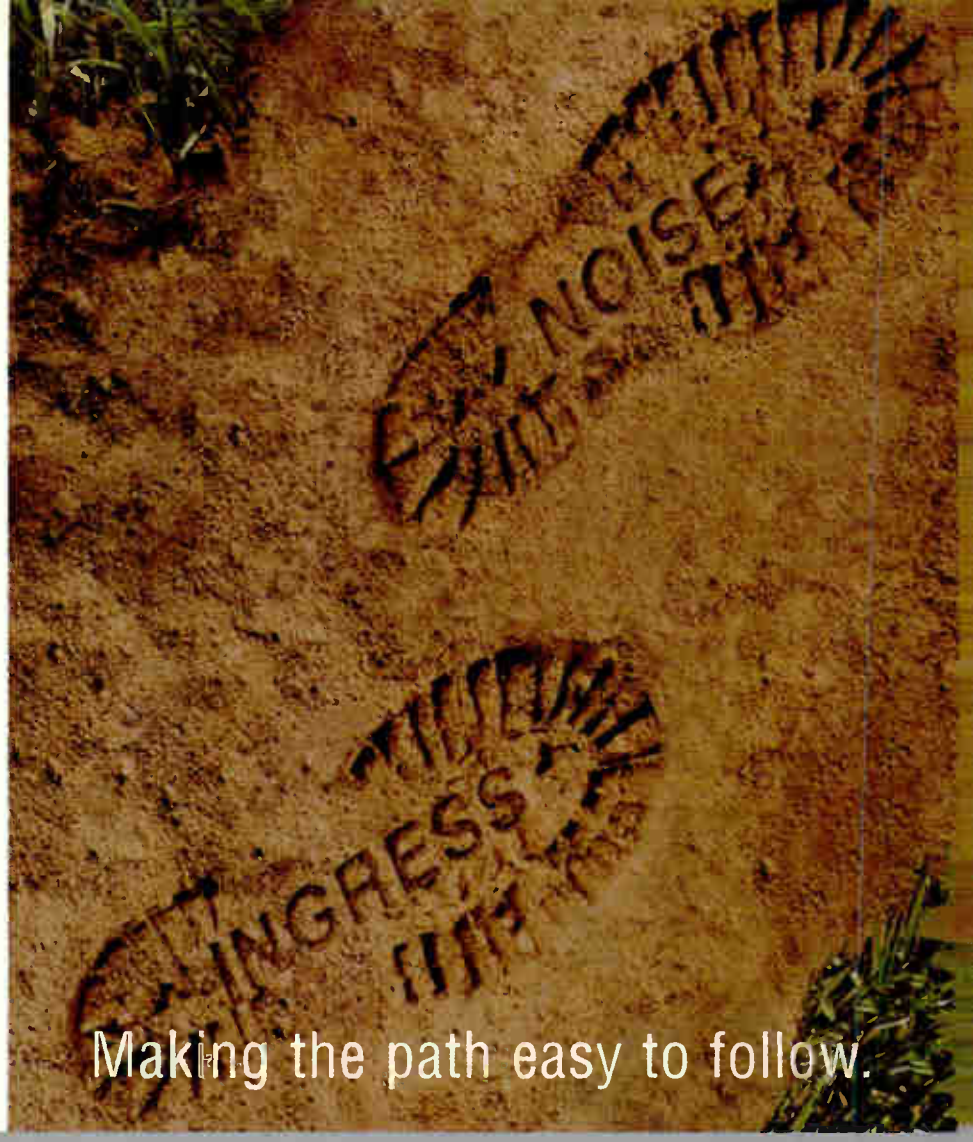
Attendees needed to look long and hard for solutions specifically aimed at multiple system operators (MSOs). Within the carrier/service provider zone, it was apparent that vendors were targeting network provider, rather than access, needs.

Vendors addressed customer service for this audience with solutions that assist a carrier in the service of its own customers. For example, **SmartPipe** discussed how carriers could use their software to build enterprise virtual private networks. **EMC** offered software and services for network storage of end-user data. **Congruency** offered software and hardware to enable a carrier to provide unified messaging and Web-clipping on their Internet protocol (IP) telephony station sets. **Avaya** talked about "hosted solutions," such as the use of an Avaya multimedia hub, to implement business services.

A similar emphasis on network provider needs could be found in the IT zone. The integration of separate element management systems into a central operations support system (OSS) was a dominant application. **General Bandwidth** announced a new system for providing flow-through provisioning for derived DSL voice lines. **Verizon**, as a partner in the booth of database vendor **Informix**, offered its software for resale to other carriers. **Comanage**, a relatively new company, discussed a range of solutions including fault management, provisioning and service level agreement monitoring.

Broadband competition

The wireless zone was the only zone of the three that stimulated some thought on competition in broadband services. The consensus on the floor was that the best market for wireless access remains consumers with no broadband alternative. This could change. For example, wireless technology vendor **Navini Networks** added



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In this environment, it's imperative to have the tools you need to anticipate, prevent and solve network problems. That includes everything from go/no go field-portable hand-helds that let your installers reduce the truck roll time to fast, reliable headend equipment that helps your network managers diagnose and eliminate trouble spots up and down the line – from the PSTN to the set-top box.

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to its wireless Internet access solution by joining with **Broadband Gateways** in a show of wireless residential telephony with PBX-like functionality.

Telecom vendors familiar to cable attended the show, but in general their exhibits focused on high-speed core networks and network services. **Nortel** demonstrated the OPTera Connect PX photonic switch, a 1008 duplex port, up to 80 gigabits per second (Gbps) line- rate device. This product applies the emerging automatic switch transport network (ASTN) architectural standard and generalized multi-protocol label switching (GMPLS).

Tellabs showed the TITAN 6500 switch and unveiled a new FOCUS HX optical networking system that features up to 40 Gbps line rates, switching in steps of 100 Gbps and 160 colors of dense wavelength division multiplexing (DWDM).

ADC introduced a microelectromechanical systems (MEMS)-based optical switch that may be configured as either a 1x2 or 2x2 port device.

Lucent Technologies demonstrated interoperability between its new NX64000 Internet protocol (IP) core router and its own line of optical networking products. Lucent also showed hosted IP-calling services over a 7R/E-based IP Centrex offering.

Although most vendors were aware of the **CableLabs** specifications, SuperComm highlighted other standards implementations, such as asynchronous transfer mode (ATM), session initiation protocol (SIP), and multiprotocol label switching (MPLS).

Despite the emphasis on traditional telephony, exhibitors who chose to include cable telephony products were rewarded.

ADC's Mark Podesta indicated "surprisingly high interest for this show" in the CUDA 12000 CMTS and DV6408 video transport system his company had on display. Tellabs seemed to enjoy a similar level of interest in its CableSpan 2700 system. The bottom line from this year's SuperComm, however, was the focus on incumbent telcos adding services in traditional markets.

A reminder: E-mail me your vote for the "killer" application as requested in my July column. CT

Justin J. Junkus is president of KnowledgeLink, Inc., and applications consultant for ANTEC. He may be reached at jjunkus@knowledgelinkinc.com.

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Communications Technology's Readers' Choice Awards 2001

Who Did

Vendors submitted a record 53 products to vie for Readers' Choice honors. Congratulations to the 12 finalists and the 'final four' winners.

This is our second annual Readers' Choice Award competition, so many of you know the routine. Vendors submit entry forms, and we turn the whole batch over to our distinguished panel of judges (see sidebar, page 38) who then select finalists in each of four categories. Then we let our readers pick the winners through balloting conducted at the annual SCTE Cable-Tec Expo.

This year, we received 53 entrants, and our judges picked 16 finalists, four in each category.

Please see the sidebar on page 40 for a listing of the other finalists. We also detail them in our monthly product roundup section (see Marketplace, page 84).

Of the winners, three involve advanced services (two data, one telephony) and the other sits at the linchpin of the hybrid fiber/coax (HFC) network, the optical node. For more about these winners, please read on.

Motorola scales

Everyone wants the cost-to-grow curve to look more like a straight line than a staircase. That's the main point of scalability, a virtue perhaps more often claimed than exhibited.

Several Readers' Choice judges, however, said **Motorola's** Starline SG2440 Scaleable Optical Node is the real McCoy. "Truly scaleable," wrote one. "Flexibility" and "easy... migration path" are other words judges associated with this year's winner in the distribution/line and transmission category.

Motorola's SG2440

A successor to Motorola Broadband Communications Sector's four-output SG2000 platform, the SG2440 enables independent and incremental segmentation of both the downstream and upstream sections of the node.

"Most nodes today are one (receiver)-by-one (transmitter)," Lou

You Vote For?

By *CT* Editors

Donofrio, director RF products and optical nodes for Motorola, says. The idea is to let operators transform that configuration into four-by-four capability, or anything in between, simply by replacing a configuration plug-in board to support any receiver and/or transmitter module additions.

"It's an insurance policy," says Donofrio. "You're not going to throw away 80 percent of the cost to do the upgrade."

Wavelength division multiplexing (WDM) and digital return are key enablers. Sending broadcast channels over one or more of the four output ports, for instance, operators can then overlay narrowcast bands as segmentation dictates. The return path also can be variously configured.

"There are a ton of options," Donofrio says. Those include fiber-efficient, time division multiplexing (TDM) and WDM technologies.

Donofrio says the inspiration for the SG2440 was the realization that increasing demand for advanced services would require operators to adjust their networks quickly and efficiently. They appear to have nailed their target.

"This product is very timely for the operator," wrote one judge. It allows segmentation "with minimum service interruptions and incremental capital outlay."

Cadant supports C4

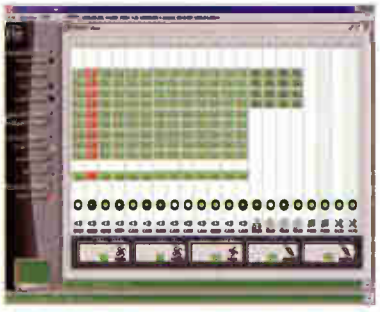
The data business is still a relatively new line of work for cable operators. This year's winner in the headend category, **Cadant's** G2 IMS, aims to make it easier to run an advanced cable modem termination system (CMTS).

"The C4 CMTS, which is what the G2 IMS manages, is a complex piece of equipment," says Gary Pientka, lead engineer for the G2 IMS. Cadant listened to feedback and "got comments from customers, such as 'We don't want high-priced engineers sitting there to watch our box,'" he says.

So how do you simplify management while meeting the demands of the equipment? One way is to streamline command-line interface.

Pientka says the typical way of typing command syntax requires not only the correct order but also an understanding of how one command may affect others.

"The G2 IMS takes a lot of those commands and, in essence, groups that action together," Pientka says, "checking interdependency between values and making sure everything's correct." >



Cadant's G2 IMS

Take the example of adding a cable access module (CAM), or "blade," for the C4. With command-line interface, you would need to enter a number of syntaxes around such variables as downstream bandwidth, the signal rate and power level, says Tim Doiron, Cadant director of marketing.

"The nice thing about the G2 IMS is, from one screen, you can get a look at everything associated with provisioning a CAM, click a button and submit," Doiron says.

In addition to configuration, the Java-based G2 IMS also conducts fault and performance management of one or more C4s, using standard simple network management protocol (SNMP), and enables the viewing of status information down to individual cable modems, all apparently without the need for any white coats.

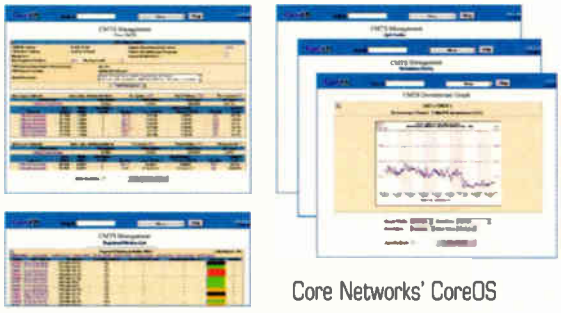
One judge applauded the "intuitive graphical interface." Another made this compelling point: "The ability to control and monitor CMTS functionality will improve the performance and reliability of data modem service."

Core empowers engineers

The CoreOS CMTS Manager from **Core Networks** addresses that same operator need to control and monitor the CMTS.

Monitoring, management and scalability comprise a large concern for operators in the cable modem business, Core Networks CEO Jeff Campbell says. The CoreOS CMTS Manager, this year's network diagnosis winner, aims to reduce that bundle of worries.

"Monitoring the network, and managing the capacity and the node splits and the node moves, and scaling the network for the next level of growth is really where the big challenges are," Campbell says.



Core Networks' CoreOS

One judge clearly agreed. "The need to have a better handle on network performance for cable modems is imperative to the success of this business," this judge wrote. "(We) need to identify and remedy any congestion in the network quickly."

Another lauded the product more directly: "With the CoreOS software, proactive bandwidth management becomes a reality."

How does it work? By gathering information from the cable modem management information base (MIB) via SNMP and displaying it in a variety of combinations and formats, depending upon system needs.

Using real-time probes that measure both upstream and downstream channels and respective CMTS and modem Internet protocol (IP) addresses, it offers both a top-down view of the data system and a detailed performance picture of each modem.

"The CMTS manager is empowering to the engineering staff," Campbell says. That includes engineers that manage budgets.

What if you discover a rapid growth in the use of several units? "Maybe all you need to do is redistribute how your data flows, not buy a new CMTS," Campbell says. >

> Readers' Choice Award Finalist Judges

Alex Best, consultant, Cox Communications
Walter Ciciora, principal, Technology Consultants
Paul Gemme, vice president, plant engineering, Time Warner Cable
Nick Hamilton-Piercy, senior technology advisor, Rogers Cable
Ted Hartson, principal, Scottsdale Television Labs
Archer Taylor, senior engineering consultant, The Strategis Group

Thanks.

Clarent's Customer Premise Gateway 2102S was voted the "Best New Customer Premise Product" at the 2001 SCTE Cable-Tec EXPO.

Mom would be so proud.

If she only knew what that was.

Clarent's CPG 2102S was chosen "Best New Customer Premise Product" by *Communications Technology* readers and attendees of the 2001 SCTE Cable-Tec Expo. It provides customers with reliable access to VoIP services across fiber/coax networks, and simultaneous access to data traffic such as email and Internet information. For more information about Clarent or our full line of CPG products, visit Clarent.com or call (630) 771-4200. Special thanks goes to *Communications Technology's* nomination panel.

CLARENT.

> Readers' Choice Finalists

Customer Premise
Cisco Systems' CVA122 Cable Voice Adapter.
Colubris Networks' CN100 Wireless local area network (LAN) router.
Ericsson PipeRider HM204c enhanced security cable modem.

Distribution/Line and Transmission
Synchronous' ChromaSpan Automatic Rate Sensing Transponder.
Synchronous' Digital Video Broadcast-Asynchronous Serial Interface (DVB-ASI) Transport System.
Wireless Bypass DL-5800 Wireless Cable Access Radio.

Headend
Motorola's Optical Services Manager (OSM) 4800.
Motorola's Distributed Broadband Module (DBM) 2000.
RiverDelta Networks' hardware-based, distributed policy-based routing and multi-protocol label switching (MPLS) per-flow control.

Network Diagnosis
AM Communications' MapVault, a Web-based storage system that allows distributed secure access to network design map.
ComSonics' Sniffer Shadow Field Leakage Detector.
Incognito Software's IP Commander 3.2 multi-platform dynamic host configuration protocol (DHCP) management software.

Clarent ramps up IP voice

Echoing analysts and other players in the industry, Elizabeth Cholawsky, senior vice president of marketing for **Clarent's** local access business unit, says it's not *whether* but *when* IP will surpass circuit-switched telephony.

Claiming four billion service minutes in 2000, Clarent is clearly a factor driving IP's upward growth curve.

This year's customer premise category winner is the Clarent customer premise gateway (CPG) 2102S, an integrated modem and telephony device that acts as the "endpoint" of the company's OpenAccess IP telephony solution.

"Several MSOs have refrained from launching telephony service until IP telephony was available," wrote one judge. "Clarent offers a complete solution."

Why call this customer premise equipment (CPE) a gateway? "We've taken some of the functionality out of the network and put it here," Cholawsky says. Media gateway control protocol (MGCP) translation, which bridges the public switched and IP-based networks, is one example of the smarts that reside in the unit.


Clarent CPG 2102S

"If you do all translation at the core of the network, you get into traffic jams," Cholawsky says.

The CPG 2102S is designed to provide IP telephony to any office or residence where a Data Over Cable Service Interface Specification (DOCSIS) 1.0 connection is available. It is software-upgradeable to DOCSIS 1.1.

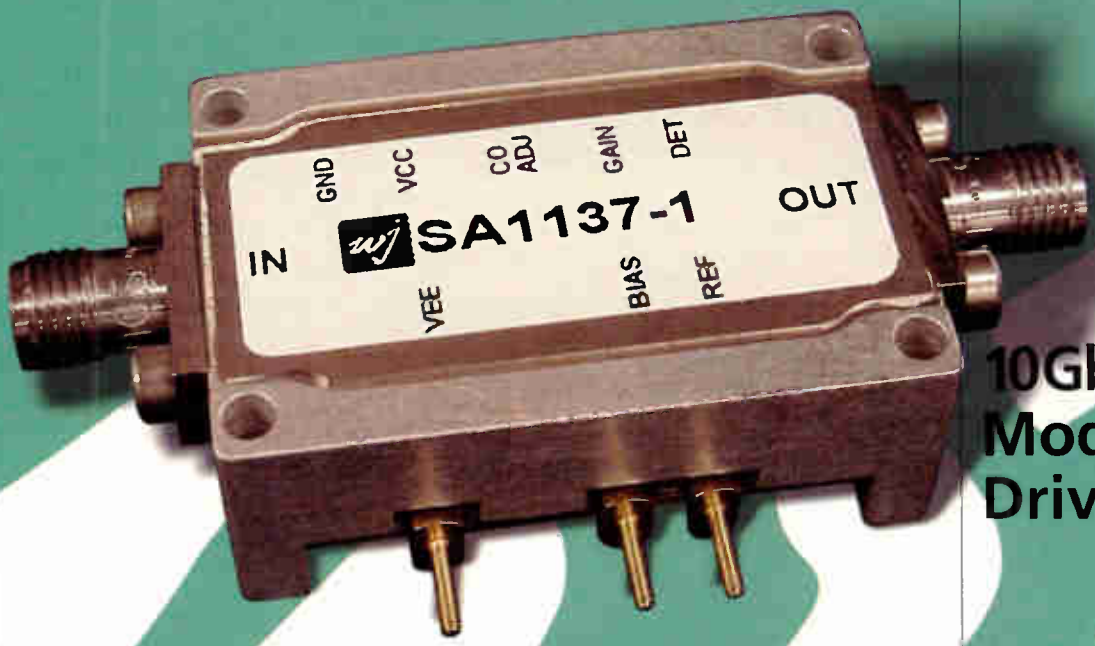
Other components in Clarent's local access telephony solution include a command center database and call manager.

It's dubbed OpenAccess because of its standards-based orientation. "Behind the scenes, nothing is proprietary in the solution," Cholawsky says. As a result, Clarent can partner with numerous applications developers.

Appreciations and kudos

Thanks to all the companies that completed the 53 entry forms, to the judges that contributed their valuable time and to those who voted at the Cable-Tec Expo. Congratulations to all winners, who impressed judges and readers alike. CT

SA1137



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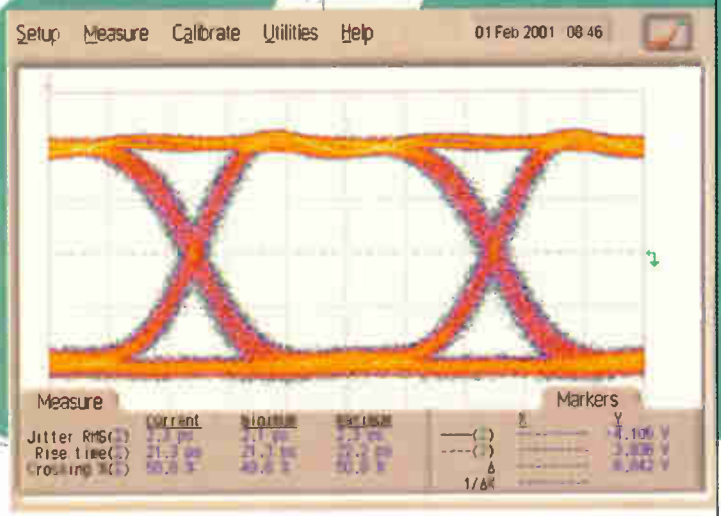

The SA1137 is another addition in WJ's series of hybrid-based products optimized for existing OC-192 networks. The SA1137 is a full-function amplifier capable of driving $LiNbO_3$ modulators and provides integral modulator bias and control. While the SA1137 is optimized for 10Gbps applications (data rates up to 12.4Gbps), WJ's proprietary thin-film, process and integration technology has applicability to 40Gbps OC-768 systems and beyond. For more information, please visit us on our website at www.wj.com.

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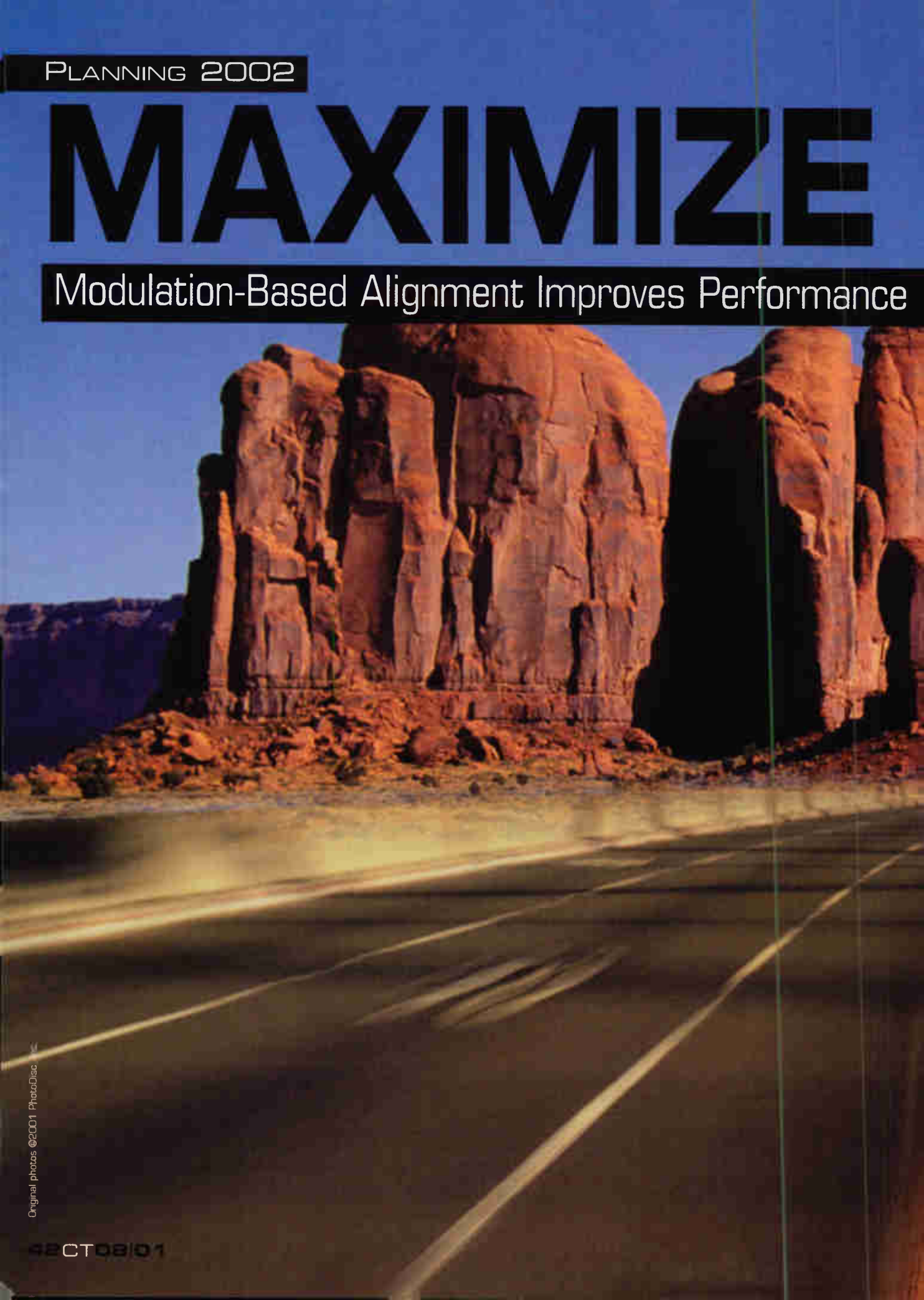

Your Return

By Dr. Robert L. Howald,
Motorola Broadband Communications Sector

Cable operators adding two-way services may improve their return performance by using modulation-based alignment criteria.

Traditionally cable operators have defined their return path digital signal levels based on a power-per-Hertz methodology. It's time to look for new solutions to improve return path performance.

Operators have used the power-per-Hertz method because it simplifies complex issues associated with different services and needs. It also is easily understood, readily implemented and effective for most of today's needs. The reason it works is the inherently high carrier-to-noise ratio (CNR) of the hybrid fiber/coax (HFC) channel obtained with typical approaches for implementing both analog and digital returns. For the worst-case design environment, represented by a completely full return band, the CNR achieved supports today's services.

Technology advances and progress in system design will create more opportunities for the cable return path. A 5 MHz to 42 MHz return path filled with all 16-QAM (quadrature amplitude modulation) signals would represent only about 120 megabits per second (Mbps). This figure compares unfavorably with the theoretical capacity available given the high CNR of HFC returns. Even long links designed with lower performance analog technology have capacities nearing 400 Mbps.

Increased capacity and optimized performance are goals of all major communications infrastructures designed today, including cable's evolving Data Over Cable Service Interface Specification (DOCSIS). Higher performance analog lasers, new digital technologies and increased return bandwidth splits are examples of technologies to enhance the return path.

Operators should consider other procedures that enhance the return. With sophisticated signaling, in some cases augmented by more bandwidth, it is natural to think about a power allocation method that may improve performance. With returns now operational, the time is ripe to consider how to optimize their usage. To close the gap on the true capacity of the return, operators need to understand the optimal way to align the varying signal types on a return path. The analysis

that follows addresses this question from the standpoint of bit error rate (BER) performance. Presented is a straightforward solution that results in BER-optimized channel levels for each service as a function of its modulation type and bandwidth characteristics.

In the initial stages of getting the return path "online," many in the cable industry followed a pragmatic approach that was easy to understand and implement, of adequate performance and consistent with existing procedures and equipment

This approach was a nice fit for gradually activating the return, because the reverse channel has some unique qualities well-suited to a conservative approach including the need to support multiple services, staggered deployment of new services, a variety of signal formats and bandwidths sharing the spectrum and a finite amount of available power.

Power-per-Hz also allowed operators and field personnel to transition into digital smoothly, enabling secure grasp of the learning curve going forward.

In a power-per-Hz channel lineup, CNR is constant across the band, and headroom is available as services are added. An example points out the most obvious shortcoming. A DOCSIS channel could be a 2560 kilosymbols per second (ksps) quaternary phase shift keying (QPSK) channel, or a 2560 ksps 16-QAM channel. These two modulations are about 7 dB apart in performance versus CNR for a given low BER, yet would be allotted the same power. Clearly, this technique does not align levels optimally.

FIGURE 1 DERIVATION OF K TERMS

$$K1 := \left[\frac{Na}{Na+\left(\frac{a\cdot Nb}{b}\right)+\left(\frac{a\cdot Nc}{c}\right)+\left(\frac{a\cdot Nd}{d}\right)}\right]\cdot\ln\left(a\cdot\frac{A}{2}\right)+\left[\frac{Nb}{Nb+\left(\frac{b\cdot Na}{a}\right)+\left(\frac{b\cdot Nc}{c}\right)+\left(\frac{b\cdot Nd}{d}\right)}\right]\cdot\ln\left(b\cdot\frac{B}{2}\right)$$

$$K2 := \left[\frac{Nc}{Nc+\left(\frac{c\cdot Na}{a}\right)+\left(\frac{c\cdot Nb}{b}\right)+\left(\frac{c\cdot Nd}{d}\right)}\right]\cdot\ln\left(c\cdot\frac{C}{2}\right)+\left[\frac{Nd}{Nd+\left(\frac{d\cdot Na}{a}\right)+\left(\frac{d\cdot Nb}{b}\right)+\left(\frac{d\cdot Nc}{c}\right)}\right]\cdot\ln\left(d\cdot\frac{D}{2}\right)$$

$$K3 := \ln(2)-\frac{Pt}{\left(\frac{Na}{a}\right)+\left(\frac{Nb}{b}\right)+\left(\frac{Nc}{c}\right)+\left(\frac{Nd}{d}\right)}$$

TABLE 1 THEORETICAL CHANNEL CAPACITY OF VARIOUS RETURN PATH CONFIGURATIONS

Link Type	CNR (dB)	BW (MHz)	Capacity (Mbps)	
IFPT				
2 dB Link	42	37	515.93	
9 dB Link	41	37	503.64	
12 dB Link	37	37	454.51	
15 dB Link	32	37	393.09	
DFB				
2 dB Link	46	37	565.06	
9 dB Link	44	37	540.50	
12 dB Link	41	37	503.64	
15 dB Link	35	37	429.94	
Block Conversion				
2 dB Link	42	148	2063.71	
9 dB Link	41	148	2014.58	
12 dB Link	40	148	1965.44	
15 dB Link	39	148	1916.30	
Digital				**2 x TDM**
8 bit	34	37	417.66	835.31
10 bit	43	37	528.21	1056.42
12 bit	55	37	675.62	1351.24

TABLE 2 BER VS. LOADING METHODOLOGY FOR CNR = 25dB

	Uniform Loading		Optimized Loading	
ChannelType	**Power-per-channel**	**BER**	**Power-per-channel**	**BER**
QPSK 1	11.7 dBmV	0.00E+00	5.5 dBmV	0.00E+00
QPSK 2	3.6 dBmV	0.00E+00	-2.4 dBmV	0.00E+00
16-QAM	11.7 dBmV	0.00E+00	12.4 dBmV	0.00E+00
64-QAM	13.6 dBmV	7.70E-07	20.4 dBmV	0.00E+00
Avg. BER		**4.30E-08**		**0.00E+00**

Looking ahead on the return

Where enough throughput capacity or bandwidth exists, techniques will evolve to use them. For the reverse path, operators should consider the following potential evolutionary paths:

- Increase in traffic and usage of available spectrum
- Increase in spectrum desired to transport
- Higher level of modulation sophistication
- Higher throughput from the same spectrum
- Throughput closer to theoretical channel capacity

The reverse path is the enabler of two-way, high-speed communications over HFC. Initially, the return simply will move from a lightly loaded spectrum to increased activity. As the activity continues to increase, reverse path segmentation will occur. These architectural modifications (splitting nodes, removing RF combining aggregation) will attempt to keep each end-user satisfied by assuring an average bandwidth accessibility.

Eventually, segmentation options may become too costly, and operators will need to make changes. Techniques that make the most of existing infrastructure often make sense rather than taking on spending risk. One option being pursued by newer broadband providers is extending the return

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TABLE 3 BER vs. Loading Methodology for CNR = 20dB

	Uniform Loading		Optimized Loading	
ChannelType	Power-per-channel	BER	Power-per-channel	BER
QPSK 1	11.7 dBmV	0.00E+00	6.0 dBmV	2.10E-10
QPSK 2	3.6 dBmV	0.00E+00	-1.7 dBmV	3.20E-11
16-QAM	11.7 dBmV	2.30E-08	12.5 dBmV	1.10E-09
64-QAM	13.6 dBmV	2.40E-03	20.1 dBmV	7.70E-09
Avg. BER		**1.30E-04**		**9.20E-06**

TABLE 4 BER vs. Loading Methodology for SNR = 25 dB, Low End Noise Floor Increase

	Uniform Loading		Optimized Loading	
Channel Type	Power-per-channel	BER	Power-per-channel	BER
QPSK 1	11.7 dBmV	0.00E+00	0 dBmV	2.00E-08
QPSK 2	3.6 dBmV	0.00E+00	15 dBmV	2.90E-09
16-QAM	11.7 dBmV	8.80E-04	14 dBmV	1.10E-06
64-QAM	13.6 dBmV	7.80E-07	-8 dBmV	7.40E-07
Avg. BER		**3.10E-04**		**4.50E-07**

spectrum. The end result is more spectrum, but lower CNR for everyone because of the need to share power.

Improving modulation

As efficient use of bandwidth continues to be an important variable in network architectures, moving to a higher order of modulation is anticipated. For example, the natural next step in the return for QAM signals would be to implement 64-QAM. The CNR to support *uncorrected* 64-QAM with high performance (1e-8 BER) typically is available with a 28 dB margin, and coding gain reduces this CNR burden further. Mature from forward path development, 256-QAM would be a natural next step. If more bandwidth-efficient modulations are able to be implemented successfully, they will be.

Every additional two bits per symbol for QAM requires 6 dB better CNR. Therefore, the currently large CNR margin will be eaten into by exchanging excess CNR for throughput. In such a scenario, it becomes important to know how to manage your CNR on a per-channel basis properly, to treat the sophisticated signals with respect.

Table 1 (page 44) shows the theoretical channel capacity of various return implementations under the simplifying assumption of additive white gaussian noise (AWGN) only.

As the numbers reveal, modestly performing reverse links are capable of theoretically achieving around 500 Mbps for single return spectrum. A full boat of 16-QAM DOCSIS return channels—all on, all the time—cranks out about 120 Mbps. Thus,

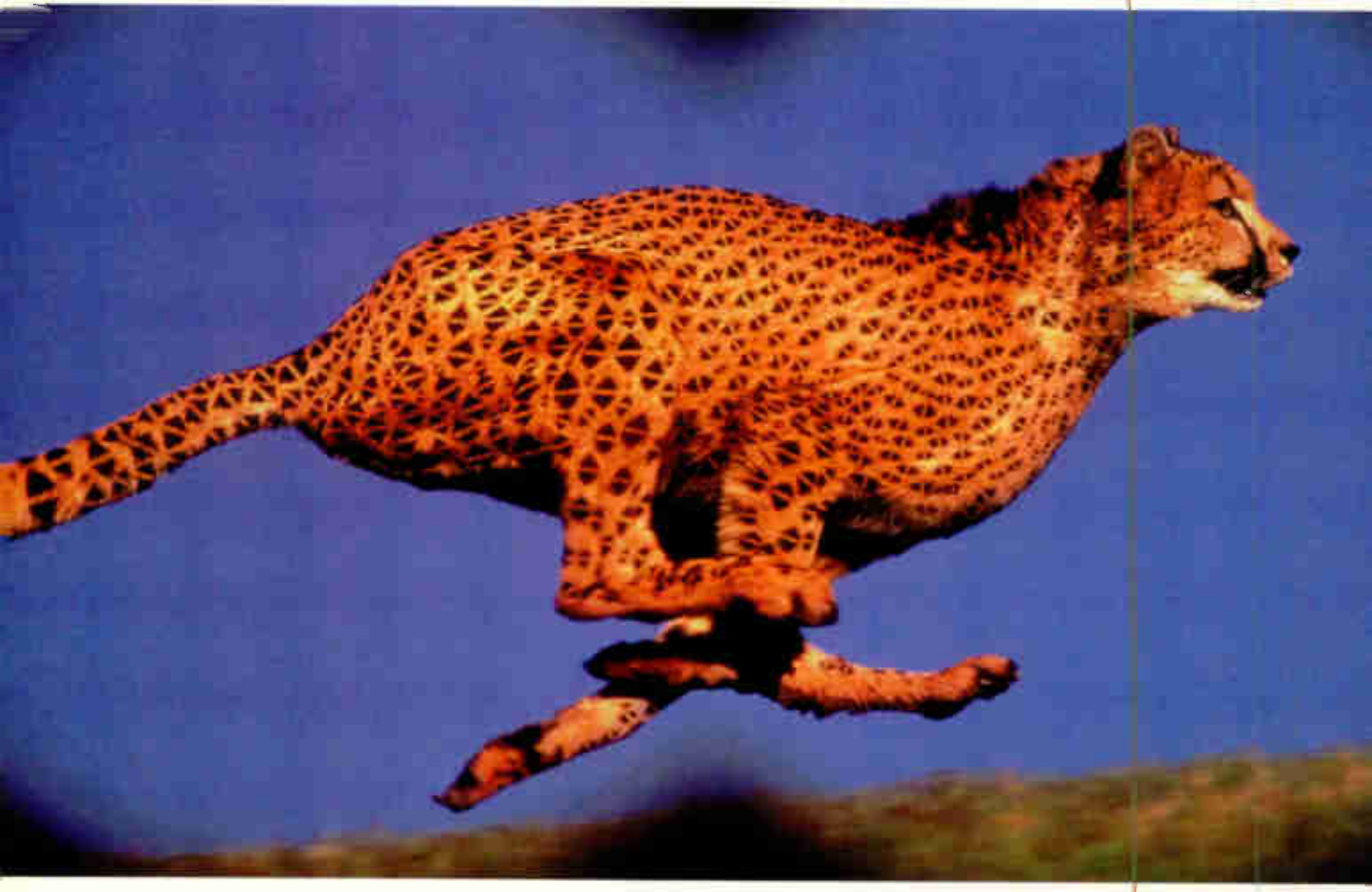
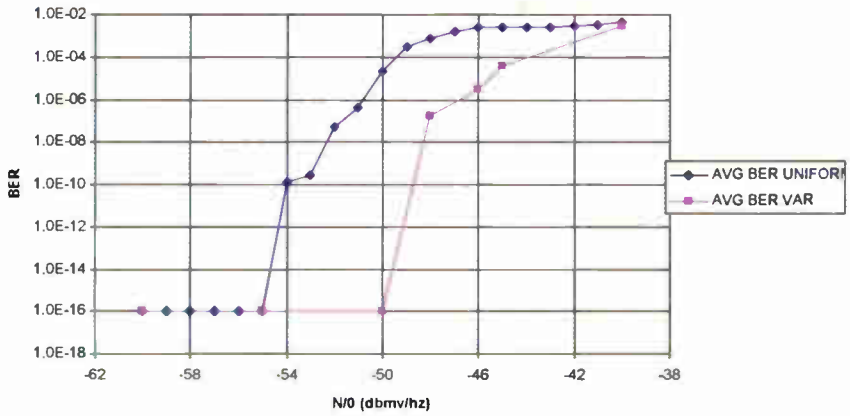


FIGURE 2 AVERAGE BER FOR OPTIMIZED VS. UNIFORM LOADING



the capacity available and the rate actually used when transmitting do not approach efficient use of the available CNR.

To determine an optimal allocation, based on minimum average BER, we work with known BER expressions of modulation schemes; flat AWGN noise floor across (most of) band; known power constraint associated with analog/digital (A/D) converter or laser drive; common range of target BER; and known mathematical tools for minimization/maximization.

Given the previous set of information, and a goal of minimum BER, the analysis may proceed. The goal is to minimize the average BER, which is expressed mathematically as:

$$BER\ (avg) = (N_1\ BER_1 + N_2\ BER_2 + N_3\ BER_3 + \ldots N_k\ BER_k)/(N_1+N_2+N_3+\ldots N_k)$$

where BER_k represents the BER expression for signal type k, and N_k represents the number of channels of this signal type. BER expressions take the same general form:

$$BER = A_k\ Q[(B_k\ E_b/N_o)^{1/2}]$$

where Q(x) is the well-known error function relationship associated with the integration over a Gaussian probability density function (PDF), and the coefficients A_k and B_k vary by modulation.

The next mathematical step is to use the Chernoff bound, another common, if less well-known, very good, simple approximation to Q(x) for this case. The version used here is:

$$Q(x) \approx 1/2\ \exp(-x^2/2)$$

The variable under the discretion of the system designer is the signal

power. Thus, we may express the problem as the following:

Minimize BER(avg) =
$\text{Min}[N_1\ \text{BER}_1(P_1) + N_2\ \text{BER}_2(P_2) + N_3\ \text{BER}_3(P_3) + \ldots N_k\ \text{BER}_k(P_k)]$

where P_k is the signal power of the k^{th} signal type, and $\text{BER}_k(P_k)$ implies the BER of that signal type as a function of the power allotted. Obviously, minimum BER is obtained by allowing all of the channels to maximize P_k. Of course, this is not a practical solution, because constraints exist on the total power driven by clipping limitations associated with RF drive to the A/D converter or laser in the node. This turns the problem into solving for:

$\text{Min}[N_1\ \text{BER}_1(P_1) + N_2\ \text{BER}_2(P_2) + N_3\ \text{BER}_3(P_3) + \ldots N_k\ \text{BER}_k(P_k)]$
under the constraint that:

$P_T = P_1 + P_2 + P_3 + \ldots\ldots P_k$

This problem is now expressed in the form of a generalized class of problems that may be solved using the Lagrange multiplier technique. Pages of mathematical details may be derived with the help of a calculus book. Using *w*, *x*, *y* and *z* to represent the signal powers of four different types of example services and associated signal types sharing the return spectrum, the power allocated to each becomes:

w:=(-1/a) (K1+K2+K3-1n[aA])
x:=(-1/b) (K1+K2+K3-1n[bB])
y:=(-1/c) (K1+K2+K3-1n[cC])
z:=(-1/d) (K1+K2+K3-1n[dD])

where *A*, *B*, *C* and *D* are constant multiplier coefficients, determined by the particular modulation used for channel *w*, *x*, *y* and *z*. Also, *a*, *b*, *c* and *d* refer to expressions associated with the modulation types. In the example to follow, the types are QPSK, 16-QAM, 64-QAM and a second QPSK service:

a:=Ta/(2) (No_watts_per_Hz)
b:=Tb/(10) (No_watts_per_Hz)
c:=Tc/(42) (No_watts_per_Hz)
d:=Td/(2) (No_watts_per_Hz)

For Na individual channels of type *w*, Nb of *x*, Nc of *y*, and Nd of *z*, the K terms are shown in Figure 1 (page 44).

An example

An example will illustrate the point. Assume a minimum guaranteed performance DOCSIS return CNR of 25 dB at the end of the total link. This could be represented, for example, by a 12 dB analog Fabry-Perot (FP) link from Table 1, with 16-way headend combining, or an 8-bit digital return link with 8-way combining.

Consider the following channel types in a lineup:

- 35 x 320 ksps (DOCSIS) QPSK (QPSK 1)
- 25 x 320 ksps (DOCSIS) 16-QAM

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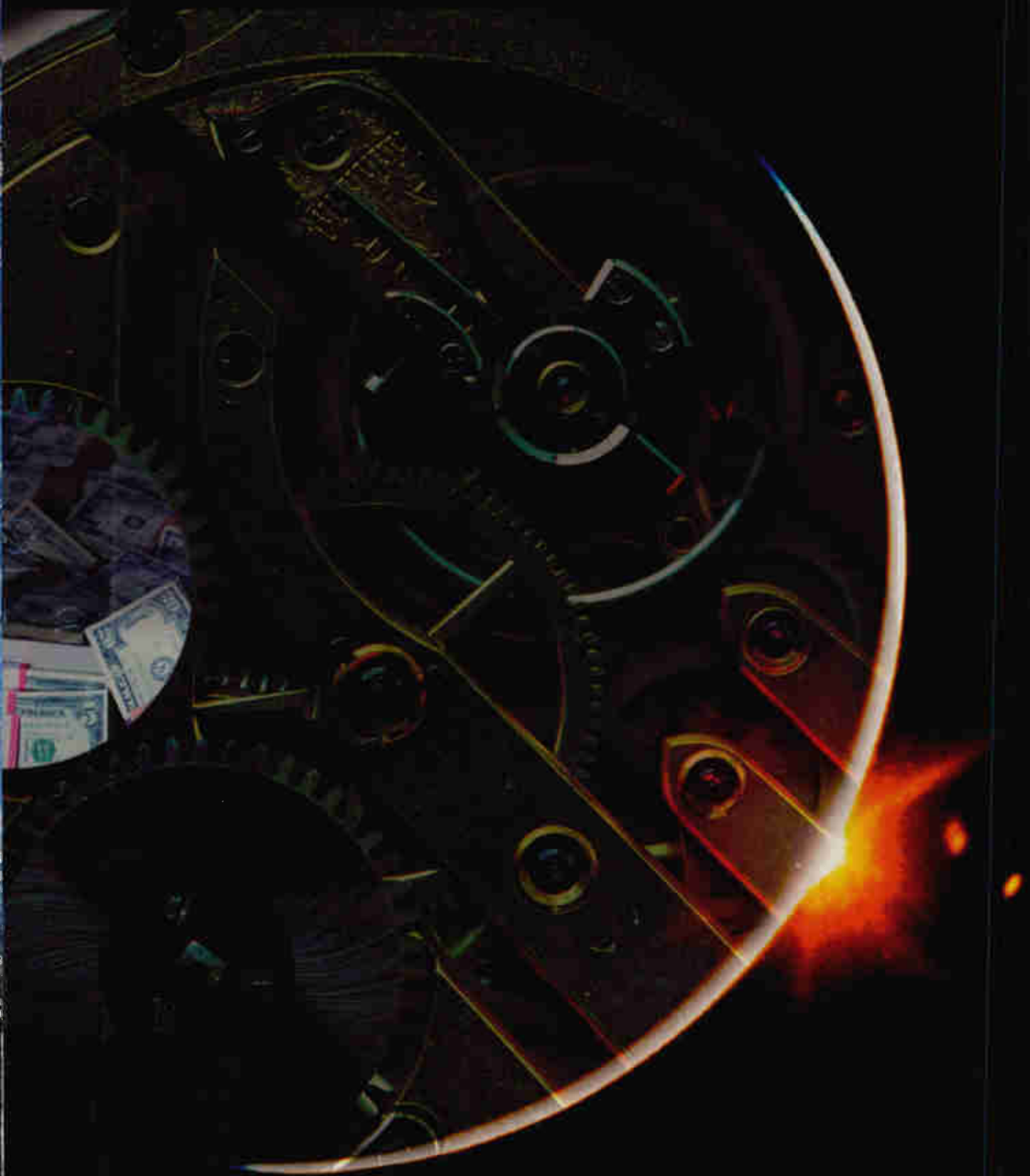

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Automated discovery and provisioning: These concepts, increasingly familiar in the broadband communications industry, have the power to make or break your business.

How? Using advanced software to model services and work processes by customer location, it is possible to make the installation and subscription provisioning process faster and cheaper.

However, most currently available platforms are largely network-focused; that is, they rely on network technology to solve the problem. These solutions are adept at, for example, detecting whether a cable modem is on the network, but are not suited to tackling the numerous other tasks involved in provisioning and customer fulfillment. Is the rest of the network—the switches, the gateways, the billing system and customer service systems—in place for this user? Are they interconnected in the provisioning process?

Manually provisioning all of the elements in the network is the most expensive and time-consuming aspect of turning subscribers into revenue generators. Reducing errors and truck rolls each and every time a subscriber plugs in a new device or requests a new service can save an operator millions of dollars.

Operators Must Automate Orders

Arris and Ceon have solved this problem through what we call event-based provisioning. By integrating Ceon's *It's On*™ application suite for service fulfillment with Arris' Cornerstone® Cable Provisioning System 2000 and Cornerstone® Voice solution, we can automate the entire customer order process.

With event-based provisioning, we can ensure that all network elements and software systems are operational and performing all of the provisioning tasks accurately and automatically. Customers can thus begin using, and paying for, any and all services they desire. By using the event-based provisioning functionality that is part of Ceon's *It's On*™ service fulfillment platform, cable operators can reduce their provisioning process from several days, in some cases, to several minutes.

Event-based technology is just now making its way to the marketplace. But early indications are that it will become an industry standard in a very short time. This type of automation will be particularly crucial as the cable industry takes the next step into offering multiple services.

Solution Needed for Complex Provisioning

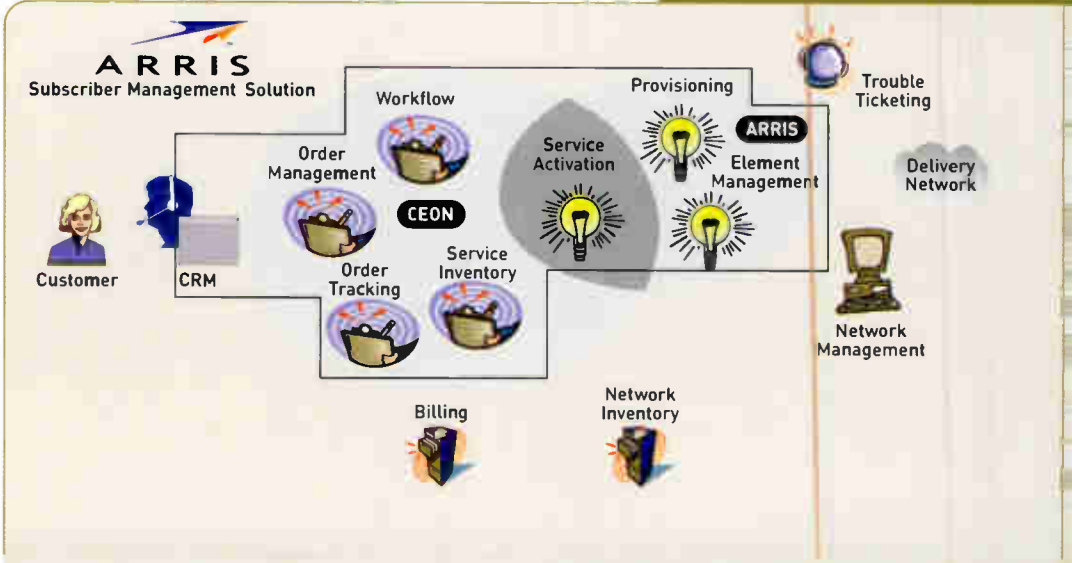
As more and more cable systems begin deploying Data Over Cable Service Interface Specification (DOCSIS) networks, they put themselves in the realm of truly advanced services, such as voice over Internet Protocol (VoIP), streaming media and other interactive services. No longer will cable operators merely install a modem for Web access. Cable operators will launch a variety of new services, and the number of events involved in detecting and provisioning subscribers to those services will increase exponentially.

Automated discovery of network devices is an important first step. But cable operators also have to know what it is they want to do once the cable modem is discovered on the network. Orders must be placed. Customers must be registered. Telephone numbers and IP addresses must be assigned. Billing records must be updated. Perhaps a truck roll has to be scheduled. All of the business actions governing new subscriber services must be linked to that new modem. Event-based provisioning resolves and manages all of these events and more, automatically.

Lower Costs, Improve Service

In today's fast-paced world, the speed at which a network can discover and process events will determine how profitable network services will be. In today's environment, the bulk of these tasks are human-focused and, thus, expensive and slow. The processing of events is delayed, which means billing is delayed, which means revenue is delayed. Event-based provisioning is the wave of the future. It is the vital link between the subscribers and the network. With event-based provisioning in place, customers receive better service at a lower cost to the operator.

Where We Sit in the Big Scheme



Poor Provisioning Can Sabotage Your Services

DON'T LET IT HAPPEN TO YOU

Flexible provisioning systems are essential in today's fast-growing market, as cable operators must react quickly to changing customer needs to be competitive. Operators who succeed will be those that can launch transaction-based Internet and streaming media services in new markets as soon as demand emerges.

What's more, operators must creatively bundle their video, voice and data services as well as provide a range of quality of service (QoS) levels. New service launches must be quick and responsive to ever-evolving customer interest.

Failure to operate in this environment will lead to increased customer churn, as subscribers search for alternative service providers. The result is falling subscriber counts, reduced revenues and long break-even times.

Bundling voice, video and data services; linking those services to the underlying network; and resolving which customers have access to which bundles are some of the provisioning challenges cable operators face. Legacy provisioning systems have not integrated all aspects of the provisioning process and, therefore, hinder your ability to quickly launch new services and adapt bundles to changing market needs.

Solving the Problem

So what's the solution? To overcome these challenges, cable operators need more than an incremental improvement in one or two steps of the provisioning process. They need a next generation, event-based provisioning system that has the ability to respond quickly to the changes initiated by customers, the network and hardware devices.

An event-based provisioning system must support flexible order fulfillment, providing workflows that can be modified at any point in the system to adapt to changing requirements. It must also be able to leverage next-generation technologies through the use of applications based on open access development tools. Scalability and the ability to provision any service on any network for any underlying technology are critical factors.

Arris and Ceon have partnered to deliver just such an event-based provisioning system. Because Arris has integrated Ceon's *It's On*™ service activation system with Arris' Cornerstone® Cable Provisioning System 2000 (CPS 2000) and Cornerstone® Voice platform, cable operators can deploy a single system to provision their current and future voice, video and data services.

Single System

Unfortunately, most cable operators currently lack a single, unified provisioning system that can accommodate changing network, service and technology requirements. Today, each service—voice, video and data—typically has its own provisioning and service activation system. These legacy systems are inflexible and require manual entry. For each new order, network administrators must engage in "swivel chair provisioning" first turning to one system to enter video information, then to another to configure data services and to a third to activate voice services.

Such manual provisioning is not only slow, but prone to errors. Every time a network administrator manually enters data into a separate provisioning system, the chance of error increases. These errors can ultimately prevent the service from activating.

Failure to quickly activate service has two results. It annoys the customer, giving him or her a chance to look for an alternative provider. And, it consumes employee resources, as network administrators hunt through multiple systems to uncover errors.

Manual Provisioning Hinders Growth

Manual provisioning has another unwanted consequence. It prevents the rapid addition of new customers, which slows revenue generation.

We're all familiar with the three-to-four-week installation windows required when cable operators first launched high-speed data services. While cable operators have made great strides in training installers for data, progress on the provisioning front has been slower. Industry sources suggest that using the current data-over-cable service provisioning process, it would take at least 20 years to move all of America Online's customers from dial-up access to broadband connections.

BUILDING THE BUSINESS CASE*	Before Event-Based Provisioning	After Event-Based Provisioning
Truck Roll Costs	$150	$75
Installs per Year	500,000	750,000
Price of 1st Line Telephony Services	$25/month	$25/month
Penetration of 2nd Line Telephony Services	20% at $10/month	$20% at $10/month
Total Revenue (1st and 2nd Line)	$172 million	$243 million
Total Truck Roll Costs	$75 million	$56.25 million
Margin	$97 million	$186.75 million
Net Gain (Excluding cost of software)		$90 million

*Net gains shown are for the first year of deployment. Additional revenues and cost savings accrue in subsequent years. Based on one truck roll.

We've seen this same inability to rapidly provision new customers on the telephony front as well. Cable operators who launched circuit switched telephony initially were unable to meet their subscriber projections due to the slowness of manual provisioning. It wasn't until adding event-based provisioning *after* launching service that they were able to hit their targets and shorten backlogs.

The migration to Internet protocol (IP) networking hasn't simplified things. Using today's legacy systems, activating an IP telephony circuit can take as many as 23 steps or more, many of them requiring manual entry at multiple network elements (see Figure 1). Such complexity slows service launch, hinders revenue generation and costs money.

Saving Money With Provisioning

Cable operators who deploy event-based provisioning can greatly reduce the time needed to perform an install while simultaneously increasing the productivity of each installer. The result is quicker revenue generation.

If you assume an installer-based model, then consider the following: Arris' customers have estimated that its event-based provisioning solution can reduce per-install costs by 50 percent and increase installer productivity by 50 percent. Let's assume the average cost of an install is approximately $150, then the cost savings per install would be $75. Multiply that by 500,000 installs per year, and cable operators could save $37.5 million per year. If productivity increases by 50 percent, and you're performing 500,000 installs with manual provisioning, then by deploying event-based provisioning, you can perform 750,000 installs per year—250,000 more. (See table on page 3.)

Flexibility Fosters Creative Bundles

What's more, unlike the Arris/Ceon event-based provisioning system, antiquated legacy systems make it difficult to respond to changing consumer demands. Today's subscribers, shaped by the instant communication provided by the Internet, e-mail and cell phones, want to add or drop communications services or features at the touch of a button.

You'll need to offer customers the ability to add a second VoIP line, increase the guaranteed bandwidth of their high-speed data connection, subscribe to a streaming audio service, order a pay-per-view movie and add an online gaming subscription with a click of the mouse. Web-based provisioning that accommodates customer changes in real-time and interfaces with your billing and other back office systems will be essential.

Plus, you'll need to quickly implement the new service bundles that your marketing department develops. Special promotions like back-to-school offers that combine VoIP and high-speed cable data service for the college crowd; ITV, digital cable, audio streaming and VoIP for families with teens; virtual private network (VPN) services, VoIP and high-speed data for the small office/home office can all be accommodated.

Because Ceon's *It's On*™ provisions services on both the Cornerstone® Voice and CPS 2000 platforms, cable operators can deploy either circuit switched telephony or VoIP. If you already offer circuit switched service, you can add VoIP when the market demands it, without replacing your provisioning system.

Ceon's *It's On*™ provides flexibility to accommodate evolving technology platforms as well as changing subscriber demands. If you can't activate web-based service requests in real time, customers will turn to service providers who can.

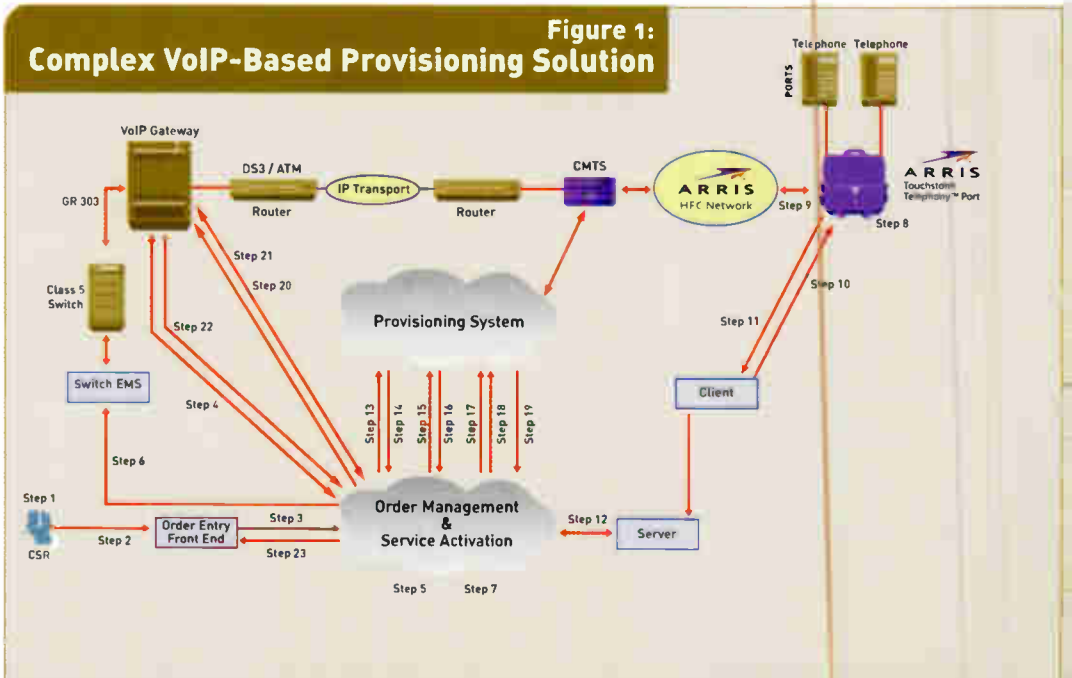
Plan Today

In the past, cable operators focused on building out the network without considering provisioning until *after* they launched new services. As a result, they're constantly trying to catch up with demand, and backlogs occur. By deploying Arris/Ceon's event-based provisioning system, cable operators solve this problem, allowing them to:

- Speed service introduction
- Reduce error rates and lower costs
- Increase market penetration
- Improve QoS and reduce churn
- Reuse existing capacity and increase return on assets

Arris can deliver an end-to-end solution that includes hardware and software necessary to design, build, manage, deploy and creatively bundle today's and tomorrow's voice, video and data services. You can't afford to wait. Plan for event-based provisioning today.

Figure 1:
Complex VoIP-Based Provisioning Solution



EVENT-BASED PROVISIONING
simplifies service activation

INCREASE YOUR REVENUES AND LOWER COSTS TODAY

The broadband universe is expanding. With cable operators, DBS providers and traditional telcos all vying to attract broadband consumers, cable operators must become more competitive. The answer is simple and ready today: deploy an event-based provisioning system to speed new service launches, increase revenue generation, reduce truck rolls, improve customer satisfaction and lower customer churn.

Arris and Ceon have partnered to deliver just such a system. By integrating Ceon's *It's On*™ with the Arris Cornerstone® Cable Provisioning System (CPS) 2000 (see sidebar), Arris delivers a single, event-based provisioning platform that enables cable operators to rapidly create, bundle and provision new services. What's more, this flexible solution allows subscribers to personalize their service selection via a Web interface.

So what is event-based provisioning? Event-based provisioning simplifies service fulfillment by coordinating complex order management and communications processes among multiple network devices, actors and services. The Arris/Ceon system can:

- Automatically detect a network element or a series of network elements upon installation (for example, Cornerstone® Voice Ports for switched cable telephony and Touchstone™ Telephony Modems in a VoIP network)
- Associate those elements to a service definition based on the network topology
- Provision the service within seconds of detection according to the rules of the service represented by a workflow
- Update all other required business and operational support systems (OSSs)

What's more, the architecture at the heart of this event-based provisioning system can handle all events from all sources, as opposed to legacy platforms that typically manage one event going from one device to another. Further, events are not limited to those initiated from devices in the network; events generated by a customer service representative (CSR) as well as orders placed by subscribers via a web portal or interactive television (ITV) are also processed.

This integrated platform can provision, configure and activate headend or distribution node elements such as cable modem termination systems (CMTSs), Voice over Internet Protocol (VoIP) gateways, and virtual private network (VPN) gear. It also incorporates a workflow component and an open applications programming interface (API) to enable communication and coordination with other business support systems (BSSs)/OSSs such as billing, network management and inventory. The Arris/Ceon solution provides a complete service fulfillment package, offering service and product management, order management, service inventory management and event-based provisioning.

CORNERSTONE® CABLE PROVISIONING SYSTEM 2000

Arris' CPS 2000 plays a critical role in the company's event-based provisioning system. Because Arris and Ceon have developed adaptors that enable CPS 2000 to talk to Ceon's *It's On*™, cable operators have an integrated provisioning platform they can deploy today to launch high-speed data and VoIP services.

CPS 2000 is a turnkey, fully redundant, fault tolerant, carrier class provisioning platform for Data Over Cable Service Interface Specification (DOCSIS) 1.0 and 1.1 cable modems. It incorporates Internet Protocol (IP) Naming and Address Management with Dynamic Host Configuration Protocol (DHCP), Domain Name Server (DNS), Trivial File Transfer Protocol (TFTP) and Time of Day (ToD) server functionality. By integrating these servers into one platform, Arris has simplified provisioning for cable operators. Administrators no longer need to spend valuable time and money configuring and managing disparate DOCSIS servers, each with its own user interface.

Auto Provisioning Enabled

To further reduce manual provisioning costs, CPS 2000 includes tools to enable cable operators to automate provisioning and offer subscriber self provisioning. Software adaptors enable Ceon's *It's On*™ to send provisioning commands directly to CPS 2000 and then on to the Cornerstone® CMTS. The system also supports auto discovery of cable modems via pre-defined profiles. These profiles either immediately activate service to subscribers or point subscribers to a Registration Web Page where they can select their own cable modem class of service. Ceon's *It's On*™ captures this order information and routes it to the appropriate OSSs.

Carrier-Class Scalability

Once you've solved the automation challenge, it's essential that your event-based provisioning platform be able to accommodate swelling subscriber counts. CPS 2000 can scale to support millions of DOCSIS-based NIDs through the implementation of a Structured Query Language (SQL) database. This capability allows for all DOCSIS server and cable modem provisioning parameters to be stored, replicated and distributed throughout the network. As a result, administrators can deploy DOCSIS servers in each HFC headend, and manage cable modem or Touchstone™ NID provisioning from a central location. This moves provisioning information closer to the customer, which decreases provisioning processing time and reduces costly backbone data traffic.

By implementing the Arris subscriber management solution, cable operators can speed new service launches, generate revenues more quickly and reduce operations costs.

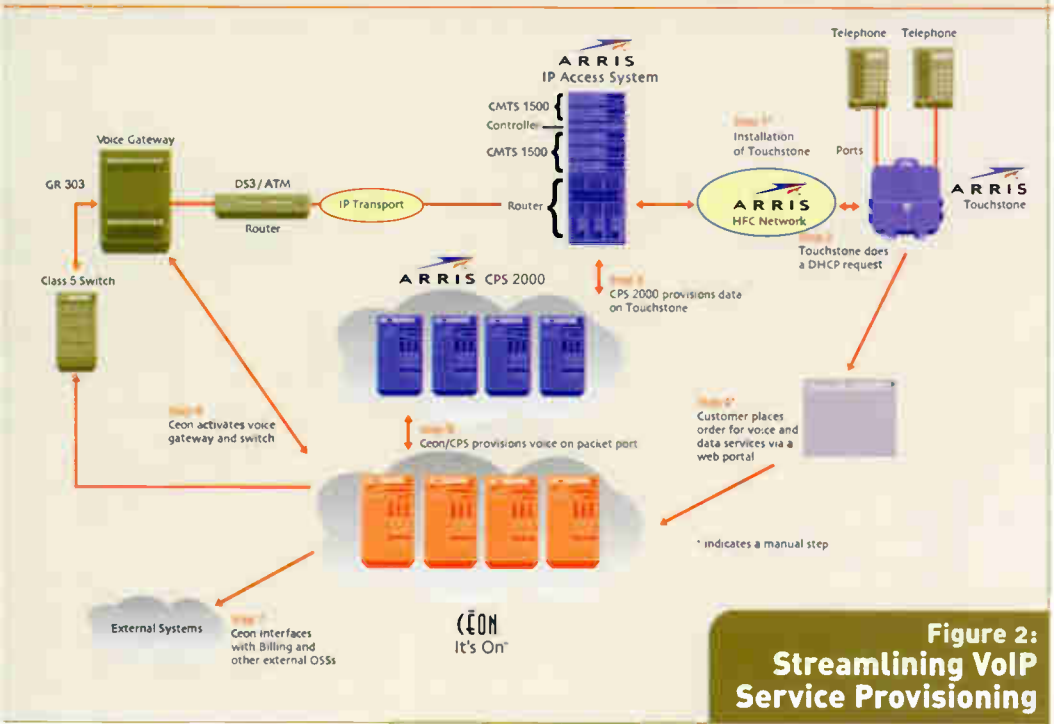


Figure 2: Streamlining VoIP Service Provisioning

With competitive pressures getting fiercer each day, it's essential that you capitalize on each new service launch. To accommodate the rapid growth and speed revenue generation anticipated by deployment of voice over IP (VoIP) telephony, you must have in place an event-based provisioning system that can automate service activation for each customer.

Without event-based provisioning, VoIP service activation requires more than 20 separate steps, many of them manual, and multiple truck rolls before a customer starts receiving service. Not only is such manual provisioning costly and prone to errors, but it greatly hinders your ability to quickly scale the service to reach new markets and satisfy pent up demand.

By launching VoIP service with the Ceon/Arris next generation, event-based provisioning system already in place, you can activate service in the seven steps outlined in Figure 2, with most of them occurring automatically.

Underlying Architecture

Ceon's *It's On*™ is a provisioning and order management platform for all communications services. It is comprised of three main applications:

- **Service Management:** Ceon's Can-U-Bundle—performs product creation and modeling; bundles services into new products
- **Service Selection and Validation:** Ceon's Can-U-Serve—interfaces to the CSR, web, and interactive TV; dynamically offers only those products that can be delivered to an address; ensures orders are taken correctly
- **Service Delivery:** Ceon's Can-U-Deliver—handles order management, workflow, order tracking, flow-through service provisioning and touchless service activation

Ceon's *It's On*™ simplifies provisioning by modeling individual services separate from their delivery technologies. This modeling enables cable operators to isolate implementation processes and develop separate business rules for supplying services. It also links those services to billing and OSSs. As a result, Ceon's *It's On*™ can dynamically reconfigure work processes; dynamically translate products into services and services into work orders; and dynamically generate service activation commands.

Adaptors Provide Communication

How is this accomplished? Information that is specific to an operator is contained in the workflow script and the data loaded into the object model. This enables Ceon's *It's On*™ to define a service and specify the workflows necessary to activate and manage that service. But the event-based provisioning system still needs to talk to the network elements and OSSs to activate service. To do this, Arris and Ceon have developed adaptors to enable Ceon's *It's On*™ to send instructions to network elements. Ceon's *It's On*™ acts as a mediator and associates messages sent between network element adaptors, OSS adaptors and the workflow system to perform activations or other management services.

An adaptor may listen for in-bound messages from other systems and perform out-bound functions such as programming a switch, a network interface device (NID), host digital terminal (HDT) or another OSS. The function to be performed is defined in a message generated by the specific workflow for the service. The rest of the facilities in the system are generic or generic for a device.

The beauty of these adaptors is that they eliminate the need to manually provision network elements. For example, the Cornerstone® CPS 2000 adaptor can perform any function on the Cornerstone® CMTS or Touchstone™ Telephony Port NID. CPS 2000 automatically detects when a new DOCSIS-certified cable modem or Touchstone™ Telephony Port NID is installed on the network. It then relays that information to Ceon's *It's On*™, which is the broker to the order entry, back office and billing systems. The provider-specific workflow then tells the CPS 2000 which functions to activate on the Arris CMTS or NID. The result: service activation requires fewer steps and less human intervention (see sidebar, Streamlining VoIP Service Activation).

Speeding Launches

The flexibility of event-based provisioning enabled by the Arris/Ceon partnership allows cable operators to launch new service bundles quickly, while simultaneously containing costs.

The service models found in Ceon's Can-U-Bundle application let your marketers add new product bundles, change existing bundles or withdraw current offerings without disrupting your network. This ability to quickly respond to changing market demands is essential for any operator wishing to gain and retain customers. By offering subscribers the hottest new service packages, they won't have an excuse to search for an alternative broadband provider when you can't deliver. Plus, the more bundled services your customers buy, the more difficult it becomes for them to change providers, thus saving you money by reducing subscriber churn.

Reducing Costs

Additional cost savings accrue via Ceon's Can-U-Serve application. By enabling Web-based order fulfillment, customers can add or change their service lineup without ever talking to a CSR or needing a truck roll.

For example, using the web, customers could check to see if the Touchstone™ Telephony Modem and IP telephony service bundle were available in their area and if their PC met the minimum requirements for service. If yes, a Touchstone™ Telephony Modem could be shipped to the customers, who could complete the install when convenient. Customers benefit because they don't waste time at home waiting for an installer to arrive, and operators benefit because they save the cost of a truck roll.

Another key benefit is that only those products that can be delivered are offered. Ceon's Can-U-Serve dynamically adjusts the product offerings to reflect those bundles that are deliverable to that address. Customers aren't frustrated by ordering services they can't have, and operators can easily adjust the offerings as services roll out to new areas.

What's more, the automated nature of the system ensures that orders are taken completely and correctly for the entire service bundle. No longer will network administrators need to manually enter provisioning data into to separate systems—one for voice, a second for data and a third for video services. Operators thus avoid costly provisioning errors.

But the benefits don't stop there. Because Ceon's Can-U-Deliver application automatically provisions network elements, cable operators can activate services within seconds instead of days or weeks. This "touchless" activation can occur on any network with any technology and at any size. The result: increased time to revenues, higher customer satisfaction and lower operational costs.

By implementing event-based provisioning, cable operators can change their network technologies, update processes, adapt business rules, implement new OSSs and launch new services without negatively impacting the existing services.

Deploy Today, Reap the Rewards

Cable operators face significant challenges in their efforts to deploy services efficiently in today's competitive market. By implementing event-based provisioning, cable operators can overcome many of these challenges.

Incremental changes to provisioning are no longer sufficient. It is only through a strong, automated linkage between the management of service offerings and the underlying networking assets that the necessary operational efficiencies can be fully realized. It requires the commitment to automation of customer care and operational support processes that event-based provisioning provides.

Arris and Ceon can deliver an event-based provisioning platform today that can help you speed service launches, increase revenue generation, lower operational costs, improve customer satisfaction and reduce subscriber churn. Can you really afford to wait? Your competitors won't.

TOUCHSTONE™ NIDS CARRY THE LOAD

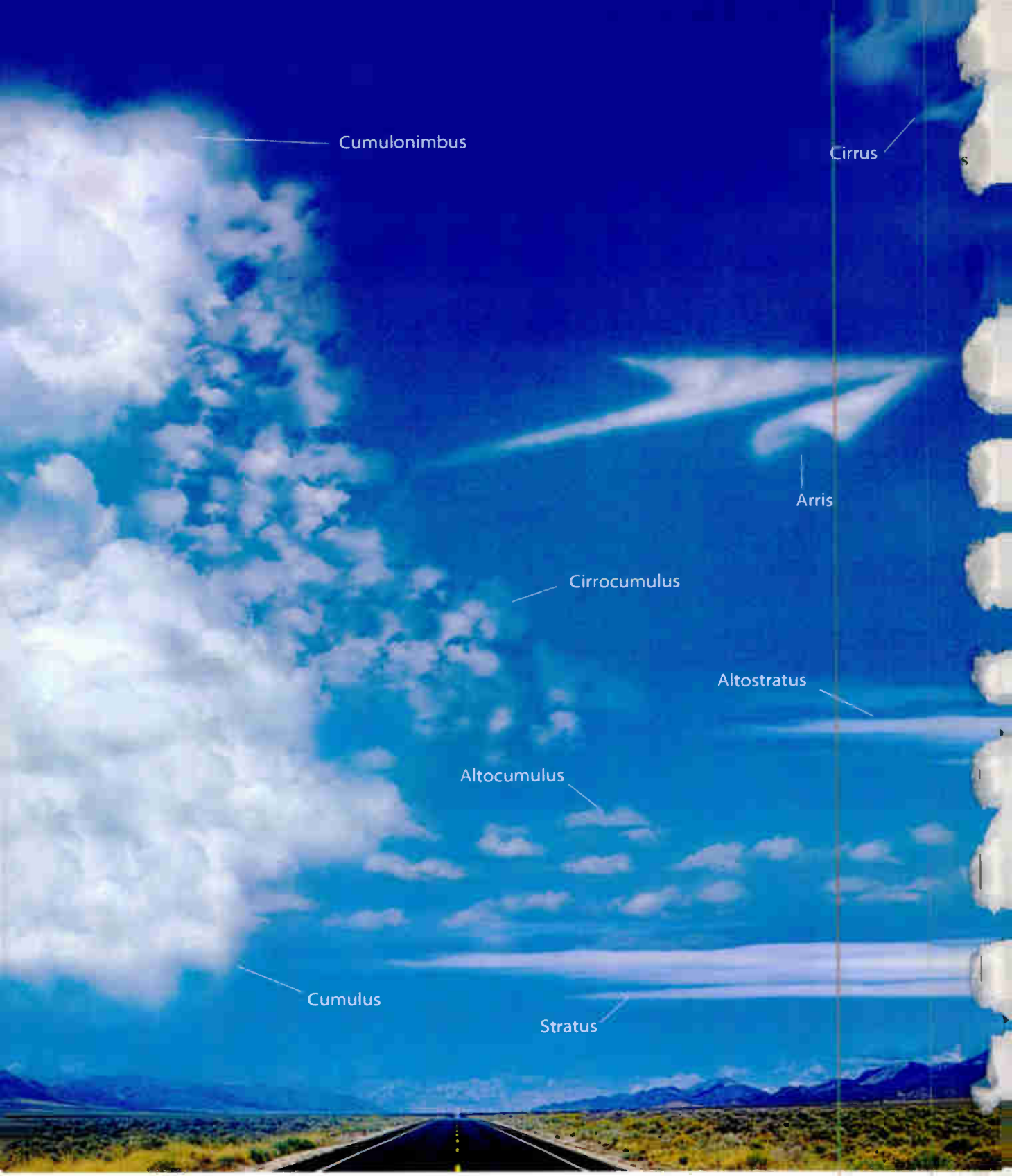
The Touchstone™ Network Interface Device (NID) family from Arris is based on its industry-leading Packet Port™ technology. The Touchstone™ NIDs replace both a cable modem for data and a switched telephony NID on the side of the home. This robust, carrier-grade NID family is integrated with the Arris Cornerstone® CMTS family to provide VoIP services. The Touchstone™ family consists of the Telephony Modem designed for indoors and the Telephony Port for outdoor deployments supporting four lines of carrier grade voice with CLASS features.

BILLING INTEGRATION

Arris realizes that automated provisioning and service activation are just one part of the broadband puzzle. In order to make money, cable operators must be able to bill for those new services. Ceon's *It's On*™ currently integrates with many popular billing systems and contains easy-to-implement integration tools.

Customers who wish to employ CPS 2000-only installations for element provisioning will also need the ability to integrate with billing systems.

To ensure that your legacy billing systems and other OSSs can communicate with CPS 2000, Arris offers its SolutionLinx™ Partners Program. Upon joining, third-party developers have access to software APIs, licenses and a developer's tool kit for Arris products. In addition, Arris provides its SolutionLinx's™ partners with access to products three months before their market introduction and with time for testing in its research labs. As a result, SolutionLinx™ partners can integrate, test, document and debug their applications in advance of the product launch.



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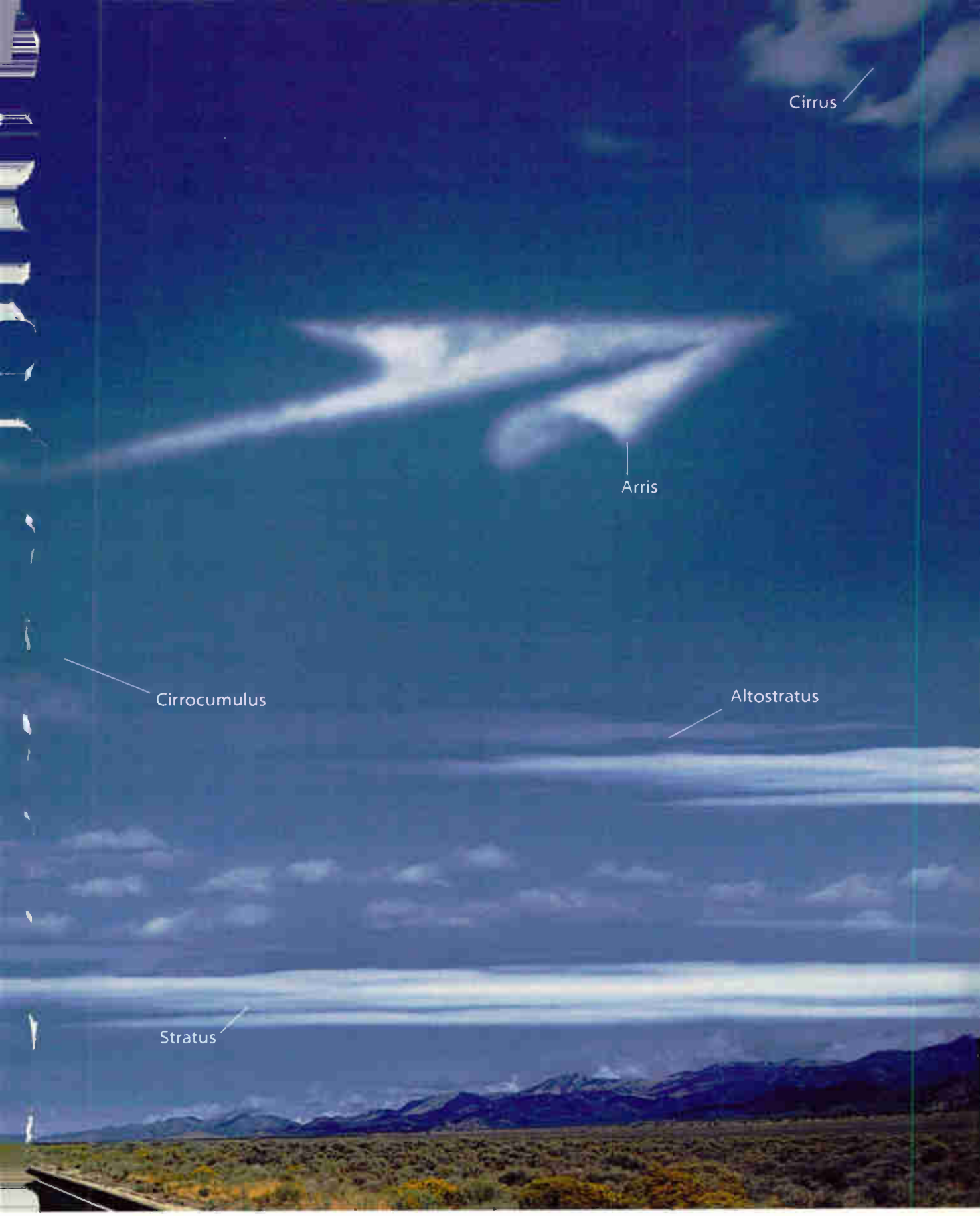

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• 8 x 50 ksps other QPSK
• 4 x 500 ksps other 64-QAM

Table 2 (page 44) shows the predicted BERs for the two loading scenarios based on this set of inputs. If the CNR is dropped to 20 dB, the results of Table 3 (page 46) are obtained.

Clearly, better BER performance is obtained when the loading accounts for the modulation type. What the technique does is exchange the excess power allocated to robust modulations, such as QPSK in this example, to the less robust modulations. The resulting average BER is minimized overall.

However, note that on an individual channel basis for CNR = 20 dB, the QPSK channels do begin to count errors where in the uniformly loaded case they did not. Again, this example emphasizes that the optimization covers all channels, but perhaps with some degradation if other channels make up for that los with their performance gains.

Figure 2 (page 47) plots the average BER for optimal and uniform loading (measured). Here, "AVG BER VAR" refers to the optimal (variable) loadin case, as compared to the uniform, or power-per-Hz approach.

The techniques used to generate the results in the example have been extended to cases of further practical interest, many of which may be handle with minor modifications to the analysis. In principle, the Lagrange analysis approach is a generalized solution—i only needs a set of equations to start out with to solve.

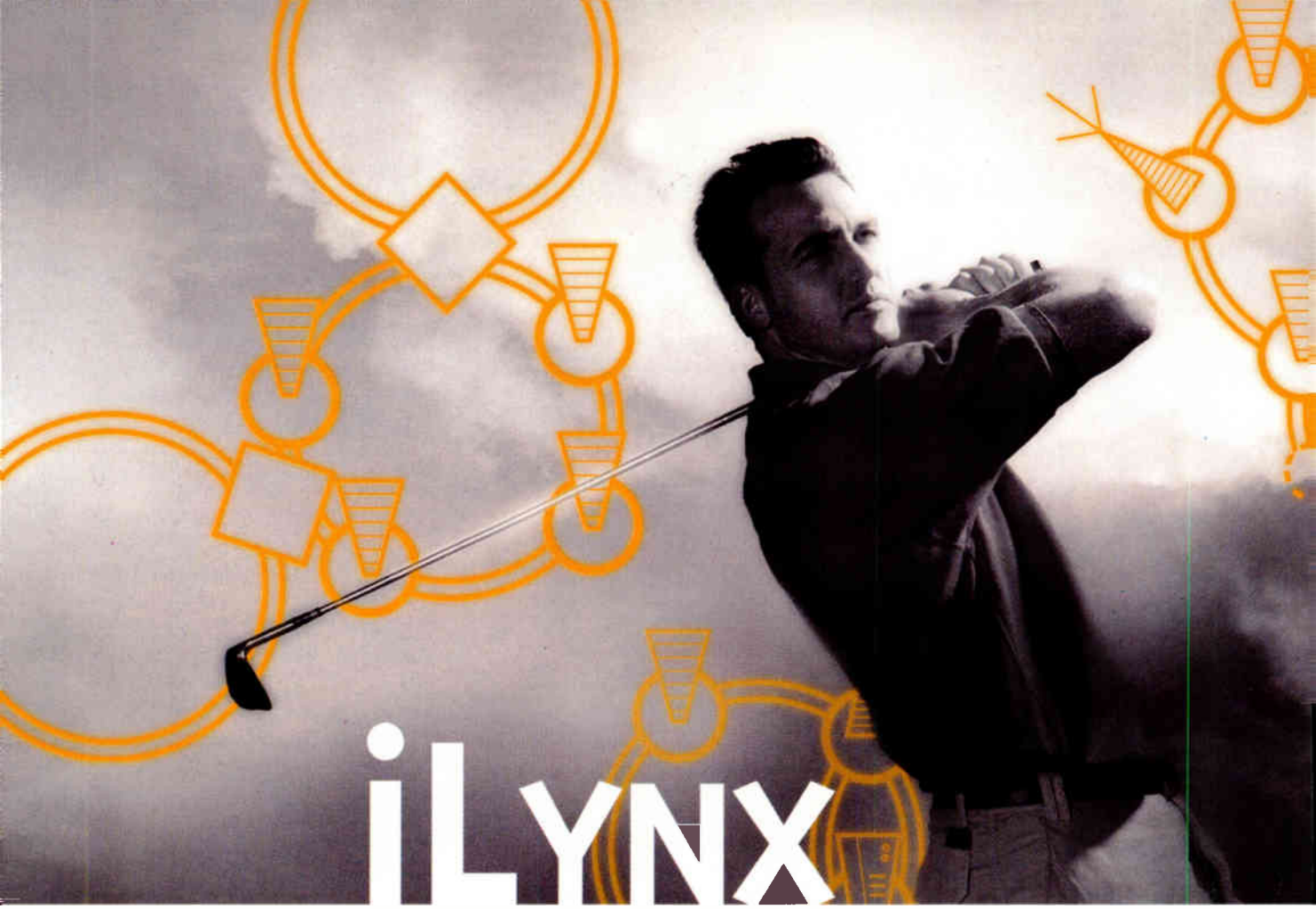
In the example, the equation that was solved was minimum BER for an all-flat, all AWGN, impairment only However, the BER expressions whe various other impairments, or othe

BOTTOM LINE

> **Get More From Your Retur**

Cable operators may more efficiently load their return path by optimizing BER channel levels for each service as a function o modulation type,. The use of such a tool becomes valuable as the need for higher bandwidth efficiency and higher through put is sought, all while achiev ing better performance in the quickly evolving world of cable TV data traffic.

Being governed by a per-Hz methodology is a sensible way begin activation of the return, but with return spectrum filling, and reverse path service maps being implemented and stabilized, the opportunity to maximize the investment in return path performance is possible with this approach. It requires no equipment investment, and uses existing infrastructure more efficiently with easily programmable mathematical algorithms and slight modifications in fie alignment techniques.



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CONNECTING WORLDS TRANSMITTING IDEAS

system variations, are included also may be captured with this approach. Examples include:

- Inclusion of forward error correction (FEC), using the BER approximations for coded systems
- Inclusion of interference, using BER expressions that account for carrier-to-interference ratio (C/I)
- Inclusion of clipping-related effects with BER expressions that account for this probability
- Inclusion of non-flat noise floors

Consider an example of a nonflat noise floor, based on the prior case channel lineup. It is assumed (but not recommended!) that a 16-QAM DOCSIS channel is placed in the low end of the spectrum. The noise density there is assumed to be 10 dB higher than the rest of the band. The results for a return path with "CNR = 25 dB" (not including the noisy end) are shown in Table 4 (page 46).

Again, the superiority in terms of performance for the optimized loading approach is evident.

What's it all mean?

A more optimal way of loading the return path, in terms of minimum average BER performance, is available. The use of such a tool becomes valuable as the need for higher bandwidth efficiency and higher throughput is sought, all while achieving better performance in the quickly evolving world of cable data traffic.

Being governed by a per-Hz methodology is a sensible way to begin activation of the return, but with return spectrum filling, and reverse path service maps being implemented and stabilized, the opportunity to maximize the investment in return path performance becomes possible. This approach requires no equipment investment, and uses existing infrastructure more efficiently with some easily programmable mathematical algorithms and slight modifications in field alignment techniques.

This method is not offered to be considered the "right" way to align return, but is merely meant to illustrate that other options exist for reverse path engineering, and that some of these options become more valuable as the services that the reverse supports become more sophisticated. It is always a worthwhile goal to determine the "optimum" performance in a systems engineering problem, so that engineers have a frame of reference against which to compare their system performance. In the case of optimization, it also happens to be a methodology that can be implemented. CT

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Recruiting & Training

Thinking Outside the Box

By Beth Arnholt, Comcast Cable Communications, and Pam Nobles, Comcast University

Having trouble finding or training technical people? These steps and principles simplify the process.

You can't go anywhere today without hearing about the shortage of good people in technical fields. How do we find the right people and convince them to work for us? How do we keep them happy? These are good questions, but the answers are often complicated.

Career as product

Let's start with recruiting. To begin to develop a plan, try adjusting your thought process. Recruiting is a product development process, and your product is a career at your company. As you would with a more tangible product, such as video-on-demand (VOD), you need to follow a series of steps.

First, go out into the marketplace and define your target market—what are the demographics and needs of the individuals who will buy your product? Then define the benefits—why would they want to buy it? Third, test market your product to work out the kinks and ensure that it is ready for rollout. When recruiting, these steps are sourcing, marketing and interviewing.

The biggest mistake that most companies make when recruiting is assuming that it is the responsibility of the human resources (HR) department alone. Successful organizations realize that recruiting is part of every employee's job description—listed under the category of "other duties as assigned." As a hiring manager, it may be the key to your success. As a co-worker, it may make your job both easier and more secure. Hiring the right people leads to increased productivity, higher morale, more balanced workloads and more opportunities for growth.

Finding the right people cannot be done by an HR department that makes up only 3 percent to 5 percent of your overall workforce. Each person in an organization has a unique set of opportunities to meet and recruit the right players because of their background, network and skills. The number and quality of recruits builds quickly if everyone is involved.

Once everyone is involved, what should they do? No one answer to this question exists, but an overriding concept does emerge. Recruiting, when done right, is a proactive process. General job fairs and newspaper advertisements build a good foundation for recruiting efforts, but they are reactive in nature. You place the ad or set up the table, then wait and hope that the right people find you.

Think outside the box: How could you be more proactive in your efforts? How do you seek out the people you really want? Some ideas generated during presentations at the **Society of Cable Telecommunications Engineers' (SCTE)** Cable-Tec Expo in May include:

- *Service experiences:* Was the person at Home Depot extremely knowledgeable? Did the sales person at Radio Shack really impress you?
- *Internet sites:* Don't just use the large job boards. Identify non-traditional sites where people you want may visit. Examples are SCTE, **Women in Cable & Telecommunications (WICT)**, the **National Association of Minorities in Communications (NAMIC)**, local city sites, chat rooms for areas of interest and so on.
- *Community involvement:* Do you belong to social groups, teams, churches and so on? Do your children? Talk to those around you at these events. You typically ask them what they do by the third question anyway.
- *Existing employees:* The time it takes you to hire a new employee may be longer than training that high-potential person who is missing one piece of the puzzle!
- *Publications:* Read differently. Did someone win an award? Did someone author an interesting technical paper? Was someone quoted saying something interesting? Find them.
- *Professional associations:* Use activities such as the SCTE Expo to meet others interested in the same business. Use your network.
- *Schools:* Don't just post your positions at local schools. Consider doing a presentation to a class, using your alumni network, or helping develop a school-to-work program in your industry.
- *Employee referrals:* Whether you have a formal program or not, the

> Shaping A New Career Path?

By Alan Babcock, NCTI

I started in the cable industry as an installer. My on-the-job training lasted just a couple weeks, and then I went solo. The job was fairly easy to learn and the training process was adequate for the complexity of the skills involved.

We all followed a similar career path: Start as an installer and move up. To make more money and gain additional responsibility and prestige, we climbed the ladder to get further and further from the customer until we eventually made it to headend tech. This model worked for years because as jobs became more complex, the knowledge and skills needed for each job on the ladder tended to build on the competencies of the previous position.

Well, the time is past due for questioning this traditional career path. Reality has changed, but our perceptions of that reality are a bit slow to change.

Reality today is that the most complex jobs are at the ends of the network—the headend and the home. The skills needed at the ends of the network are mindboggling.

While the ends of the network have become more complex, the transportation network between them remains relatively stagnant. That isn't to say the network hasn't changed—it has. Dense wavelength division multiplexing (DWDM), return networks, centralized powering and other technologies are being deployed, but when compared to the ends of the network, the changes are pretty small.

These realities make me wonder if it isn't time we change the positions of the rungs on the career ladder. What if we found a way to teach entry-level technical workers on less complex sets of tasks and expectations? What if that training could be done in just a few weeks (as in the old days)? What about a professional track for technical workers to recognize their ability to provide exemplary service to customers?

A new model

Let me suggest the following model. The entry point for a technical worker isn't as an installer. The entry level should be as a network technician. The network tech is responsible for working in the plant to maintain it's mechanical and electrical reliability. Demand and preventative maintenance of the network is essential. Those of us who have been around for a few years most likely have experienced the need for more effort and resources in the preventative maintenance area. With the wide array of services offered today, reliability is even more critical.

At least two entry-level positions could exist for network technicians: one for those more interested in the mechanical aspects of plant construction and maintenance, and one for those more inclined or adept in the electronic aspects of network support. As individuals gain experience and knowledge related to network operations, they could work their way up one of three paths.

One path would be to become highly skilled network technicians or construction technicians. The outside plant is an extremely valuable asset, and experts are needed in all facets of the plant. The mechanical engineering aspects of loading on a pole, maintaining acceptable strand sag and many other issues demand the best mechanical engineering skills and knowledge.

Another path would be for those who have a knack for electronics, data, video or voice and prefer a minimal amount of human contact. Work in a headend may be very rewarding for those who pride themselves in solving technical problems, but it isn't for everyone, and it shouldn't be the only job considered the top of the career ladder.

The third path is toward the "home" of the network. The technician/installation professional who likes working with people and the challenge provided by complex in-home video, voice and data networks. This professional has perhaps the most challenging job because of the changes found in consumer electronics. Couple the need to understand the newest gadgets on the market with the ability to explain how the customer may access the program guide on the digital set-top terminal, and you have a very special home-end professional.

Alan Babcock is vice president, learning and development, for NCTI. He may be reached at alan@ncti.com.

turnover rate on people you hire as referrals typically is substantially lower than other hires. Encourage your employees to think proactively.

- *Miscellaneous:* Put a sign on your vans, run a message on your audio response unit (ARU). Think outside the box!

The key to developing a good sourcing program is feeding information to the HR department. Let them do the legwork, but provide them with strong channels to pursue. They are not reading the same materials, meeting the same people or joining the same organizations that you are. You interact with a different pool of candidates, and observe potential candidates' professionalism, leadership skills and technical knowledge. Train your employees to take advantage of these opportunities as they arise, and the quality of your candidate pool will improve.

Training as a retention tool

Once your new field technicians are recruited, training performs a critical role in retention. During the SCTE Expo, attendees of the "Retaining Your Technical Team" workshop tried to find some answers. Asked to identify barriers to training, participants discussed several problems, including:

- Weak management commitment;
- Employees who are just looking for a paycheck, and new hires who are not a good fit for the job;
- The lack of good training programs and inconsistency in training;

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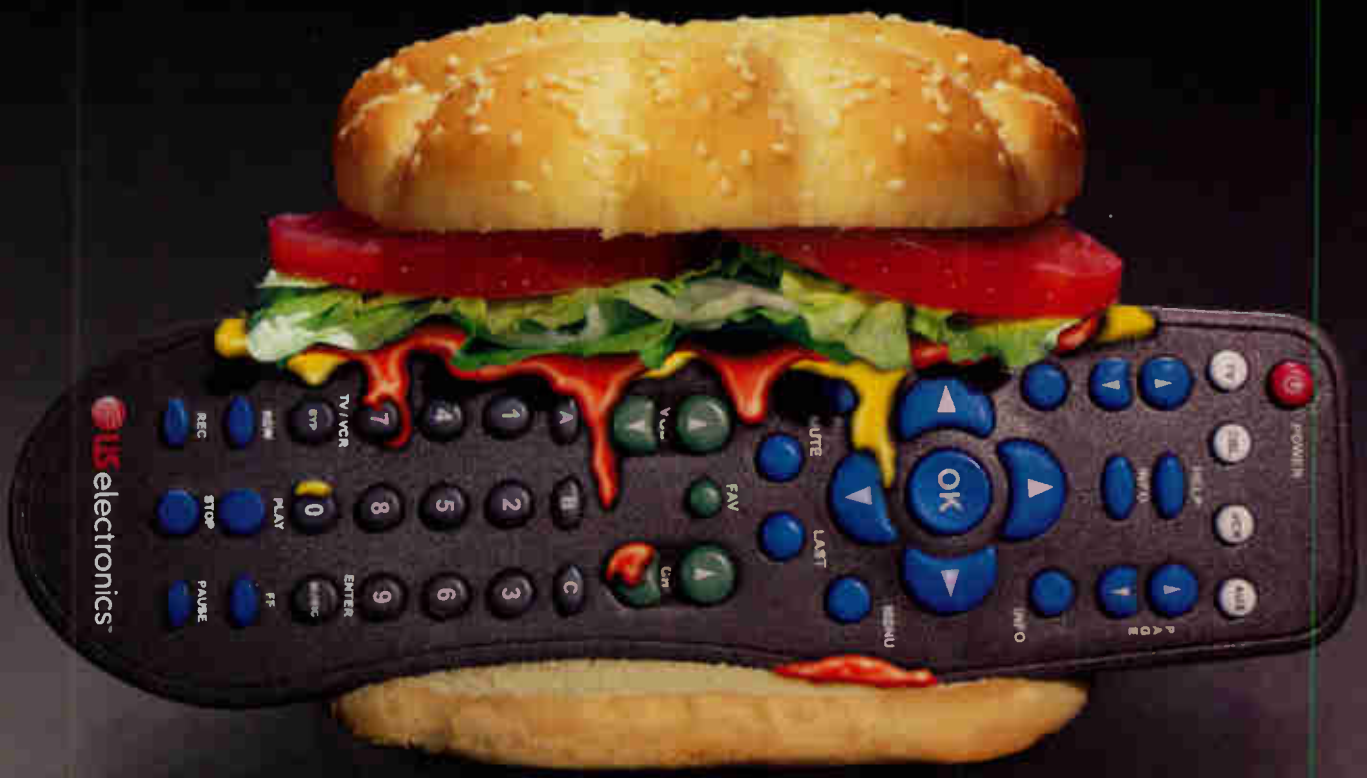

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> Thinking Outside the Box

Recruiting and training your technical team may seem daunting. Here's a quick list of ideas that should bear fruit for your organization.

- Adjust your thought process about recruiting by defining your target market (sourcing), specifying the benefits (marketing), and getting ready for a large scale rollout (interviewing).
- Recruiting must be a part of every employee's job description.
- Be proactive.
- Consider your own service experiences with helpful workers as opportunities to recruit. Other vehicles for finding people include Internet sites, community involvement, existing employees, publications, professional associations, schools, employee referrals, signs on vans and messages on the audio response unit (ARU).
- Keep the human resources (HR) department involved.
- Promote culture change by equipping the technical workforce for the future.
- Establish a career path for each employee.
- Create a more conducive environment for learning by providing training tools, creating consistent core content, using a variety of presentation methods and appealing to multiple learning styles.
- Develop and certify technical trainers.
- Break the "Reasons Not to Train" cycle, and make sure you offer your employees both the commitment and necessary time away from work to enhance their careers.
- The view that training is an operational burden—the focus is on training costs, time lost and the fact that the system is shut down for training;
- Not enough qualified trainers and lack of supervisor and/or subject matter expert (SME) involvement; and
- Technicians who are intimidated by new technologies.

Answers to these problems were not quick in coming. Where do you start? Successfully implemented learning and development plans involve a combination of components. Two of these components relate to retaining employees—producing a structure that promotes culture integration and creating an environment conducive to learning.

Culture integration

Installers are installing not only traditional video services, but voice and data services as well. Long-term success depends on equipping the technical workforce to respond to the challenges of current and future

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The **RP-100** incorporates an auxiliary RF input to allow for signals to be continued with other RF signals.

Easy to use

The **RP-100** is designed for minimal set-up and adjustment, just turning and pushing the rotary selector it is possible to define all the configuration parameters (carriers level and frequency).

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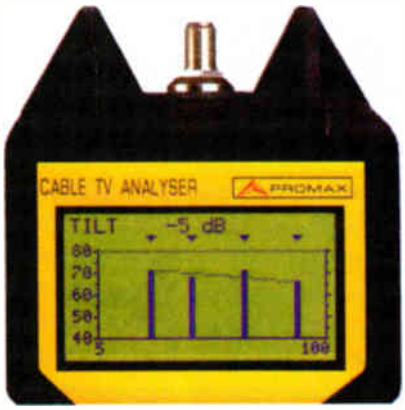
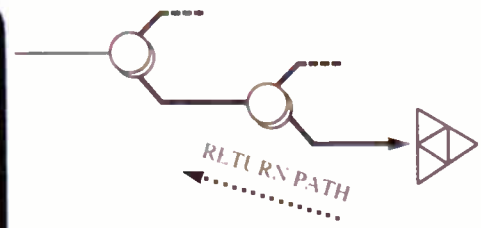


Example of tilt measurement using a **PROMAX-8+**



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the next generation of technicians who are highly skilled in adapting to the full spectrum of customer needs by delivering exceptional service and a "one-stop shopping" experience.

CommTech is a skill-based pay program that rewards demonstrated skill development. The career path consists of six levels. Technicians must certify through written and practical exams before moving to the next level. CommTech defines the career paths of field technicians. They receive a salary increase upon certification. Technicians do not have to wait until a position is open to progress to the next level. This essentially puts the technician in charge of his or her career and provides more opportunities to move up and earn more money.

For installers and technicians, this means jobs have been combined.

installations or trouble calls. The installer is no longer the entry-level position, but the "master craftsman," capable of fulfilling a variety of customer service needs (see related sidebar, page 58). This is a huge culture change for the technicians and for operations. An environment conducive to learning helps to promote this change.

The training environment

Employing variety in learning methods while presenting a consistent message is not only possible, but also very conducive to learning. Taking a hybrid approach to learning methods—including classroom and instructor-led training, Web-based, self-paced and multimedia—makes the learning environment rich and enjoyable. College courses may be incorporated into this curriculum. Tuition reimbursement

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rectly supports this
culture. Training is deve[illegible]ulum di-
lar format, which makes it
portable. For example, a new tech
learns the basic skills to prewire a single
family home. Part of this training in-
cludes how to handle the coaxial cable
and install F-connectors, which is its
own self-contained mini-course. In fu-
ture training modules, such as overhead
and underground drop installation,
cable handling and F-connector train-
ing will be applicable again. The cable
and F-connectors module may be in-
serted directly into the course. If the
technicians are experienced, this "learn-
ing point" may be skipped.

A consistent approach ensures the same message is communicated at each location and at each CommTech level. The changing environment, including different trainer presentation styles and technician learning styles, requires offering more options. Providing options through modular development allows the trainers to customize for their system and for their learners. Courses are simpler to schedule because the modular format allows course sizes to be easily modified. Providing options also allows the learners to customize their own career path.

People have a variety of learning styles. Although a specific style is typically favored, learners need to involve all the senses in the process—seeing, hearing and doing—in order for learning to occur. Hybrid environments provide more appeal to individual learning styles. Technicians who are actively learning are more satisfied in their job, and more willing to stay.

Trainer development

Most of the technical trainers in our industry have grown up through the technical ranks, starting as an installer or service technician. They are often promoted because they are good technicians, they know the subject and have a desire to train others. They typically are technical SMEs and may not

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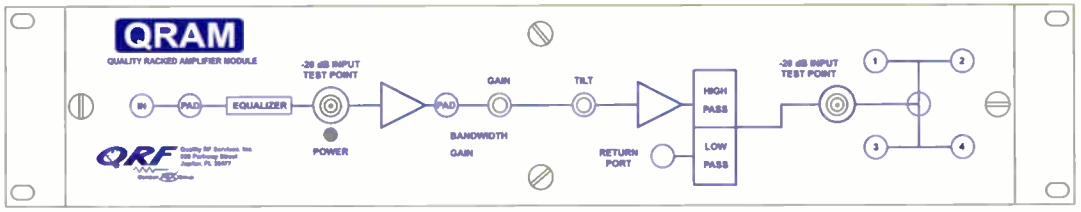
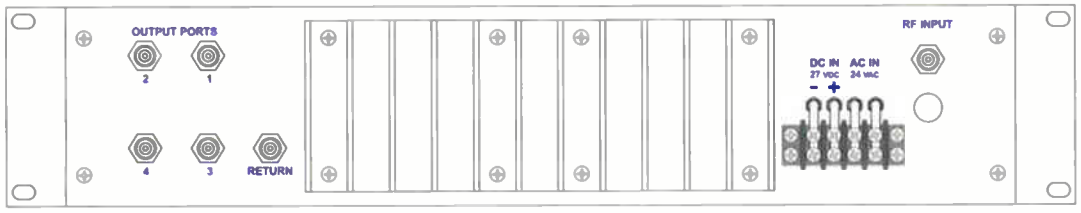
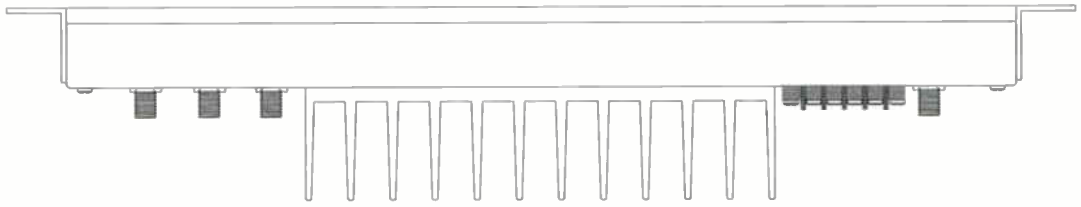


QRAM Front View



QRAM Rear View



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be trained trainers, instructional designers or course developers. The value of their experience cannot be underestimated. The key is looking at a consistent approach through identifying trainer competencies, and training and certifying to these competencies.

Comcast University's goal is to equip our technical trainers with the skills needed to effectively prepare our technicians for new product and service offerings. The foundation of the trainer's development is a combination of training skills and content knowledge. Both are necessary elements in the certification process.

Operational challenges

Lack of management commitment—or the perceived lack—continues to be a deterrent to training field technicians. Securing qualified trainers and training programs, as well as taking employees off the job for classes, continues to be a challenge. It's certain that we need to break through the cycle of reasons not to train.

Training will help retain your employees. But it's not the training alone. Training must be coupled with a structure that promotes culture integration. Create an environment conducive to learning. Provide the training tools that make up quality courses. Develop and train the trainers. Offer career growth and educational opportunities. Break through the operational challenges.

You've worked hard to recruit your technicians. Don't lose them! Attach training and salary increases to a career path, and add credits for a college degree. With such a plan, the prospects for long-term retention of your team are promising. CT

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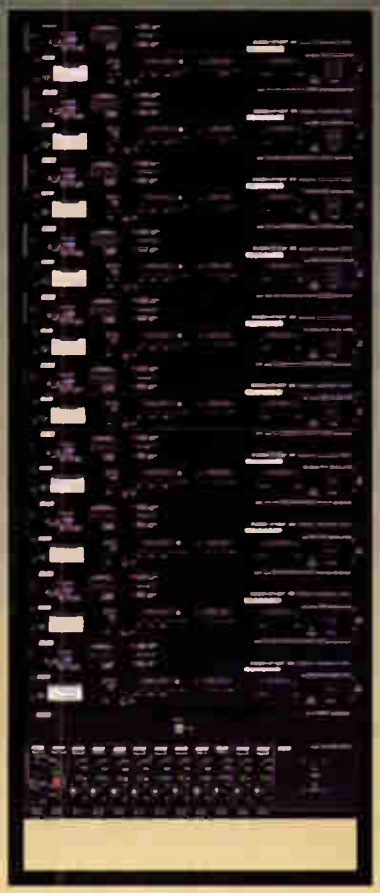

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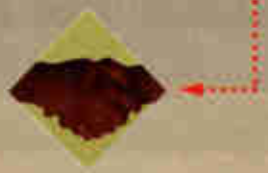

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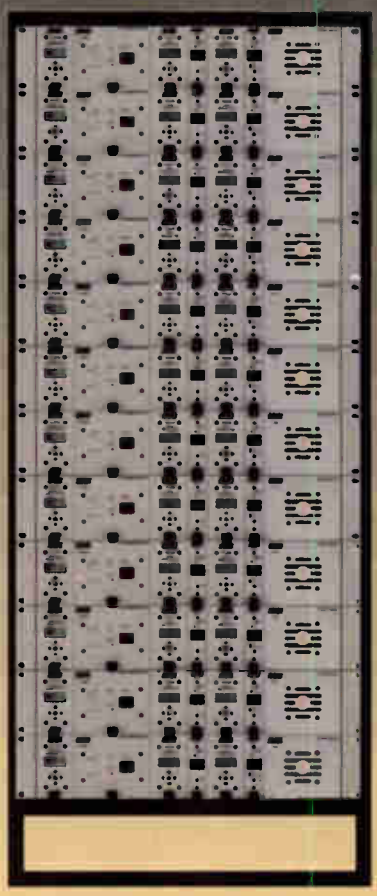

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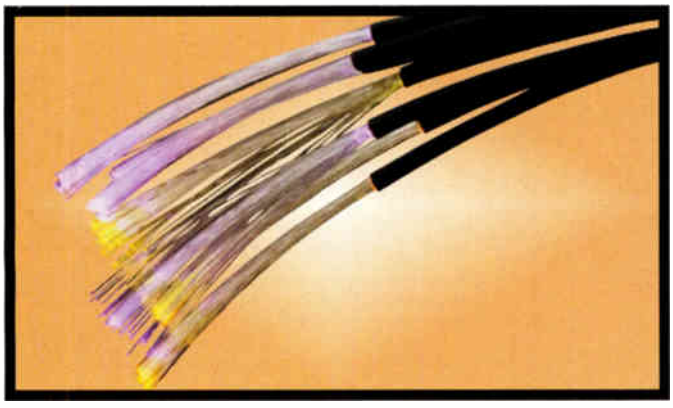
Plant Extensions

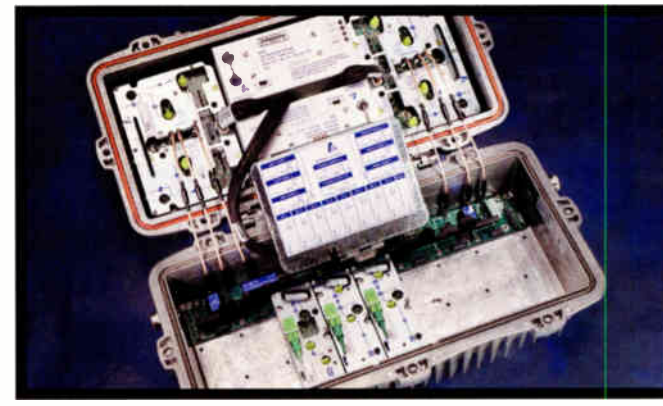
Extension checklist...

- Find and study original specs
- Determine tie-point
- Check power supplies for overloading
- Call design company ASAP
- Update master system map
- Document fiber plant changes/additions

Engineering Changes in the Finished Plant

By Jim Chartre
Cable Constructors, Inc.





Following sound principles when extending an existing plant saves money and time.

As operators complete major upgrades to 750 MHz and 870 MHz, population growth and development will continue to occur within the finished plant. The need to incorporate plant extensions into the existing design will increase. These extensions may be categorized into three types: small extensions entailing passive devices only, medium-sized extensions requiring the addition of active devices, and major extensions with much rework and additions to the fiber plant as well.

Several rules of thumb should be followed for all types of plant extensions.

Small plant extensions

Small plant extensions typically entail a few spans of new cable and taps, and do not require any additional amplifiers to design and construct. An example is the addition of a few new homes or an apartment complex. Because they are so small, many of these changes are designed and built by the operator instead of sending them out for design and drafting.

Even though the design is fairly simple, remember two important things when adding a small extension. First, follow the original plant design specifications. This includes maintaining the original forward and reverse tap levels, as well as the crossover spec and any return conditioning that may be called for. Second, make sure that all plant changes are documented.

It is very easy to just get these types of extensions designed on site and built quickly. However, if the changes are not documented and added to the master set of prints for the plant, the slow process of losing the integrity of the system maps will begin. If you look at the money that was invested in creating an accurate set of system maps, the small amount of effort it takes to maintain the accuracy of these maps is well-spent.

Medium-sized extensions

Medium-sized extensions require the addition of one or more amplifiers to build, but are not so large that you'd need to add a new fiber node. An example is the addition of a small development of 20 to 30 homes. Make sure adding more amplifiers does not overload the existing power supply. If it does, the existing power supply may have to be relocated or a new one added to accommodate the current consumption of the additional amplifiers.

If the new amplifier(s) are far away from the power supply, they also should be checked for low operating voltage. The existing end-of-line (EOL) plant specs should be maintained, and the new amplifiers should stay within the maximum cascade allowed for the system architecture. These types of extensions may require some rework of the existing plant in order to provide signal to the new area. >

Major plant extensions

Large plant extensions are ones so large that they are only served by adding another fiber node. An example of this is a large new development in a node that already is near its maximum allowable number of homes passed.

The two criteria to use when deciding whether to add another fiber node are the maximum cascade of the system architecture, and the maximum house count allowed by the architecture. If a plant extension is so large that it cannot be designed within the existing maximum amplifier cascade, then consider another fiber node for this area. Also, if the new extension contains so many customers that the existing node service area now exceeds the maximum allowable number of homes passed, then also consider another node.

If you are lucky, the original fiber design provided extra fibers in the vicinity for just this purpose. If not, new fiber optic cable must be installed back to the transmitters, or at least back to an area where spare fibers are available for use. All modifications made to the fiber plant also must be well-documented. If you decide to use spare fibers to feed this new node, you don't want them reallocated later because someone didn't know they were already in use.

Some general rules

Regardless of the size of the extension, certain information always is needed for design. First, a clearly defined tie-point to the existing plant must be provided. Also, information regarding existing plant equipment that will be affected, such as power supplies or downstream amplifiers, should be provided along with the tie-point. Remember that just because the power supply may be able to handle the increased amperage loading, you'll still need to check the new amplifiers

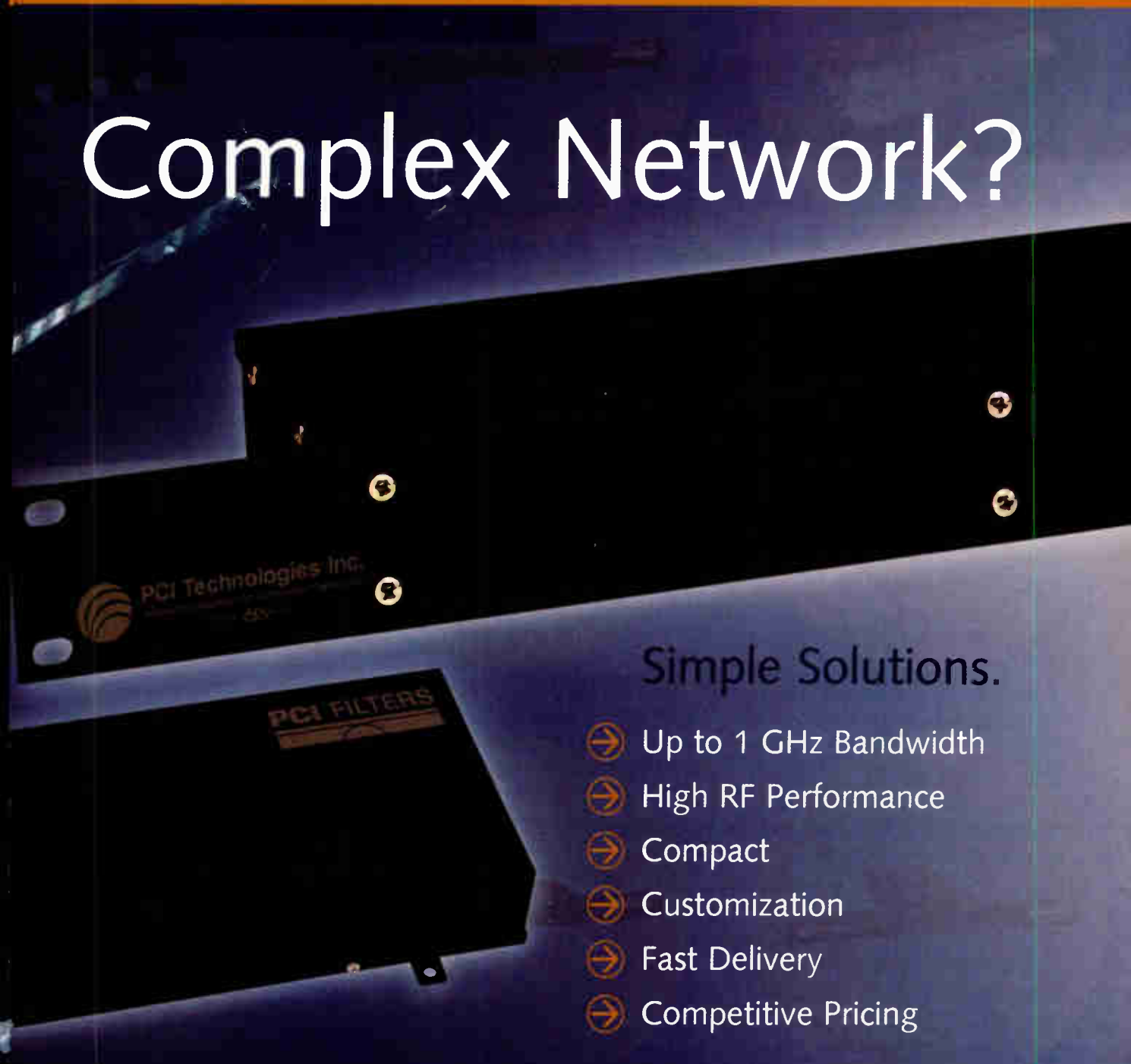
BOTTOMLINE

> Handling Extensions

As operators complete plant upgrades, they will see a greater need to incorporate plant extensions into their existing design. Follow these guidelines:

- Be familiar with and follow the original plant specifications.
- A clearly defined tie-point is necessary.
- Check against overloading the existing power supply.
- The operator should give sufficient lead-time to get the extension designed properly.
- The design house should provide a quick turnaround and be able to handle emergency projects.
- Make sure the master set of system maps is updated.
- Document all changes or additions to the fiber plant.

Complex Network?



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against low operating voltages.

Ideally, if the same company that engineered the plant designs the extensions, that company should already have a complete set of maps for the system and be familiar with the design architecture.

Give the design house enough time to complete the mapping and design. Conversely, the design house must be prepared to respond quickly to situations that require a quick turnaround.

An example of quick response is when an operator has access to an open trench, but only for a short time. Designs such as these may immediately be hand-sketched and faxed out to the site for cable installation, and the final maps completed and delivered later for splicing and activation. Extensions should always be drafted onto the master set of system maps, and not on separate maps of their own. A bill of materials for all hardware needed to build the extension also should be provided.

Other considerations

The design frequency of the extension needs to match the design frequency of the plant. However, in a situation where the plant is about to undergo an upgrade/rebuild, the engineering team could design the extension with the specifications and equipment planned for the new plant.

This new extension may have to be temporarily tied into the existing plant, and may have diminished EOL performance until a fiber node is placed there. Technicians should perform noise and distortion analysis to see if these reduced levels are acceptable.

A common thing

As more and more cable systems complete their bandwidth upgrades and roll out new services, most design work on their plants incorporates new extensions. The operator should provide enough information for the engineering company to design the extension, and also try to give enough forewarning to get the extension properly mapped and designed within a reasonable timeframe.

The designer needs to be familiar with all plant specifications and make every effort to return extensions in a timely manner, as well as be prepared to deal with emergency designs that sometimes require an extremely quick turnaround time. Most importantly, operators should document any part of the plant that is affected or altered by the extension into the master set of system prints. All fiber documentation should be updated, as well. CT

Jim Chartre is manager of system design at Cable Constructors, Inc., and sits on the SCTE Badger State Chapter Board of Directors. He may be reached at chartrej@cableconstructors.com.

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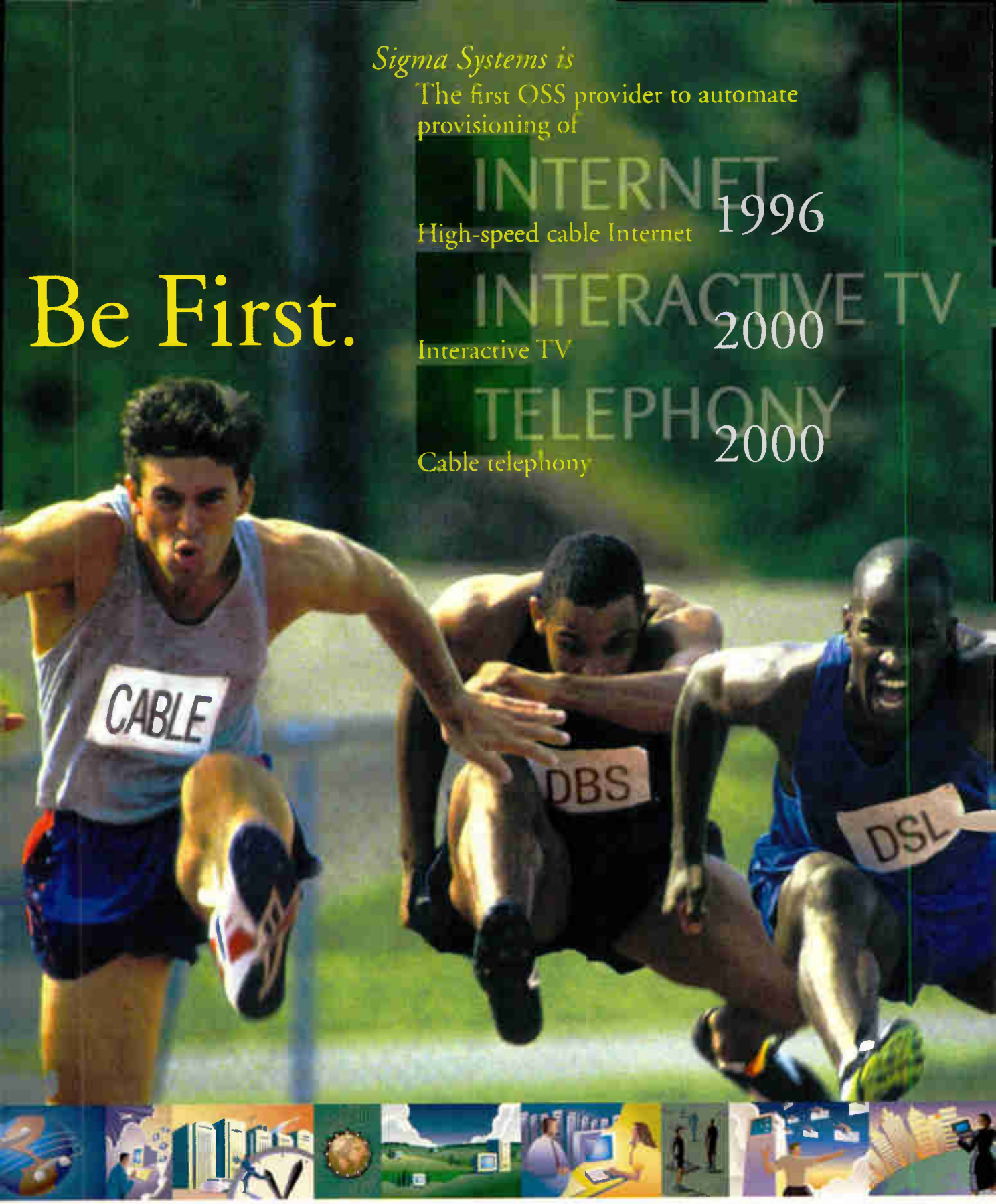

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Time to Get AGGRESSIVE

NCTA Attendees Urged Toward New Services Now

By Jonathan Tombes, *CT* Senior Editor, and Laura Hamilton, *CT*'s Reading Editor

"Sticky" and revenue-enhancing applications generate the most attention amidst some worries at this year's NCTA show.

With attendance down and the economy slowing, talk at this year's **National Cable & Telecommunications Association (NCTA)** Cable 2001 Convention in Chicago turned almost combative.

"During downturns, that's the time to move ahead aggressively," Richard Green, **CableLabs** president and CEO, said during the opening general session. "This is the time to be aggressive, especially technically."

From breakfast meetings to technical sessions to floor demos, Cable 2001 gave evidence that the industry's technical community is on the same wavelength as Green, pushing itself to create, deliver and sustain the right mix of advanced services.

Interactive slowdown?

News of **AT&T Broadband's** decision to slow down its deployment of **Motorola** DCT 5000 advanced set-tops broke shortly before the show. Sure enough, it created a buzz, raising questions about the direction of interactive TV (ITV).

Motorola's own message was bullish. While introducing three new 5000-class set-tops and a digital convergence platform (DCP) line of consumer terminals, the company underscored its commanding position in the current installed base with the announcement that it had shipped its 15 millionth digital set-top.

Today's operators are making a careful study of what services they want to offer tomorrow, Dave Robinson, Motorola BCS president, said. As they decide, they'll buy both thick and thin boxes, he predicted.

Leveraging the installed base seems to be today's strategy. "Right now, the (DCT) 5000 is not economic," Kim Kelly, executive vice president, chief operating officer, and chief financial officer for **Insight Communications**, said. "The (DCT) 2000 is a workhorse, and customer satisfaction has soared," she said.

Stock in the DCT 2000 class is rising in part because developers have turned it into an outlet for their interactive apps. **Liberate Technologies**, for instance, deployed with Insight in Kentucky and Ohio, using **Source Media's** local content and video-on-demand (VOD) from **Diva**. Liberate also showed its pre-integrated solutions with VOD providers **nCUBE, Concurrent** and **SeaChange**.

From the start, **WorldGate** had aimed its ITV services at the installed base. At the NCTA show, it announced Tacoma, Wash., as its next deployment with AT&T. Using the DCT 2000, WorldGate will enable AT&T's digital subs to interact with programs and ads, send e-mail and make purchases. The service includes other features, such as current information from **The Weather Channel**, a digital photo app from **NDS Group** and **PictureVision,** and local theatre listings from **Zap2it Movies.**

So when will AT&T deploy high-end boxes? >

(left) Attending the NCTA Chairman's Reception (left to right):John Hildebrand, vice president, multimedia technology, Cox Communications; Karen Lennon, CEO, Beyond 7 Interactive Media; Dick Green, chairman, CableLabs; and David Fellows, principal, Pilot House Ventures.
(below) CNBC anchor Sue Herera moderates a panel with (left to right) Brian Roberts, president, Comcast; Jerry Kent, president and CEO, Charter; Mel Karmazin, president and COO, Viacom; and C. Michael Armstrong, chairman and CEO, AT&T.
(far below) U.S. House Speaker Dennis Hastert and Convention Chairman Jerry Kent open the Cable 2001 exhibit floor.

"Go talk to customers," Dan Somers, CEO of AT&T Broadband, said. Having already done so, he said VOD and personal video recorder (PVR) functionality are in demand.

Make it sticky

Somers denied that the loss, or churn, of digital subscribers posed a severe threat to AT&T's cable operations. "If you look at our digital churn and our basic churn, there's not a whole lot of difference."

But including VOD and PVR functionality in one package, as his customers recommend, is clearly one way to make digital service more "sticky" (a term adopted from the dot.com world that connotes customer retention).

The "sticky" app is, accordingly, a territory that many vendors are seeking simultaneously to occupy.

PVR technology, for example, is positioning itself to support VOD deployments. Tim Elliot, senior director for systems architecture for **Keen Personal Media**, delivered a paper arguing that a hybrid system consisting of set-tops with integrated PVR storage may optimize the capability of a headend VOD solution. The trick here is to download the first 15 minutes of every premium access program into the local drive in the set-top.

VOD provider nCUBE, on the other hand, demonstrated a full-blown headend-based approach, which enables operators to store a week's programming for up to 200 digital channels on nCUBE's n4 servers, giving the subscriber full VCR-like functionality.

Whichever way VOD scales, **AT&T Broadband Labs'** Mark Cronshaw argued against using the telephony-based Erlang-B traffic model, because it is likely to overestimate blocking probability. Instead, calibrate according to actual, time-varying VOD session traffic, he said.

S-A's new weapon

"Immediate access to information"—that's what subscribers told systems provider **Scientific-Atlanta** they wanted from their cable operators. As a result, S-A launched InView, an ITV information app offering flexible news, information and entertainment aboard the Explorer set-top platform. **ScreamingMedia** is the first announced provider of customized content for this service.

On other fronts, S-A announced that **Comcast** had picked it to help the operator meet its goal of providing VOD access in a phased rollout to as many as two million homes.

The secret weapon to S-A's ITV strategy is arguably **PowerTV**, its homegrown middleware division. In another technical paper, PowerTV CTO Dr. Ken Morse reviewed the engineering challenges "from inception to delivery" of a software platform targeted for the Explorer 2000 class and above.

What drives success? "Memory management cannot be stressed enough," Morse said. Another prerequisite is an "optimized, integrated software stack."

More stickiness

Many ITV developers have already included communications services, such as e-mail, in their services. New players are expanding on that theme.

Comverse unveiled its iTVGate as a way to provide unified messaging over TV, short message service, instant messaging, Web-originated info services and even ITV telephony services.

Similarly, the Messaging Channel from **Integra5** is a software and hardware solution that leverages an operator's digital tier and works with all voice devices, essentially eliminating the need for a keyboard.

Music is another potentially strong app. Following in the wake of middleware vendor **CanalPlus**, Diva announced it would carry **Universal Music Group's** "The Viewing Lounge" to allow subs to create custom blocks of music video programming.

Wherever music leads, operators may want to revisit the recommendations of Jeffrey Riedmiller, an engineer with **Dolby Laboratories**, whose paper

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addressed the need to minimize discrepancies in audio levels between analog and digitally tiered programming. "A 10 dB difference is definitely going to generate a phone call," he said.

Add home networking to the sticky list. It's another way for operators to differentiate themselves and compete on more than price, Don Apruzzese, director of business development for semiconductor technology provider **ShareWave**, said. But he warned: "Your competition is looking at it, and in some cases they are ahead of you."

Demographics, please

While consumers decide what sticks, operators are looking to maximize the value of both their high-end subs and the plant that serves them. One company that aims to help is **Navic Networks**, whose Set-top Data Services (SDS) promises to wrest more efficiency from these boxes.

Using a tiny client on the box and a centralized database manager, SDS improves existing data transfer capabilities, Terri Swartz, vice president of marketing for Navic Networks, said. To what end? Applications include set-top monitoring and management, audience measurement, addressable advertising and digital downloads.

Another start-up seeking to tap the attractively self-selected demographics of digital cable subs is **everstream**, which announced its third-generation S3 Ad Engine that gives advertisers the ability to target commercials to preferences of individuals or specific groups.

Beefing up its own targeted ad portfolio, interactive software and infrastructure player **OpenTV** partnered with **Predictive Networks**, a creator of anonymous behavioral models of user preferences and affinities, to enhance the OpenTV service platform suite.

Insert programming, here

A case study delivered at a breakfast sponsored by SeaChange and **Cisco Systems** provided a tutorial on transport streams insertion (TSI), also known as digital program insertion.

Triggered by digital penetration rates and new standards governing both cue tones and server/splicer communication, TSI is poised to expand exponentially the number of unique placement opportunities for advertisers, James Kelso, SeaChange vice president, explained.

The technical challenge is managing statistical multiplexes so that the ongoing sharing of bits among channels never reaches the crashing point.

In other ad insertion news, **Terayon** announced a marketing alliance with **RespondTV** that will combine its CherryPicker digital management system with RespondTV's interactive content and transaction processing capabilities. Terayon also unveiled an enhanced graphical user interface (GUI) for its CherryPicker software management system. >

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Programmers and vendors vie for attention on Cable 2001's exhibit floor.

While the regulatory and business challenges of open access are confusing, the largest multiple system operators (MSOs) have now completed initial trials, with vendors now offering to help them open their plants to multiple Internet service providers (ISPs).

Terayon, for instance, announced that it has added support for multiprotocol label switching (MPLS) to its BE 2000 broadband access system. MPLS is an Internet protocol (IP) technology that has gained currency as a way to facilitate open access.

ADC also demonstrated its approach to this problem, using its Cuda 12000 IP Access Platform and Protocol Analyzer and related family of software.

A panel sponsored by **Sigma Systems** addressed the challenges of open access, a topic muddied by ambiguous answers to such basic questions as, "Who owns the customer?"

Sigma CTO Tim Spencer said such ambiguity makes it difficult to tell where technical trials end and the market trial begins. Veenod Kurup, director of data operations support systems for **Cox Communications**, which has deployed components of Sigma's Cable in a Box, said that open access's technical assumptions are based on how complicated the market is. "You can make it as complicated as you want," he said.

Where else is cable's high-speed data service headed? Amplifying the message of cable modem termination system (CMTS) vendors is software provider **Ellacoya Networks**. Its goal is to help operators "de-commoditize"

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Noise (dB)	4.5	3.5
CSO (dBc)	-72	-69
CTB (dBc)	-70	-66
Package	Surface Mt.	Surface Mt.

ARA Series Reverse Amplifiers			
P/N	ARA05050	ARA1400	ARA2001
Gain (dB)	32	32	29.5
Noise (dB)	1.7	1.7	3
2nd Har (dBc)	-60	-57	-75
3rd Har (dBc)	-63	-64	-60
Package	Surface Mt.	Surface Mt.	Surface Mt.

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the basic Internet and roll out more profitable services instead.

A founding member of CableLabs' **Cable B2B Consortium**, the initiative developing cable data service standards, Ellacoya is busy developing alliances. The company highlighted the integration of its Premium Services Delivery System with **Portal Software's** Infranet customer management and billing platform. It also announced an alliance with **RapidStream**, a virtual private networking (VPN) and firewall appliance developer.

Improving return path

The more data headed into the cable plant, the more will be headed back out again. Thus, another reason for improving the return path.

Digital return stands out as a "rule changer," contends S-A's Robert Collmus, who argued that the technology increases bandwidth, improves performance and lowers mean-time-to-repair (MTTR).

Bolstering his claim was an example of S-A's baseband digital return (bdr) solution that lowered transmitter counts and fiber by 50 percent each and altogether eliminated optical amplifiers.

Another approach to return path came from Ofir Shalvi, manager of advanced technologies for **Texas Instruments Broadband Communications Group**. Shalvi presented information on a new generation of cable modem and cable modem termination systems (CMTSs) that use an upstream technology, HI PHY Lite, an advanced time division multiple access (TDMA) scheme.

HI PHY Lite increases the upstream capacity and improves robustness to common channel impairments, while maintaining full Data Over Cable Service Interface Specification (DOCSIS) backward compatibility, he said. The object is to benefit advanced apps, such as videoconferencing and telephony.

(left to right) On the floor: Mike Willner, president, Insight; John Egan, chairman, Antec; and Dave Andersen, vice president, communications, Charter.

What keeps you up?

Telephony, fiber optics, Internet protocol (IP) transport platforms—those are only a few of the topics not covered in this wrap-up. Telephony is possibly the greatest omission, because of the notable if under-reported achievements of existing circuit-switched technology. Somers touted AT&T Broadband's acceleration from zero to 500,000 customers in one year. The total today is about 700,000, he said.

Insight's President Michael Willner said his collaboration with AT&T has played well on Main Street. "Marketing (Insight's) telephony with the AT&T brand name is a big positive."

Tapped as new chairman of the NCTA, Willner was arguably a star of the show, as was his colleague Kim Kelly, who won a Vanguard Award for distinguished leadership. So what keeps Insight's leader up at night?

"Navigating the delicate balance between short-term results and long-term strategy," Willner said. CT

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Electrons and Electricity, Part 6

This month's installment continues a series on electrons and electricity. The material is adapted from a lesson in NCTI's Installer Technician Course. © NCTI

The electrical force that causes the directed flow of electrons is called electromotive force (emf). Two other terms used to refer to emf are potential difference and voltage.

Electromotive force is a common term for the electrical force that motivates electrons to move in a conductor such as a wire. According to Coulomb's law, like charges repel and unlike charges attract. In a battery, the negative end pushes electrons into the wire, while the positive end attracts electrons into the battery (see Figure 1). This push-and-pull action creates the movement of electrons in the wire that is called directed current flow. The electrical pressure that causes the electrons to move is emf.

Potential difference is the algebraic difference between the individual electrical potentials of two points. The word potential refers to the amount of charge of a point with respect to a reference point (usually ground). The coulomb is the unit used to indicate the amount of charge at a point. A point that gains or loses 6.28×10^{18} electrons will have either a negative or positive charge of 1 coulomb, respectively. Note that the amount of 1 coulomb passing a given point in 1 second equals 1 ampere.

Because electrons repel each other due to their similar charges, they tend to move from a place where there are many electrons to a place where there are few electrons. The negative terminal of a battery has an excess of electrons, while the positive terminal has a deficiency. This potential difference of electron quantities results in an emf that causes directed current flow.

But what about two charges that are both negative or both positive? Will there be current flow, and if so, in which direction will it go? Notice that in Figure 2 the positive terminal of the battery is closest to the left end of the carbon rod, and the negative terminal is closest to the right end.

Notice that the greatest difference of potential is between the ends of the carbon rod. By placing numerical values on the amount of charge at various points on the rod, you can see that the largest charges are on the ends, with the middle sections having the smallest charges. The difference between the ends would measure 10 points. As stated previously, electrons always move from negative to positive. Here you can see that electron movement is from the most negative to the least negative, and from the least positive to the most positive areas.

The difference between -3 and -5 is 2, which is enough to result in electron movement. The same is true for +3 and +5. Notice that electrons always move in the same direction, whether they are moving from a negative point to a positive point, from a less positive point to a more positive point, or even from a more negative point to a less negative point. Of course, if two charges are equal, no electron movement will occur. This is because no difference of potential exists between them, and thus no electromotive force exists to cause the electrons to move. CT

FIGURE 1 ELECTROMOTIVE FORCE

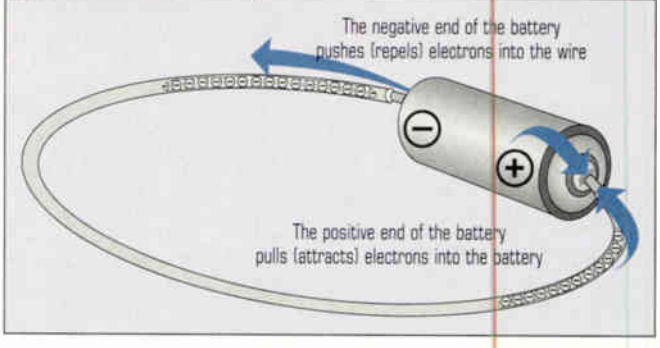
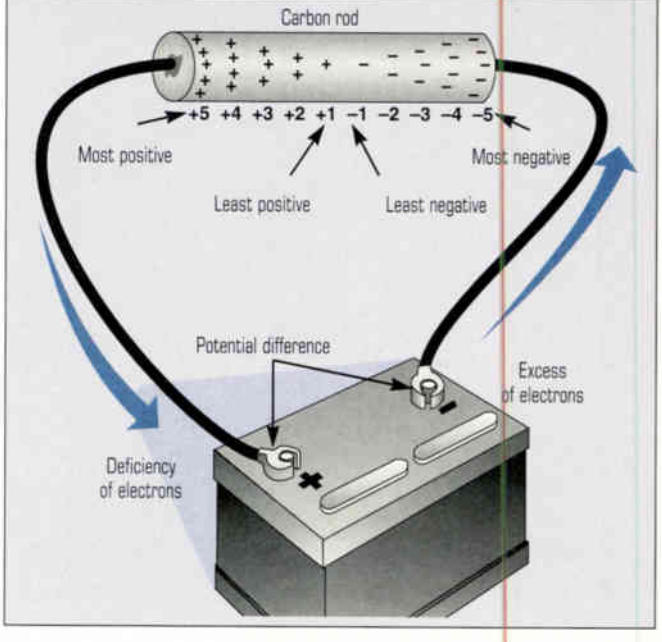


FIGURE 2 POTENTIAL DIFFERENCE



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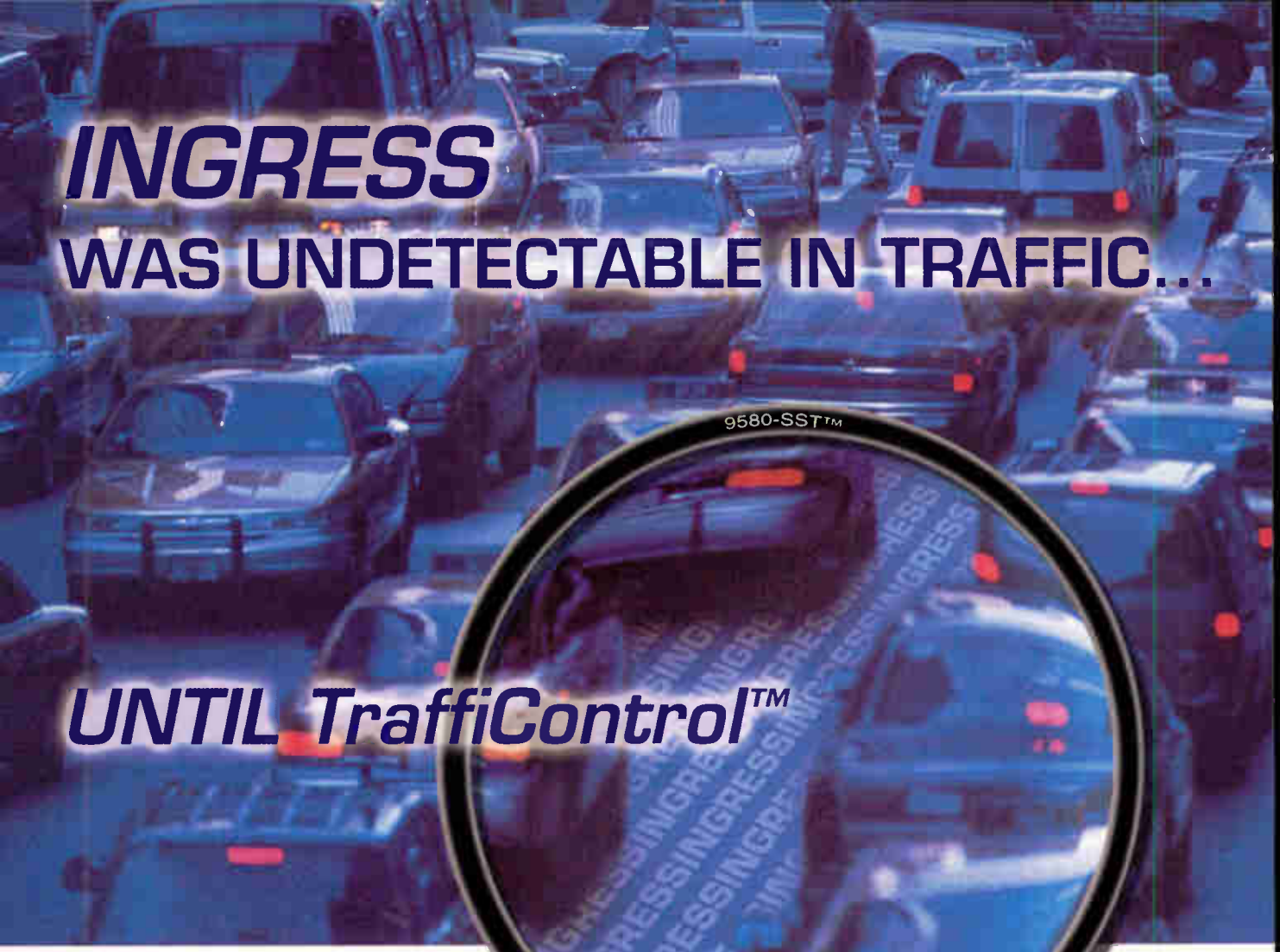

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MARKETPLACE

Editor's Note: *All the products in this month's Marketplace section were finalists in the 2001 Readers' Choice Awards.*

DISTRIBUTED CMTS

Motorola's distributed broadband module (DBM) 2000 moves the cable modem termination system (CMTS) out of the headend towards the node. The simple network management protocol (SNMP)-capable module fits into the SG2 Optical Node and can provide either copper or fiber to the customer. The DBM 2000 is especially relevant for areas without a fully loaded headend or for systems aiming to increase downstream bandwidth to individual subscribers. For more information, contact the company at (800) 523-6678, or visit www.motorola.com/broadband.

OPEN ACCESS SOLUTION

RiverDelta Networks' hardware-based, distributed policy-based routing and multi-protocol label switching (MPLS) per-flow control enables scalable open access supporting multiple Internet service providers (ISPs), subscribers and services over a broadband network. The product works in conjunction with RiverDelta's BSR 64000 router/cable modem termination system (CMTS), which examines fields within packets at wireline speeds to determine appropriate routing and quality of service (QoS). For more information, contact the company at (978) 858-2300, or visit www.riverdelta.com.

OPTICAL SERVICES MANAGER

Motorola's Optical Services Manager (OSM) 4800 is an integrated, synchronous optical network/synchronous digital hierarchy (SONET/SDH)-based, dense wavelength division multiplexing (DWDM)-enabled multi-service platform optimized for data transport. It supports voice, data and video services, while bringing bandwidth-efficient statistical multiplexing to SONET's physical layer. For more information, contact the company at (800) 523-6678, or visit www.motorola.com/broadband.

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CABLE VOICE ADAPTER

The **Cisco Systems** CVA122 Cable Voice Adapter features two voice ports, one Ethernet port and one universal serial bus (USB) port. The CVA122 supports a variety of call signaling protocols and an Internet protocol (IP) routing mode that supports routing information protocol (RIP) and network address translation for added security and network address preservation. The device is CableLabs-certified to DOCSIS 1.0 and is DOCSIS 1.1-ready. For more information, contact the company at (408) 526-4000, or visit www.cisco.com/go/cable.

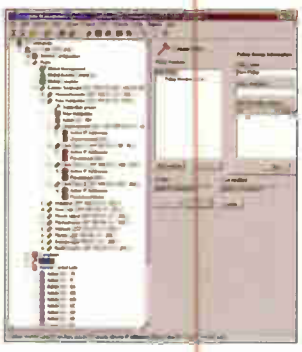
ENHANCED SECURITY CABLE MODEM

The PipeRider HM204c enhanced security cable modem from **Ericsson** adds security to the users' home Internet devices, as well as the opportunity for service providers to deliver value-added services, such as family filters and security policy upgrades. Ericsson has integrated SofaWare's Safe@Home consumer firewall security software into this CableLabs' certified modem. For additional information, visit www.ericsson.com/cablemodems.

Communications Technology's Readers' Choice Awards 2001 finalists

NETWORK MANAGEMENT SOFTWARE

Incognito Software's IP Commander 3.2 delivers multi-platform dynamic host configuration protocol (DHCP) management software for high-speed network administration and auto-configuration of modems.



Sophisticated rules and policy-based tools enable IP Commander to maintain data integrity while deploying Internet protocol (IP) service, while its proactive diagnostic tools continuously monitor a network's health. All IP and domain name server (DNS) services are managed from one graphical interface. For more information, contact the company at (800) 877-1856, or visit www.incognito.com.

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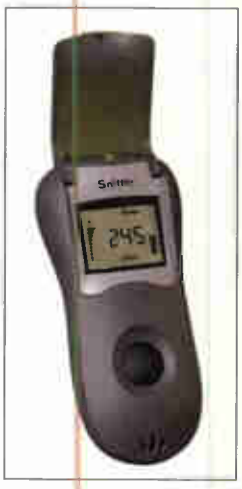

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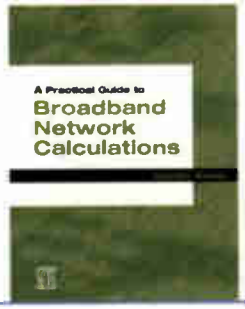

Instruct technicians in the fundamentals of cable math and network powering.

A Logical Approach to
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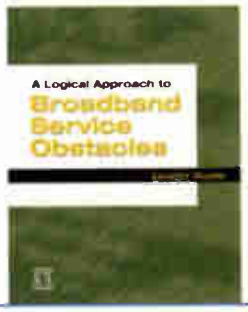

Teach your team the five basic steps for broadband troubleshooting.

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Walk your workforce through everything from customer relations to product knowledge and job accountability.

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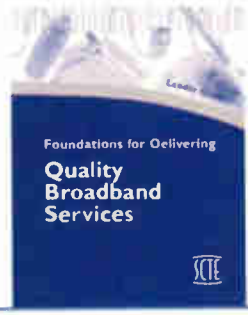

Train your field service technicians on testing, troubleshooting and conceptual knowledge.

Call 800-542-5040 or visit www.scte.org To Order

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WIRELESS CABLE ACCESS

The DL-5800 Wireless Cable Access Radio from **Wireless Bypass** is a last-mile solution for high-speed Internet connections using cable infrastructure. It provides operators the ability to offer wireless high-speed Internet services from any point in the cable network, in point-to-point, or point-to-multipoint configurations. The solution leverages the unlicensed U-NII band, making permanent and temporary installations attractive from both a cost and deployment standpoint. For more information, contact the company at Phone (603) 870-6275, or visit www.wireless-bypass.com.

DESIGN MAP TOOL

AM Communications' MapVault is a Web-based storage system that allows distributed secure access to network design maps across an Intranet, a virtual private network (VPN), or the Internet. MapVault's auto-extraction engines "crawl" the design maps, extracting equipment inventory, homes passed, miles, and detailed topology. The topology interface identifies active and passive elements between home and headend and aids advanced root-cause analysis or event correlation. For more information, contact the company at (800) 248-9004, or visit www.amcomm.com.

RATE SENSING TRANSPONDER

The **Synchronous** ChromaSpan Transponder can improve the efficiency of metropolitan dense wavelength division multiplexing (DWDM) systems, or enhance the performance of non-DWDM legacy equipment by converting optical signals between 1200 and 1600 nm to ITU wavelength signals. The unit offers an automatic rate sensing capability with clock and data recovery at 155 Mbps, 622 Mbps, 1.25 Gbps and 2.5 Gbps, or at corresponding OC rates. The transponder is available at 100 GHz spacing and on the 50 GHz grid with wavelength locking. For more information, call (800) 659-6750, or visit www.syngroup.com.

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Women in Cable & Telecommunications

Communications Technology

2001 WOMEN IN TECHNOLOGY AWARD NOMINATION FORM

The annual **Women in Technology Award** recognizes and honors leading women in technology positions within the cable and telecommunications community and creates visibility for all women in technical careers. Each year it identifies and acknowledges the achievements of one woman who has demonstrated outstanding personal and professional growth and has contributed significantly to the industry.

To Be Eligible:

- Open to all women in a technical field of cable television, broadband and telecommunications.
- Current national SCTE member and current national WICT member.

Factors of Consideration:

- Demonstrates meaningful contribution to the industry.
- Exhibits high level of knowledge, skills, and professionalism.
- Committed to community and/or professional activities that enhance the perception of the cable and telecommunications industry in general, and women in technology specifically.
- Exhibits commitment to professional development and continuing education.
- Attends SCTE and WICT conferences.

Past Recipients:

2000	Margaret Gaillard AT&T Broadband
1999	Sally Kinsman Motorola
1998	Sheri Sharp Cox Communications
1997	Yvette Gordon Sea Change International, Inc.
1996	Pam Nobles Comcast
1995	Pam Arment Pamela J. Arment Consulting

To nominate someone online, please visit http://www.wict.org/wit or complete the following information:

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Telephone: _____

E-mail: _____

PLEASE ATTACH A DETAILED EXPLANATION OF WHY YOU ARE NOMINATING THIS PERSON. (MINIMUM OF 250 WORDS)

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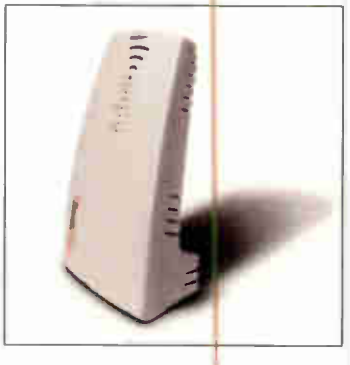
DVB-ASI TRANSPORT SYSTEM

The **Synchronous** Digital Video Broadcast Asynchronous Serial Interface (DVB-ASI) Transport System provides optical transmission of video-on-demand (VOD) signals. The system digitally multiplexes four 270 Mbps DVB-ASI signals into a high-speed data stream using an ITU wavelength laser for transmission over dense wavelength division multiplexing (DWDM) networks. The DVB-ASI data streams can be optically multiplexed up to 32 wavelengths, for a total capacity of 128 DVB-ASI streams over a single fiber. For more information, contact the company at (800) 659-6750, or visit www.syngroup.com.

WIRELESS LAN ROUTER



Colubris Networks' CN100 Wireless local area network (LAN) router uses wireless technology to interconnect computers, and features a plug-and-play design and an intelligent configuration wizard that speeds provisioning. The CN100 provides 128-bit WEP encryption on all transmissions to eliminate eavesdropping and stop intruders. It also includes a comprehensive firewall to block unwanted Internet traffic.

The device also supports virtual private networking (VPN). For more information, contact Colubris Networks at (450) 680-1661, or visit www.ColubrisNetworks.com.

Sign up. Take off. Fly high.

Become a member of SCTE (for only $48!) and watch your career soar. As a member, you'll have access to important resources—education and training, certification programs, industry news, a network of technical peers, leadership opportunities, awards and scholarships—that will help you take your career to new heights.

You'll also join a community of more than 17,000 broadband engineers, managers, technicians and installers worldwide who rely on SCTE to navigate their way to professional success.

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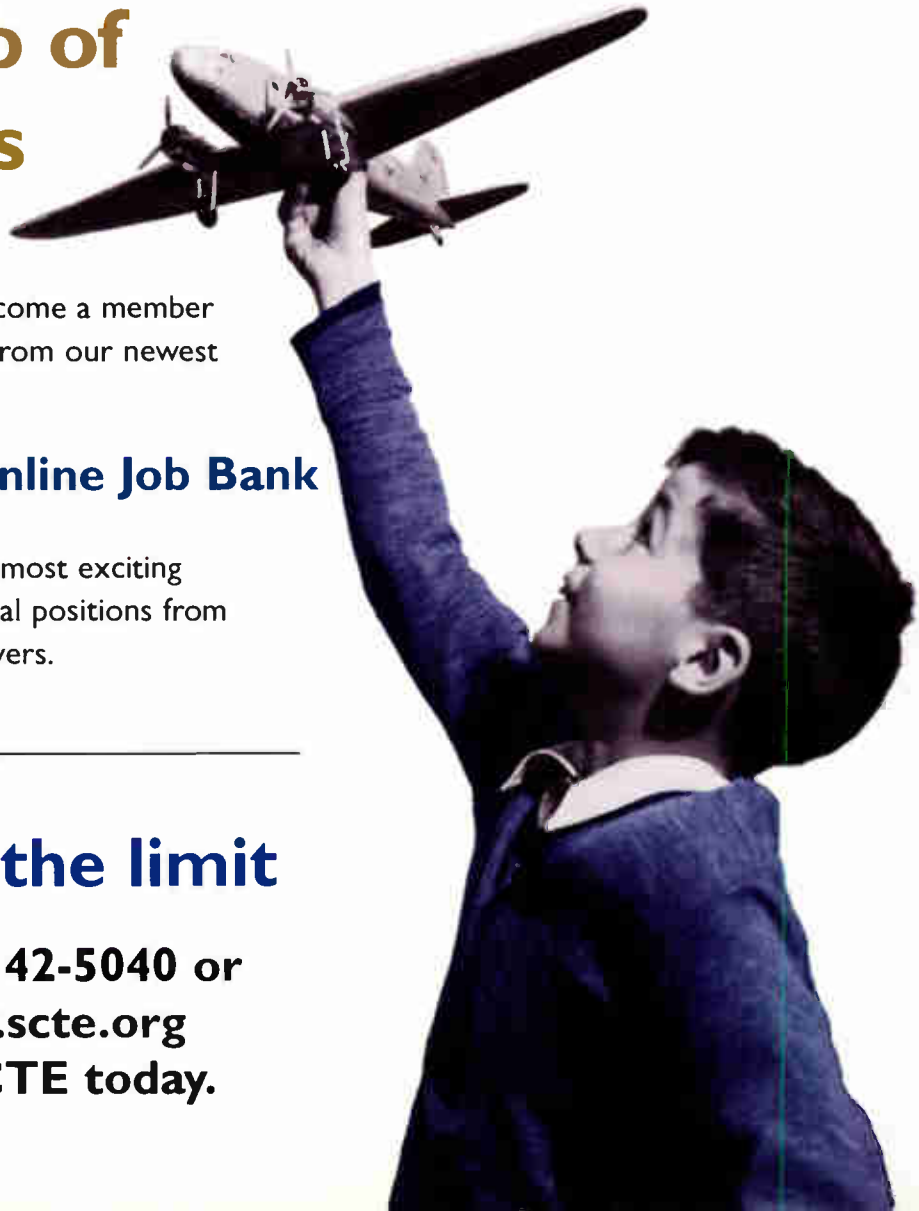

And now, when you become a member of SCTE, you'll benefit from our newest member resource—

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featuring the industry's most exciting engineering and technical positions from broadband's top employers.

The sky's the limit

Call 800-542-5040 or visit www.scte.org to join SCTE today.

Updated Seminars For New Applications

As your technical training resource, the SCTE strives to keep its seminars current. We continually update our seminars to provide you with both a focus on the latest technologies and a foundational base to see how new technologies fit into the big picture.

This fall, we'll debut three completely updated seminars that address the fastest changing areas in the industry.

Zeroing in on coax

The first seminar, which we're offering Sept. 11-13 in Seattle and Nov. 6-8 in Philadelphia, is "Coaxial Plant Design and Operation." It's tailored for advanced technicians and engineers who want to understand all of the issues involved in the coax portion of HFC networks and the technology being applied today.

We'll teach you the evolution and hardware configuration of the network, and what present architectures look like. Then we zero in on the coax portion, covering amplifier systems, powering and test and measurement. You'll learn the concepts behind plant design plus maintenance and operation fundamentals.

Digital springboard

The "Basics of Digital and High-Speed Data" course—to be offered Nov. 7-8 in Indianapolis, Ind., and Dec. 4-5 in Hartford, Conn.—is a seminar that examines each of the component pieces converging as input into the digital network. It also will demonstrate how they are assembled together so you understand, for example, how Data Over Cable Service Interface Specification (DOCSIS) cable modems work over this digital network, and what future networks are going to look like with voice, video and data all being offered over the same platform.

This seminar focuses on analyzing local and wide area digital networks and equipping you with the foundational knowledge you'll need to launch the new services that play over them. Some of the elements discussed are Ethernet, transmission control protocol/Internet protocol (TCP/IP) and the devices that operate at the physical layer. This course will not teach you to be a digital network engineer, but it will give you a good springboard from which to launch into any digital discussion. It's perfect for technicians who want to gain a solid understanding of all of the elements of the digital network and how those elements fit together.

Focus on fiber

Coming to Chicago Oct. 9-11, "Optical Fiber in the HFC Plant" is not an entry-level seminar. Rather, it's designed for fiber technicians and engineers who really want to focus on and learn more about what's going on now with optical architectures. This seminar does offer some introductory instruction on optical theory but only as a backdrop for understanding how new applications, like dense wavelength division multiplexing (DWDM), and current architectures, like star and ring, fit together. Fiber optics is a field that's seen tremendous change and growth over the last several years. This seminar covers the basics of optical fiber while also concentrating on the characteristics of modern architectures to show you how to use them appropriately.

Telephony and the return path

Earlier this year, we also introduced two new seminars. The "Return Path" course explains design, set-up, certification and troubleshooting for the reverse system. A series of telephony courses—"Fundamentals of Telephony," "HFC Telephony" and "IP Telephony"—detail call completion over the public switched telephone network (PSTN), hybrid fiber/coax (HFC) and managed IP networks. Both also are offered throughout the fall, with the telephony series (you may attend any combination in the series) hitting Washington, D.C. on Sept. 11-13, Boston on Sept. 18-20, Dallas on Nov. 13-15, and Miami on Dec. 4-6. The return path seminars will be held Sept. 18-20 in St. Louis, Oct. 16-18 in Atlanta, and Dec. 11-13 in New York.

Giving you the knowledge you need to stay current is always our top priority. For more information about SCTE's seminars, call (800) 842-5040 or visit our Web site at www.scte.org. CT

Marv Nelson is vice president, technical programs for SCTE. He may be reached at mnelson@scte.org.

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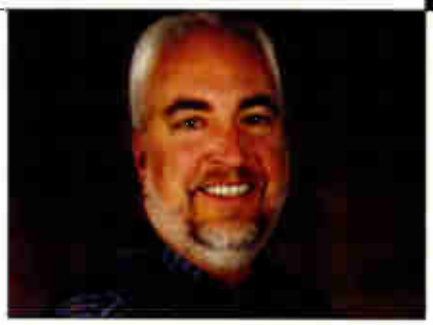


Broadband Knowledge Summit Unifies Training

Have you ever wondered what goes on in your company's other training departments? If you've ever thought, "What are those people thinking?" you know what I mean. If you really want to know, check out the Broadband Knowledge Summit.

The Broadband Knowledge Summit, a **Society of Cable Telecommunications Engineers (SCTE)** conference produced in cooperation with **NCTI**, is the first event of its type in our industry. It brings together broadband telecommunications experts from human resources, safety and training departments. The training area alone covers technical training, customer care and more.

"An organization's training goals are best achieved when all its training factions are aligned."

A primary goal of the summit is to bring individuals of diverse backgrounds and challenges together to help participants realize how training is integral to the success of their organizations. By understanding the challenges and opportunities in the varied disciplines, we hope to shape a more unified approach to training.

Through 20 years of experience with training in this industry, I have learned a few things that remain constant. For example, all the companies and people I have worked with have supported training. The goal always has been to develop better employees. The resources to achieve this goal varied significantly, but everyone believed in the value of training.

Another constant is that views differ about how to accomplish the goal. HR wants to pursue training from one angle, customer care trainers have a slightly different view, the technical trainers see the challenge through the eyes of the field technician, and the safety professionals want to make sure all employees are following and meeting the latest regulations.

Unfortunately, these differing views may make the converged training goals of the organization much more difficult to realize.

An organization's training goals are best achieved when all the training factions are aligned. The organization then reaps a tremendous return on the training investment. Employee performance increases, morale improves, bad politics disappear and the overall effectiveness of the organization positively impacts the bottom line.

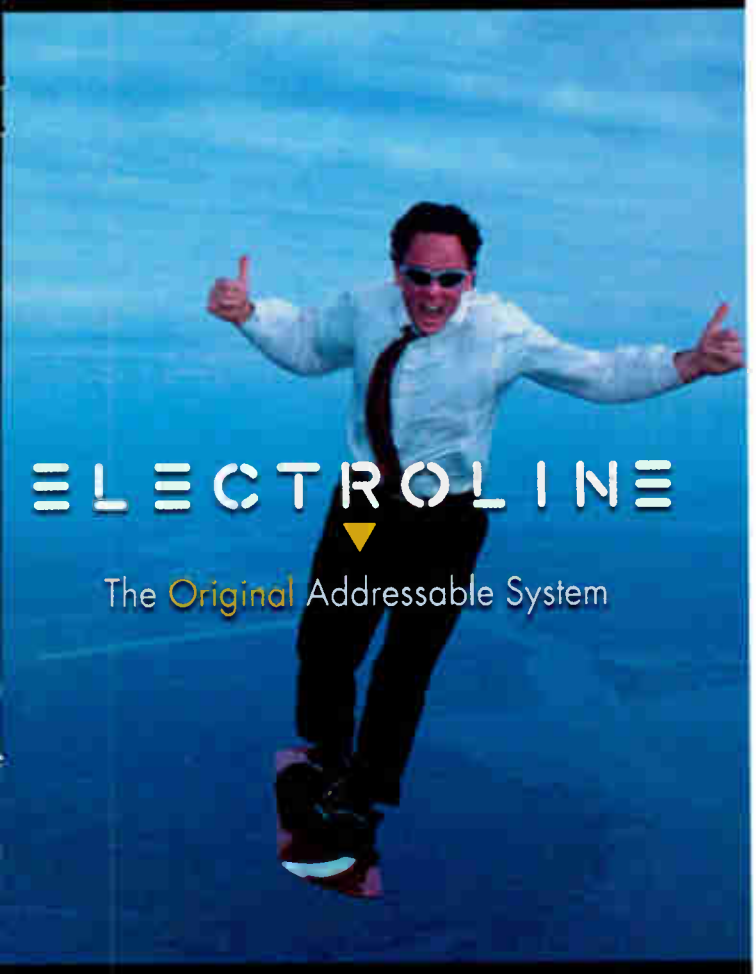
When HR, for example, understands the difficulty that technical trainers face—trying to remain knowledgeable about rapidly changing technology—perhaps skills training for trainers themselves won't be scheduled to coincide with an SCTE meeting or conference. When your technical trainers understand the challenges of solving customer problems over the phone, perhaps they will find ways to support the technical training of customer care professionals. Each of us learns from the other disciplines.

The conference is designed to provide ample time for individuals from different training-related areas to begin to see, understand and gain new appreciation for the challenges faced in other disciplines. General sessions include presentations that address common challenges. Breakout sessions are targeted at specific issues of interest to each discipline.

Finally, each attendee will develop an action plan for improving training strategies in his or her organization. The plan will include key strategies for assuring the HR, technical, customer care and safety disciplines in the company work together to positively affect the return on the training investment.

Come to the Broadband Knowledge Summit, to be held in Denver on August 6-8. It will help you condense 20 years of experience into just a few days. CT

For more information, contact Alan Babcock, NCTI vice president, learning and development, at (303) 797-9393 or alan@ncti.com; or Debbie Manoff, SCTE director of training, at (800) 542-5040 or dmanoff@scte.org.



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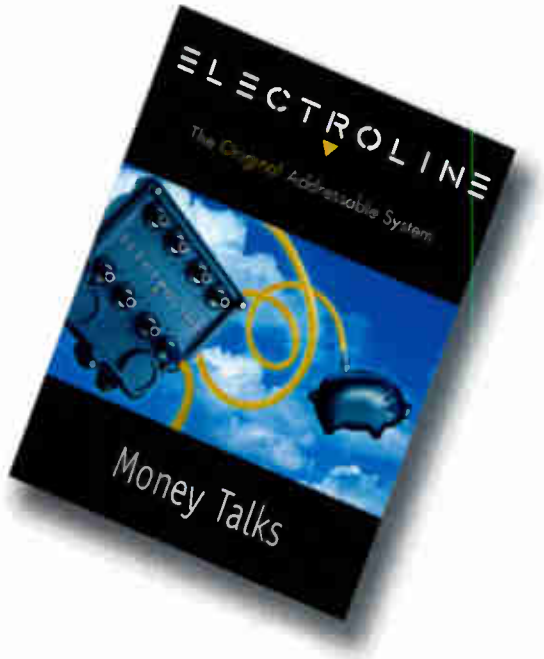

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