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MARCH 2000

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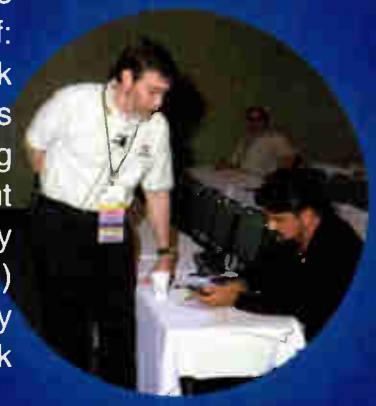

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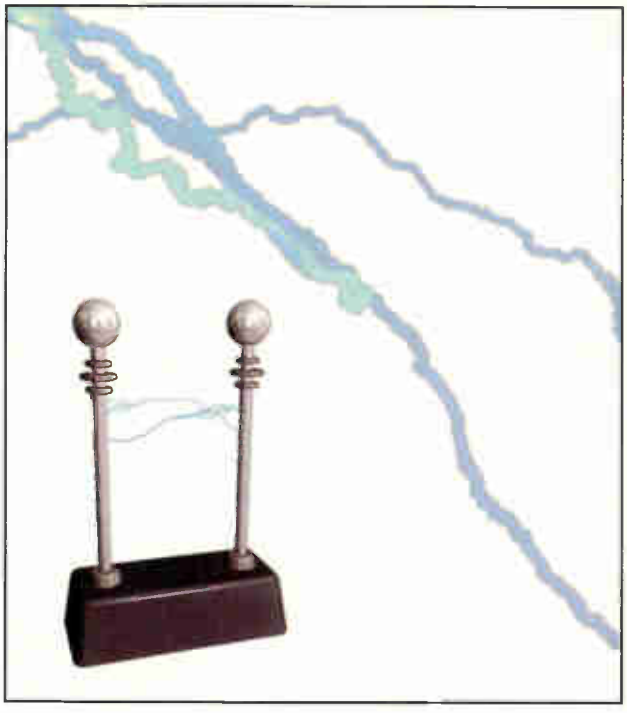

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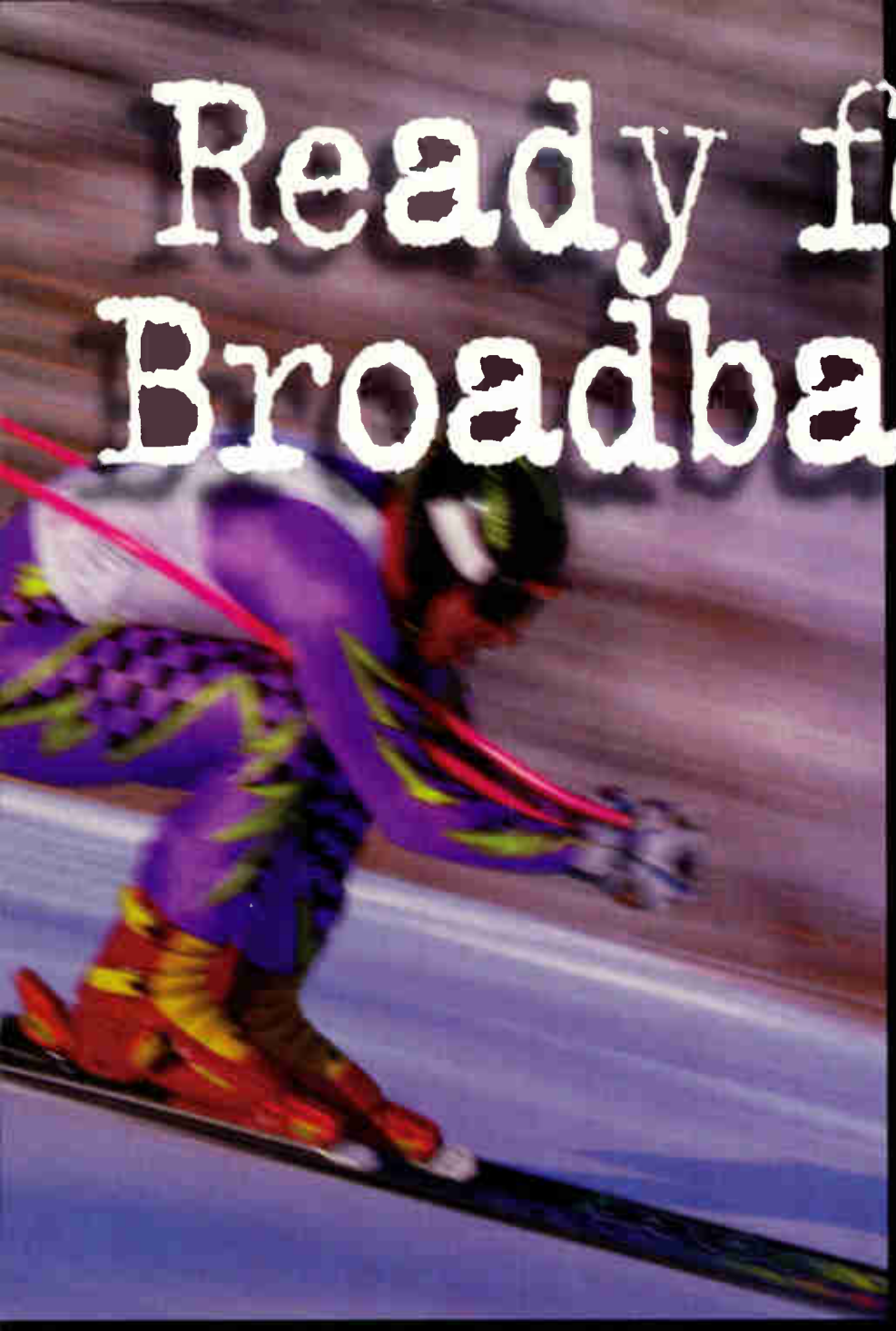

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By Rex Porter

Congratulations, Mike Smith

A highlight of the Society of Cable Telecommunications Engineers' Conference on Emerging Technologies 2000 was Mike Smith winning the prestigious Polaris Award. Though Mike won for his work with fiber optics in hybrid fiber/coax (HFC) networks, he could have been recognized for his accomplishments in many technical arenas.

I first met Mike when I was selling cable and fiber to Adelphia's system in Danville, Va. I was living in Connecticut, and we owned a manufacturing plant not far from Danville, in Chatham. I visited the plant and then would swing over to see Mike. I enjoyed the visits because he was both sociable and knowledgeable.

When I came to *Communications Technology*, I was delighted to discover Mike's involvement as our technical consultant. Because he cares about his peers and those climbing their career ladders, he helps ensure the editorial content of *CT* is technically correct. Mike also has submitted some of our best-read articles himself. He has served as a member of *CT*'s editorial advisory board since its inception.

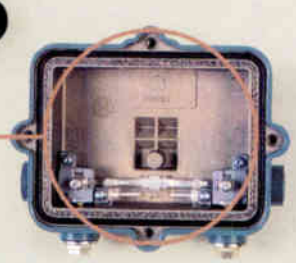
Adelphia has every reason to be proud of Mike. He displays all the attributes of a serious broadband engineer. An SCTE Senior Member, he's certified at the Engineer level of the Broadband Communications Technician/Engineer (BCT/E) program. In his 20 years with SCTE, he served as president of the Old Dominion SCTE Chapter, chaired the SCTE Engineering Committee, won the SCTE Outstanding Achievement Award in 1986, and presently serves on the Interface Practices Subcommittee. He also is a member of the Institute of Electrical and Electronics Engineers and serves on the National Cable Television Institute's Technical Review Committee.

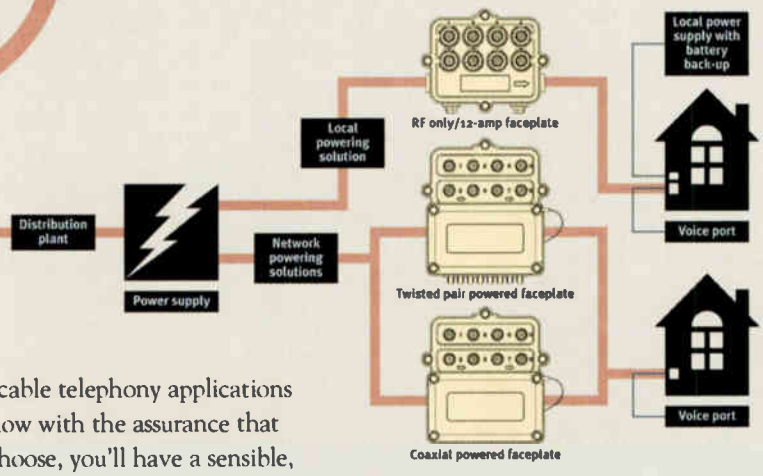
Like myself, Mike received his early electronics training in the U.S. Air Force and spent some time as a vendor to the cable TV community. He is an example for every technician and engineer to follow.

Mike is proof that regional and field engineers—not just chief technical officers—can achieve recognition for skill and dedication. And finally, congratulations to those who recognized Mike's contributions. We're pleased to see one of our own honored. As I always say, "*CT* personnel don't just write about technology—they work in it."

Rex Porter
Editor-in-Chief

3 faces 1 body 0 worries





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LETTERS TO THE EDITOR

Women in Tech Winner Thanks

Once again, I'd like to thank all of you for honoring me as the recipient of the 1999 Women in Technology Award. I have a much harder time receiving than giving recognition and praise, so I'm not sure how well I communicated my feelings at the awards ceremony. As the day progressed and I heard additional nice comments, I became more humbled and speechless. There are many stories I could have related. Here are a couple of them.

I remember back in the early 1980s attending the first Women in Cable meetings in Denver, where many talented women came together to form a wonderful organization. I could have thrown my energy into WIC, but felt that my talents could benefit a technical organization better. Women in Cable and Telecommunications, as it's now called, has grown into an excellent organization.

Instead, I put my energy into the Society of Cable Telecommunications Engineers. I had no idea when I was elected to the national board in 1983 that within months the board would have to choose between declaring bankruptcy or fighting to save SCTE. We had a very dedicated group on the board and worked as a great team. I will never forget those four years, or the friendships made.

About that time, Paul Levine approached the board about starting a technical magazine. He would give it to all SCTE members in return for being the official trade publication of SCTE. The board needed anything to gain and keep new members without cost to SCTE, so we gave him our blessing. Paul went from driving a classy Porsche to a rusty old Camaro—he'd bet the farm on his vision. Luckily for Paul, his fellow associates and SCTE, *CT* became a success.

Again, thank you for this great honor.

—*Sally L. Kinsman,*
General Instrument

Rich Cable History

Rex, I just read your article in the January issue of *Communications Technology* on SCTE Hall-of-Famer Austin "Shorty" Coryell. I found it very interesting and a bit nostalgic. I am currently tech ops manager for Susquehanna Communications in Williamsport, Pa. We have just retired one of our technicians after 30 years and have two others with more than 25 years of service. I am proud to say this system is rich in cable TV history and lays claim to a multitude of leaders such as John Roskowski Sr., Milton Shapp and Shorty.

—*Michael J. Berrier*

CableLabs Kudos

Jennifer, I just saw a copy of your December article on OpenCable and wanted to thank you for accurately representing and quoting us, as well as providing a good description of the status of the project.

—*Paul Zimmerman, CableLabs*

Write to Us

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Shaw to Deploy Liberate; Rogers to Test

By Jonathan Tombes, Deployment Editor

Shaw Communications has agreed to deploy Liberate Technology's interactive TV software platform. The question of who controls this space for e-mail, e-commerce applications, games, news and Web surfing is becoming less theoretical.

"Liberate appealed to us in terms of its look being close to a PC (personal computer), and in the way its software can coexist with others," said Peter Bissonnette, president of Shaw Cablesystems, Canada's second largest multiple system operator (MSO). Liberate is a proponent of universally accessible standards.

"That's one of our selling points because we have been absolutely religious about the use of open standards," said Charlie Tritschler, Liberate's vice president of marketing. "It makes it very easy to integrate our technology into the existing headend infrastructure."

Shaw will deploy the Liberate Connect server solution at its headend and the Liberate TV Navigator on its existing Motorola DCT-2000 and upcoming DCT-5000 set-tops. "The client piece goes into the set-top box itself," explained Tritschler. "And that can either be built in at the factory as part of their flashbuild, or it can be downloaded over the network."

"We want to get this to our customers immediately," said Bissonnette. He added that Liberate's acquisition of Virtual Modem technology from Source Media and Insight Communications boded well for quick deployment over Shaw's existing population of set-tops.

Martin Yan, host of Yan Can Cook, dishes up a plate as interactive ads summon viewers.

Also auspicious is Liberate's recent success abroad. "Since November, we have been deployed with Cable & Wireless in the UK, where they're using a Pace set-top box," said Tritschler. "They have about 46,000 of these out in the world and downloaded our software into those boxes."

Like several other MSOs, Shaw invested in Liberate last May, when the software firm renamed itself and prepared to go public. But Shaw also has invested in competitor OpenTV, whose platform Bissonnette still highly regards. "In terms of satellite, it may have more options," he said.

Canada's largest MSO, Rogers Communications, is another Liberate investor. Shortly after the Shaw announcement, news broke that Rogers had agreed to test the Liberate technology.

"We actually have not made a decision yet on deployment," said David Robinson, Rogers' vice president for financial planning and investor relations. "But we wanted to be able to evaluate their technologies, along with a series of others."

Last year Rogers signaled its interest in Microsoft's WebTV. (Microsoft has a 9-percent equity share in Rogers.) "We do not have an exclusive technology arrangement with Microsoft, although we're obviously favorably inclined toward them," said Robinson.

The world of interactive TV technology is a welter of overlapping partnerships, reciprocal investments and hedged bets. Business plans, however, require subscriptions. Shaw's decision helps push this game into the next phase.

Bottom Line on FreeDSL

By Jonathan Tombes, Deployment Editor

If digital subscriber line (DSL) service is a competitive threat, is free DSL service even more of one? While analysts are skeptical, any offering that boosts total DSL subs is worth watching.

A service of Broadband Digital Group, FreeDSL says it signed up 100,000 users in its first week of registration. It plans to activate its advertising-driven service on April 1. Is this an April Fool's prank? Or will it work?

"I am highly skeptical of the free idea," said Laurie Falconer, an analyst with the research firm TeleChoice, "not because we haven't seen free service work in the past, but because of the issues that the service providers who are selling the service are facing." As an example, she cited the time-delay issue regarding the coordination between competitive local exchange carriers (CLECs) and incumbent local exchange carriers (ILECs).

BDG reportedly will deploy a slower form of ADSL (asymmetric DSL) known as G.lite, which is designed to be splitterless, a feature necessary for end-user installations.

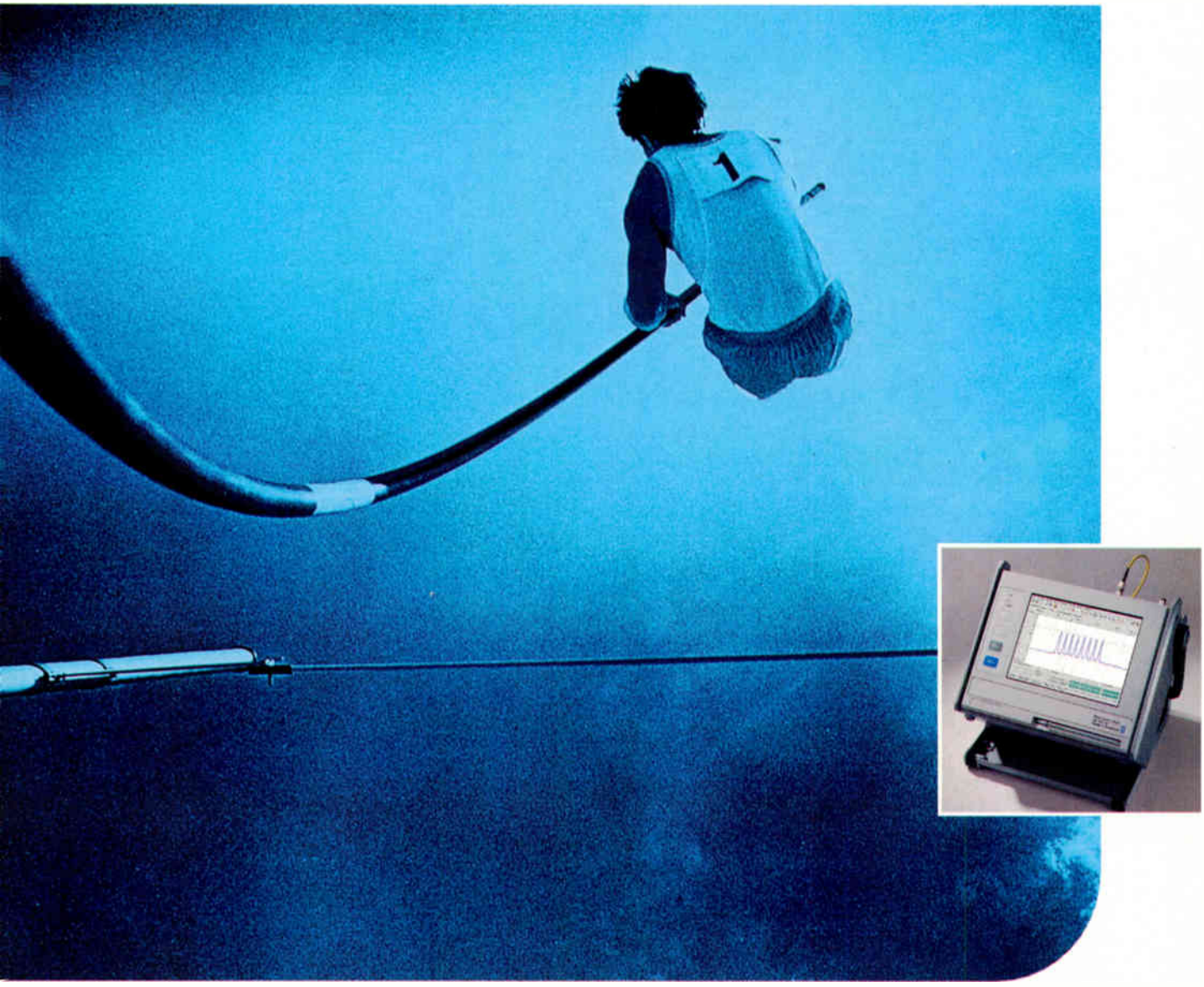
BDG plans to buy its service wholesale. Consumers typically pay between $40 and $60 per month, but US West recently began offering its MegaBit 256 (kbps) Select in some Western states for $19.95. "The DSL providers are probably working with them, but they will want to get paid," said Jeanette Noyse, an analyst with International Data Corp.

Will BDG be able to pay its bills? New media advertising is nothing new to company Chief Executive Officer Ryan Steelberg, whose two Internet advertising companies are now part of the CMGI network. He also helped found WinFire, whose browser assistant will carry targeted advertising to FreeDSL users.

A spokesman said additional revenue would come from value-added services and upgrades from the company's basic DSL service. "Revenue will be an aggregation of piece-parts," predicted IDC analyst Noyse.

FreeDSL subscribers are obliged to keep the WinFire browser open. They also must provide BDG with personal information. "BDG reserves the right," says the company in its privacy state-

Raising the bar



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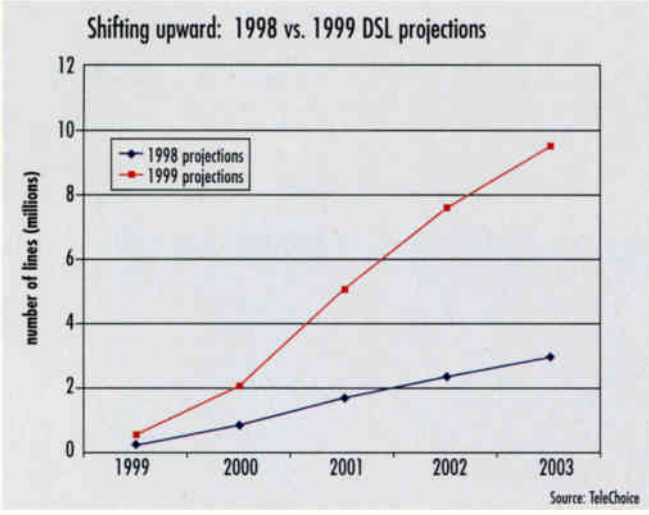


ment, "to disclose or disseminate any and all personal information gathered directly or indirectly from you or about you to third parties without your prior approval."

That may be too high a price for some. TeleChoice's Falconer anticipates some market segmentation between "the people that don't mind using a free service, (who) will put up with the barrage of ads so that they can get it for free, vs. the ones who maybe are using it for business purposes."

The bottom line is likely to be faster DSL growth. "The numbers change very fast," said Justin Beech, editor of dslreports.com. "Some ISPs (Internet service providers) are predicting more new lines just by themselves for the balance of this year than Covad has installed to date."

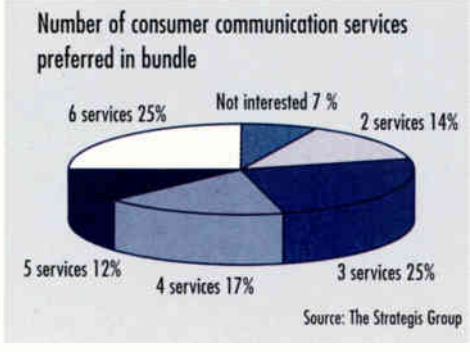
TeleChoice recently adjusted its own DSL projections. In 1998, it said that there would be 3 million lines by 2003; now it foresees 9.6 million in that timeframe. (See accompanying graph.)

Revealing Bundled Preferences

By Jonathan Tombes, Deployment Editor

A recent study from the Strategis Group indicates a strong preference for bundled telecommunications services with consumers. The study, "Branding and Bundling: Consumer Telecom Services," indicates that 93 percent of consumers are interested in purchasing bundles with at least two services.

The Strategis Group, a telecommunications market research firm, surveyed residential consumers to analyze the potential interest in bundling seven communications services: local telephone, long distance telephone, cable TV, satellite TV, Internet access, cellular service and paging. Of those who responded, 93 percent were interested in some type of bundle, and 25 percent expressed interest in a bundle of six services. (See accompanying chart.)



Only 17 percent of respondents said they would "definitely" purchase their preferred bundle; 48 percent said they would "probably purchase" it.

"As for purchasing, they're still leery," said James Mendelson, an analyst with the Strategis Group and lead author of the study. "Here the reputation factor is high. Consumers will only make that jump if there is strong brand recognition."

The study suggested price discount as the main reason for choosing a single-source provider, but reputation and reliability came in a close second. Single-billing for multiple services ranked third.

Bundled services are unavailable for many reasons. "Besides the obvious structural issues of not having the facilities, there are numerous organizational issues," said Mendelson. "Management may have the vision for integrated services, but can they make that vision understood within the company and create the structure for it?"

The study explores further challenges. Brand name and image become increasingly important because consumers are more likely to purchase bundles from a "trusted" carrier, yet bundling tends to generate fears of "putting all your services in one basket." Offering a variety of integrated solutions and marketing multiple bundles could help resolve this dilemma.

The Strategis Group also released a parallel study, "Branding and Bundling: Business Telecom Services." To purchase either study, contact the Strategis Group at (202) 530-7500 or visit their Web site at www.strategisgroup.com.

Converging Test Equipment Makers

By Jonathan Tombes, Deployment Editor

Bowthorpe has changed its acquisition focus to one of consolidation. The technology group has joined its five test and measurement equipment makers into one new global company dubbed Spirent Communications. This union mirrors the growing complexity and size of communications networks.

The five companies involved are the recently acquired Netcom Systems, Adtech, Telecom Analysis Systems, Global Simulation Systems and DLS TestWorks.

The example of a joint NetCom-TAS testing platform demonstrated at Comnet in Washington, D.C., suggests that the new Spirent sum will be greater than its parts.

Spirent's TASKIT software allows for simultaneous operation of NetCom's SmartBits multiport network performance analysis and TAS's 8250 cable network and interference emulator.

"You've got your capacity planning issues, performance issues, multimedia issues, quality of services (QoS) issues—those are the kinds of tools from a NetCom perspective we're bringing in," said Barry Phelps, president of Spirent's broadband division. "Then we go back to the TAS; that allows you to be looking at the media emulation and different media conditions to better understand the overall performance of a device or a network."

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I'm in a lab, anything that's going to make me more productive is the advantage," said Phelps. "If I'm looking at time-to-market, it's just a more efficient solution for people who are under some very tight deadlines."

"This is a unique solution that no one has been able to recreate before," said Mark Fishburn, NetCom's vice president of marketing. "It solves the problem of taking 10BaseT/USB (universal serial bus) connections from cable modem equipment at the same simulating impairments on the network with this unit from TAS."

"We don't just send out a stream of packets," added Fishburn. "We send out many IP (Internet protocol) flows, some of which represent noise, some video, some data, and then we analyze each of those streams."

Fishburn also stressed the link between his unit's testing equipment and those who set the standards. "The second that the IEEE (Institute of Electrical and Electronics Engineers) decides that this is going to be a standard in a year's time, they write up a draft, and by the time we get back from the IEEE meeting, we have phone messages saying, 'Where is the test equipment?'"

Cable-Ready Homes of the Future

By Arthur Cole, Contributing Editor

It looks like the cable installer's job is going to get easier as digital technology moves forward. Home networking systems will simplify new installations and eliminate the need for wiring the home for video and data services, according to makers of the devices.

Home networking systems are essentially consumer routing devices. They are intended to centralize control of all manner of home electronics devices—TV sets, stereos, computers—in one location. Cable engineers most likely will run into them in new homes, which are routinely being outfitted with video and telephony networking systems or even 100 Mbps Fast Ethernet systems.

New studies indicate that home networking will become a booming business in the next few years. Driven by increased demand for broadband voice, video and data services, Cahners' In-Stat Group predicts the market will expand 60 percent to $1.4 billion by 2003. In that year, the Yankee Group estimates there will be 10 million internally networked homes in the United States.

"With the networks we're putting in place, it means running cable to one place, rather than to every television in the home," said Andrew Hayden, spokesman for Home Director, a Dallas-based manufacturer of consumer networking products.

Home Director, a spin-off of IBM, recently introduced the Network Connection Center, which is capable of distributing up to 16 video signals from cable, videocassette recorder (VCR), satellite and even home security camera sources. The system can be upgraded to cable modems and digital subscriber line (DSL), as well as residential Internet gateways and control systems.

Home networking could come in especially handy in the data field, where cable installers typically will find themselves hooking up multiple modems in a single household.

"Rather than run wires to every PC (personal computer), you go to a single location," Hayden said.

Another example of how the home is starting to mirror the office is the presence of digital video amplifiers tied to the networking system. The devices are designed to ensure that incoming signals are neither too strong nor too weak to maintain a consistent image.

Professional installers are setting up most home networking systems, so it is unlikely that cable technicians will run into shoddy or questionable wiring. And as consumer set-top boxes and cable modems hit the markets, customers could soon start programming their own services, practically eliminating the need for cable installers to come out to the home.

NEWS BITES

- Scientific-Atlanta is supplying 300,000 Explorer 2000 digital set-tops to Adelphia Cable and 126,000 Explorer 2000s and Explorer 3000s to Charter Communications. S-A also is providing Charter with broadband equipment for a 20,000-mile upgrade. In other news, S-A intends to sell its satellite networking business to ViaSat.
- Motorola's Broadband Communications Sector, formerly General Instrument, is selling Comcast 1 million additional digital consumer devices. Comcast plans to deploy Motorola's DCT-2000 and DCT-5000+ digital set-tops and SURFboard cable modems during 2000 and 2001.
- UK multiple system operator (MSO) Telewest is using Harmonic's solutions for its forthcoming trial of video-on-demand (VOD). The broadband access portion the trial uses Harmonic's Video Server Gateway. Initially Telewest plans to serve 300,000 homes in the trial.
- MediaOne is using Tellabs' CableSpan platform to launch digital phone service in six New Hampshire communities. The CableSpan platform allows for providing a bundle of telephony, data and cable TV services.
- CableLabs released the OpenCable 1.0 interim specification for the point-of-deployment (POD) copy protection system. The spec covers content that crosses the POD-host interface. Implementation requires using the 5-C device certificate to authenticate the host and data encryption standard (DES) encryption to protect the content.
- Local broadcast channels are now being offered to DirecTV subscribers in Orlando, Fla., and to DISH Network subscribers in Cleveland, Ohio. These services follow passage of The Satellite Home Viewer Act.
- A Federal Communications Commission study indicates that between June 1998 and June 1999 cable rates increased 3.8 percent, vs. a rise in the Consumer Price Index (CPI) of 2 percent. Over that period, the percentage of viewers receiving multichannel video programming from cable companies dropped from 85 percent to 82 percent. CT

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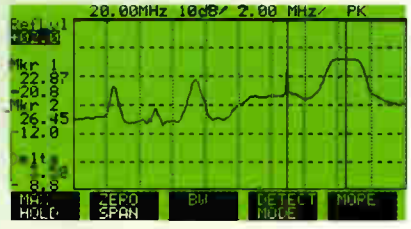

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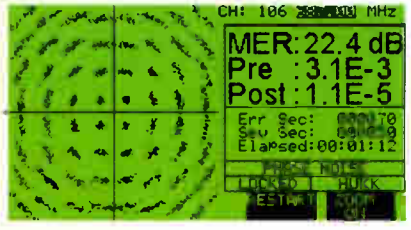

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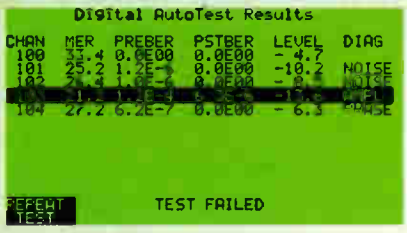

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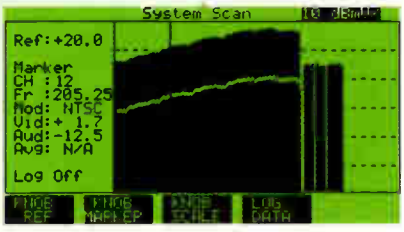

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By Jonathan Tombes

C-COR.Net Aids 21st Century Telecom

"Passive" isn't usually a term associated with 21st Century Telecom Group. But in this case, it's in keeping with the company's aggressive deployment of the hottest new communications technologies. The competitive local exchange carrier (CLEC) is building a passive network in the suburban Chicago community of Skokie, Ill., and has tapped C-COR.Net to supply the components.

The new network will be more reliable, cost less and enable 21st Century Telecom to reach more customers with its voice, video and data services.

C-COR.Net is supplying 1,550 nm optical transmitters, Erbium-doped fiber amplifiers (EDFAs) and reverse path receivers for the greenfield project. 21st Century expects to complete the first of three 50-mile sections in April.

The Skokie project calls for building a 1,550 nm transportation layer through several hub sites that feed optical nodes, targeting 85 homes passed. Such an architecture enables the CLEC to eliminate active RF devices beyond the node.

Increased reliability

"The overriding reason to deploy the passive HFC (hybrid fiber/coax) network in Skokie is that we will dramatically increase network reliability," explained John Brouse, vice president of engineering for 21st Century.

"If there's nothing RF-wise, other than cable and passive electronics in that path from the node to the customer back to the node, there are less things for failure," said Devon Kampshoff, C-COR.Net's director of sales engineering.

Better performance also results from using EDFAs at the hubs. "If you look at going from light to RF and back up to light again, you're introducing distortion products," said Brouse. "What you'll find is when you can run the optical signal into that EDFA at about 8 dBm, you're not really introducing any additional noise."

The network will broadcast 196 video and virtual audio channels. In addition, 21st Century inserts PEG (public, educational or government access) channels and high-speed data signals from its cable modem termination system (CMTS) at the hub. "The 21st Century model physically takes 1,550 nm all the way to the node for the broadcast, but in the hub mixes 1,310 nm optical signals and puts them on the same fiber to go the short distance to the node," explained Kampshoff.

In other words, 21st Century opted for coarse wavelength division multiplexing (CWDM) against dense wavelength division multiplexing (DWDM), which would mix a 1,550 nm broadcast with targeted wavelengths at 1,550 nm in the headend. On the return path, the new system receives signals at the hub and then puts them into a data format for transmission at 1,310 nm to the headend.

Cost savings

In addition to increasing reliability, the deployment makes financial sense. "You find that the all passive HFC network tends to cost approximately 15 percent more in capital," said 21st Century's Brouse, "but if you look at life cycle costs, the O&M (operating and maintenance) cost can be reduced by more than 15 percent over a reasonable amount of time."

That frees up resources. "You ask yourself, 'Do I now need to continually sweep the plant to look at plant integrity?' I no longer need to do that," said Brouse. The passive network also allows for remote monitoring. "You couldn't afford to do that if you put in status monitoring devices in all the RF devices, too," he added.

Vendor support essential

In addition to equipment, C-COR.Net is providing engineering, design and construction support. Brouse also is impressed with the vendor's network maintenance and cable modem operations support.

"They have experienced all the different kinds of problems you'd see with cable modems on an HFC network and know how to quickly troubleshoot and identify whether it is a plant-related problem or an equipment-related problem with a cable modem or servers," he said.

The company's investment in its network may already be paying off. In December, RCN Corp. signed a definitive agreement to acquire 21st Century.

Brouse sees the two companies as compatible: "We are both very forward-thinking with respect to taking fiber extremely deep into the network; we both have the same philosophy of highest reliability of plant that you can get; (and) we have a philosophy of bundled services and getting video/voice/data all integrated onto the network, all going into the home." CT

Jonathan Tombes is deployment editor for "Communications Technology." He can be reached via e-mail at jtombes@phillips.com.

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SCTE Calls in the Clans

The Society of Cable Telecommunications Engineers' first-ever Chapter Leadership Conference will be held in Exton, Pa., on March 17. The CLC will provide an opportunity for chapter leaders to exchange information, learn first-hand what's on the horizon for SCTE and learn how to take their chapters to the next level.

When the idea of a chapter leadership conference was first proposed, headquarters solicited feedback from chapter leaders to determine their interest in such an undertaking. Steve Allen, Region 1 Director expressed his unbridled support "in casting the mold for the future of our society.... to share information and ideas, to meet headquarters staff and take a look at where member dues are put to work, and to formulate future goals and policies that will benefit the whole of the industry."

At the CLC , chapter leaders will have an opportunity to:

- Network with their peers
- Gain an understanding of headquarters requirements and their connection to chapter benefits
- Discuss timely and relevant issues
- Interact with the Board of Directors

The agenda is packed with practical information and materials that can be tailored to suit each chapter. A segment of the agenda will be dedicated to roundtable discussions on topics of interest.

There will be ample opportunity to discuss timely chapter issues related to reporting, governance, member recruitment, revenue generation and industry support, and to obtain input from peer participants to aid in developing solutions without reinventing the wheel.

Conference participants will dine with the Board of Directors on Thursday evening, tour SCTE headquarters and have lunch with the staff on Friday. Attendees who extend their stay over the weekend will enjoy a Saturday afternoon tour of Philadelphia.

Bower Heads Conferences Department

Lori Bower has been promoted to director of SCTE's National Conferences Department.

In her new role, Bower is responsible for all aspects of planning and directing the Society's annual Cable-Tec Expo and Conference on Emerging Technologies, as well as SCTE seminars. This includes overseeing registration, sponsorship, housing and exhibition. She previously served as the convention coordinator for the National Conferences Department.

Bower has been with the Society for more than eight years and has worked in its certification and chapter development departments. SCTE President John Clark noted: "Over her eight years with SCTE, Lori has expanded her knowledge and experience. I am excited about having such a qualified internal candidate and look forward to working closely with Lori as she leads our National Conferences staff here in Exton."

Bower is a Certified Meeting Professional and is working to become certified in the area of meeting exhibits. She is a member of the Professional Convention and Meeting Association and the American Society of Association Executives. She is also a member of the West Chester, Pa.-based chapter of the Business and Professional Women's Club.

Bower said: "I look forward to continuing the partnership between SCTE and the broadband vendor community. Providing quality education to the Society's members through Cable-Tec Expo and the Conference on Emerging Technologies is a top priority for all of the staff in the National Conferences Department."

Haimowitz Retires

Long-time SCTE employee and member Ralph Haimowitz retired Dec. 31. Ralph has been involved with SCTE for more than 27 years, during which he made numerous valuable contributions to the Society.

Ralph is best known for his willingness to teach others. Even as he was learning about cable TV, he was always willing to pass his knowledge on. Through the years, he has been able to help many cable technicians grasp the electronics background he had mastered.

Ralph's dedication to training helped him to earn the position as SCTE's first director of chapter development in 1988.

SCTE Vice President of Technical Programs Marv Nelson praised Ralph's foresight when he put together the first Chapter Development Handbook.

"I was a chapter officer for the Great Lakes Chapter, and I was very thankful for the guidance this resource provided, Nelson said. "Ralph's work made my job as a secretary much easier. The handbook provided a concise list of requirements and the necessary forms for chapter operations. It also gave a number of helpful hints on how to successfully run chapter meetings."

When asked what he feels is his greatest career accomplishment, he said: "Passing along the knowledge and experience that I have gained to help others is what I've enjoyed the most. I hope that I have helped people to be better at what they do."

"Ralph may be retiring, but it is likely he will continue to contribute to the Society for many years to come as one of its many volunteer members," Nelson said. "Thank you, Ralph, for all that you have done to make this Society what it is today."CT

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By Ron Hranac

Cable's Top 10 Technologies

Despite what the marketing department says, our industry is largely technology driven. With that in mind, I've put together—in no particular order—the following list of the 10 technologies that I believe have most significantly impacted the way we do things. That being said, let's have a look, shall we?

Broadband push-pull amplifiers

For the first 20-plus years of the cable industry's existence, our amplifiers used single-ended circuitry. Technology improvements took us from early vacuum tube amplifiers that could carry perhaps two or three channels to 12-channel solid-state amplifiers. The trouble with single-ended amplifiers, tube or transistor, was the distortions (mostly second order) that they generated.

It was the development of broadband push-pull amplifiers that really got the ball rolling on expanding channel capacity. Push-pull amplifier circuits largely cancel second order distortions, allowing the use of previously off-limits frequencies. Push-pull amps paved the way for newer amplifier technologies, including feedforward and power doubling, both of which use push-pull technology as their basic building blocks.

AML microwave

Hughes Microwave brought us amplitude modulated link (AML) microwave. (I think the early versions had the Theta Com label.) This was multichannel microwave technology using amplitude modulation (AM), designed primarily for point-to-multipoint signal distribution. The significance of this last statement has to do with the fact that up until AML was introduced, most microwave technology used frequency modulation (FM) and was intended for medium- and long-haul point-to-point signal transport. FML microwave just wasn't practical for point-to-multipoint signal distribution.

AML allowed us to get rid of long trunk cascades and divide the system into smaller service areas. The nice thing about AML was its simplicity. The output of the receiver was the same VHF spectrum that was present at the transmitter's input. Sound familiar? We do much the same thing today with fiber.

Satellite distribution

Satellite distribution of video programming came to us in the mid-'70s, forever changing the way we do business. Up until this point, cable was little more than the broadcast retransmission service that it had been when it got its start back in the mid- to late 1940s.

Satellite-delivered programming brought us Home Box Office and other premium channels and gave birth to the whole idea of the superstation. It allowed us to be viable in major metropolitan areas and was the catalyst for incredible industry growth.

AM fiber optics

When the cable industry went to optical equipment manufacturers and suggested AM transport over fiber, we were almost laughed out of town. "That'll never work," the experts scoffed. "Laser transmitters are inherently single-ended devices and just won't work for broadband multichannel transport or distribution. And you want what kind of noise and distortion performance?"

Well, they do work, and work well. Today's lasers are being optimized for our AM links. Like AML microwave, AM fiber initially allowed us to get rid of long trunk cascades. Today's fiber technology has revolutionized our network architectures, improved quality and reliability, and in many ways reshaped our very business.

Harmonically related carrier Channelization

Broadband push-pull amplifiers gave us more channels, but with ever-expanding upper bandwidths and so many channels those ugly distortions crept up again. Only this time it was mostly third order distortions that gave us headaches. What to do? Broadband feedforward and power-doubling technology were both still several years away, and plain old push-pull was about stretched to its limit.

Enter harmonically related carrier (HRC) channelization.

In retrospect, it's simple. Change the frequencies of all channels so that they fall on exact multiples of 6 MHz (8 MHz in the phase alteration line, or PAL, world). The idea behind this scheme is that the third order distortions would fall to zero beat with the visual carriers, providing more operating headroom. The distortions are still there; you just can't see them in the picture. HRC gave us the headroom we needed until improved amplifier technologies came along.

Sync suppression scrambling

Although sync suppression scrambling has largely lost its luster, credit this technology for giving us an effective—in its day—method of conditional access (CA). It also laid down an evolutionary path to addressability, full-featured converter-descramblers (now we call them set tops), and to some degree today's digital video technology.

Sync suppression—fixed, sine wave, dynamic, RF, intermediate frequency (IF), baseband or whatever—thoroughly messed up the picture so that subscribers

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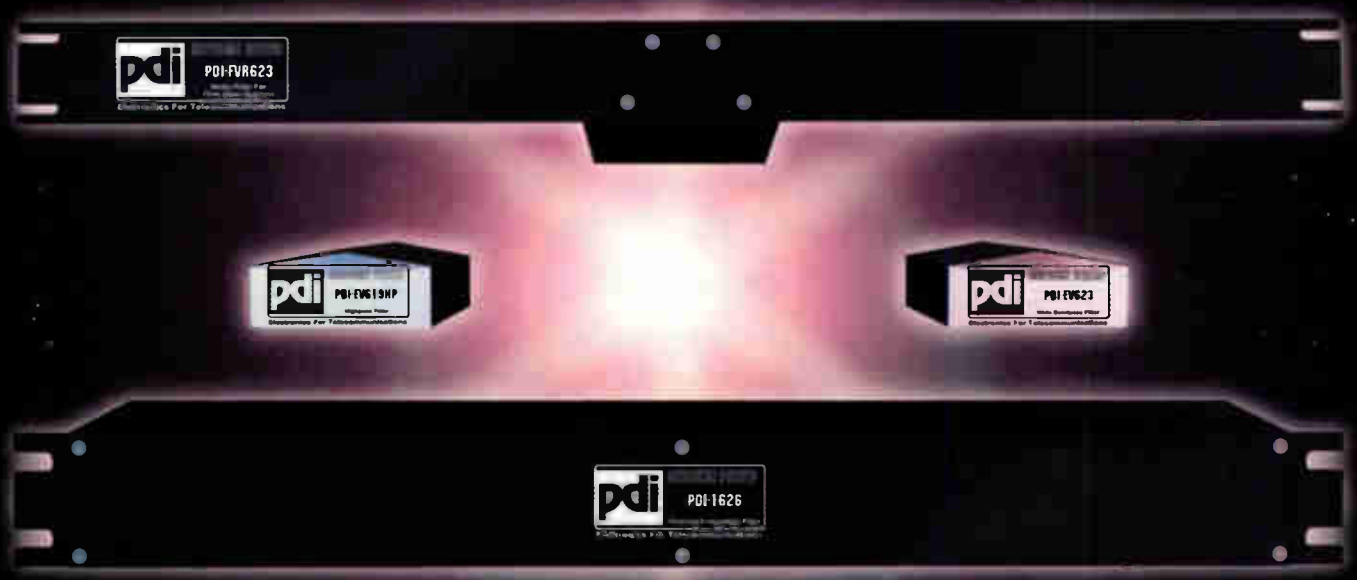

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not paying for a given channel couldn't watch it. Unfortunately, though the picture was scrambled nicely, the sound usually wasn't affected.

Who among us hasn't had calls from irate subscribers complaining about the naughty things they could hear but couldn't see? What always amazed me was how long they listened to the scrambled channel's audio before calling to gripe.

Directional multi-tap

Those of you who've been in the business long enough remember the introduction of directional coupler (DC)-based multi-taps. Pressure taps worked, but they created nasty impedance mismatches in the feeder (can you say ghosts?), had a habit of coming loose (troubleshooting trick for snowy pictures: tighten the pressure tap), and provided a good path for water to find its way inside the cable.

> "Don't you know the 'F' in F-connector stands for @#$%&*!?"

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Two-way amplifiers

So, you think two-way is a new technology? You might be surprised to learn that two-way amps have been around nearly 30 years. The ability to transmit signals simultaneously in both directions through the same cable, passive and active, takes us far beyond the tried-and-true broadcast architecture that has served us so well. Two-way amps make real-time interactivity for real.

F-connectors

I can see the e-mails now. "How did the F-connector get into your Top 10 list?! Don't you know the "F" in F-connector stands for @#$%&*!?" Well, maybe so, but it beats what we had before.

Remember the C-connector? The F-connector was a major improvement. No, don't ask—I have no idea what the "F" really stands for.

On the one hand, the lowly F-connector can provide a simple, reliable and cost-effective RF interface. On the other hand, the lowly F-connector can provide a troublesome, unreliable and, from a maintenance perspective, costly RF interface.

This poor thing still is the cause of most drop-related service calls (actually, it's the way they're installed, not the connectors themselves), and we as an industry buy enough of them every couple years to replace every drop connector everywhere.

Still, you have to admit the F-connector has had a significant impact on the way we do things, good or bad.

Direct broadcast Satellite

Ah, yes, direct broadcast satellite (DBS). Granted, it's not really a cable technology, but it has had a big-time, major impact on our business. By and large, the DBS folks are indirectly responsible for our taking customer service, networks upgrades, quality, reliability and overall operations much more seriously. As annoying as it can sometimes be, competition from DBS has made us better.

Also-rans

Finally, no list would be complete without some runners-up. Here I'd add cable modems, the transistor, amplifier hybrids, digital compression and maybe even coaxial cable itself. All are worthy in their own right, but my list had room for only 10. How about you? What does your list look like? If you disagree with my picks, and some of you certainly will, feel free to send in your thoughts. We'll share your responses in the Letters to the Editor section of a future issue. CT

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

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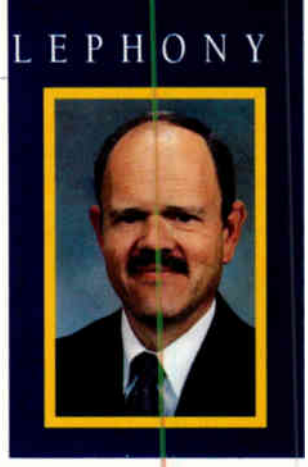
By Justin J. Junkus



Spreadsheeting Telephony: Get to the Bottom Line

Every successful telecommunications project has two planning dimensions: technical and economic. Technical people often find it all too easy to get caught up in the technology and can be tempted to shortchange the economic analysis. Particularly in telecommunications, the fun part is showing how new hardware and software applications enable delivery of services far beyond plain old telephone service (POTS). Falling into this trap, however, can cost you.

Cart and horse in proper order

The economic aspects of our industry are just as important as technology to our progress in offering new telephony services. Economics can be complex, but a couple of basic checkpoints can help determine whether particular technical solutions make economic sense.

For example, most of us know that over the life of a service offering, the revenue from that service must exceed the associated expense—ideally by a decent margin. Different services also have different revenue and expense streams. This difference is a major factor in determining which services to offer.

Business strategy may modify the priority of any given service as a customer offering. Timing of revenue and expense often are important. While the cash flow over a 10-year period for two projects may be the same, projects with heavy upfront costs often are placed lower in the company's priority list.

Competition, however, can change that list. Missing a market opportunity while waiting for a newer version of technology, for example, may mean losing the opportunity to finance the improvement.

No, not *that* kind of modeling

Economic modeling is the tool that management and technical personnel use to evaluate when technology is ready to meet markets. Any technical person who has a pet project, one that he or she "knows" would be right for the company, gains a lot of leverage in promoting the project by understanding and using an economic model.

The best part is that you don't need to be an economist to use the tool; in fact, many economic models are built using computer programs with graphical interfaces similar to the menus commonly used for testing and design.

> "The model provides an opportunity to have good, detailed discussions with your vendor."
>
> —Steve Peterson, Lucent

The engine behind the graphical interface usually is a computer spreadsheet, such as Microsoft's Excel. For those not familiar with spreadsheets, they are nothing more than computerized tables. A typical spreadsheet might, for example, show the relationship existing between subscriber penetration for telephony service and operator revenue.

The advantage of computer spreadsheets over manual tables is that formulas can be built right into the spreadsheet. The result is that we can quickly see what happens to our model when we change one or several inputs.

Basic models require a user to input values directly into the spreadsheet. More elegant models automatically transfer values from a graphical interface to the spreadsheet for calculation.

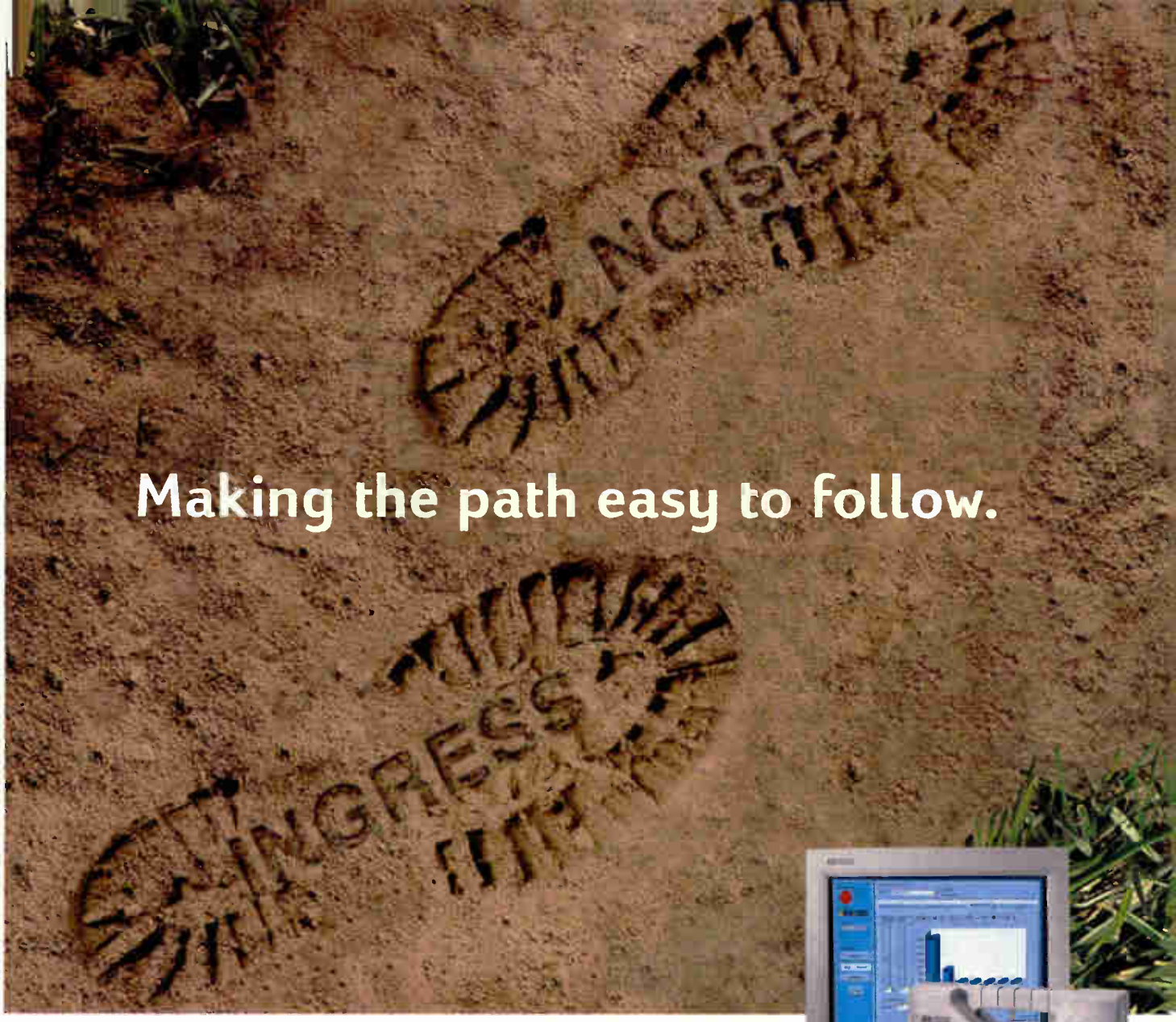
Vendor models

Vendors are a great source of economic models. As just a few examples, Arris-Interactive, Cisco and Lucent Technologies have developed telephony planning tools.

The Arris model looks at what happens to cash flow from a telephony service offering when different choices are made for the implementation technology. The choices are circuit-switched, a hybrid approach and pure Internet protocol (IP) telephony. The model user can change homes passed, penetration, churn and expenses over a 10-year model window.

While the comparisons alone provide valuable planning information, the model lets the user decide when IP technology will be ready enough to provide acceptable carrier-grade telephony service. Differences in cash flows between waiting for IP and implementing earlier with the alternative technology can then be seen.

The Cisco and Lucent models help determine whether to offer telephony as a service. In both these models, the user inputs parameters that define the expected market, such as homes passed, penetration, growth rate, take rate, churn and pricing. Expenses also are inputs and in-



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clude capital costs, transport, marketing, sales, administration and design. Cash flow and discounted cash flow are outputs that can be compared for each scenario.

The models from these two companies have other options that are useful in fine-tuning the decision process. Both companies have developed sensitivity analyses that graphically quantify how important a particular input is to the cash flow. In addition, both companies have built proprietary configuration tools that work with the model to customize it for a particular operator's needs.

The Lucent model is called the CableConnect Business Analyzer and is described in a white paper at the Lucent Web site, www.lucent.com/cableconnect.solutions/whitepapers.html. You can contact Arris and Cisco through their Web sites to ask for information on their models. The Web sites are www.arris-i.com and www.cisco.com.

The real value

Of course, each vendor's model is meant to show the vendor's product as the optimal solution. That's why it's important to note that the real value of any model is not in its ability to automate calculations. The model's real value lies in its capacity to get both you and your vendor working from the same page.

> "Any technical person who has a pet project . . . gains a lot of leverage in promoting the project by understanding and using an economic model."

As Steve Peterson, manager of corporate strategy at Lucent states: "The model provides an opportunity to have good, detailed discussions with your vendor. It helps the vendor's customer understand the business implications of technology decisions, and (it) helps both the vendor and the customer validate the assumptions behind technology decisions."

Like I said at the beginning of the column, it's easy to get caught up in technology because of all the great possibilities and fun gadgetry. Economic models, however, help focus on issues that keep our paychecks coming. CT

Justin Junkus is president of KnowledgeLink, a consulting and training firm specializing in the cable telecommunications industry. He also is applications engineering director for Antec. He can be reached via e-mail at jjunkus@knowledgelinkinc.com.

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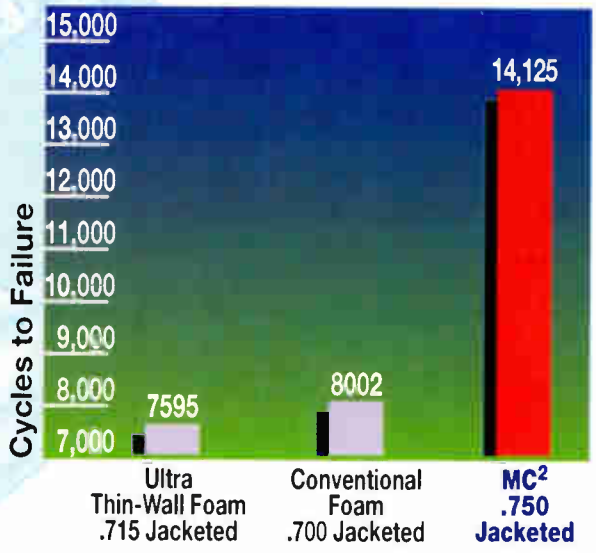

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THE BEST CABLE IN THE BUSINESS

By Jennifer Whalen

Managing Network Complexity

Today's cable networks are far more complex than anyone ever imagined. As consolidation and clustering results in fewer, yet dramatically larger, multiple system operators (MSOs), the number of devices to manage is quite staggering.

Jim Luddington, consultant for INT2-Internetwork Integration and moderator of the Society of Cable Telecommunications Engineers' Emerging Technologies 2000 panel on network management, summed it up best. In the outside plant, MSOs will have around "35 million passives, 360,000 miles of plant, 1.5 million actives, 175,000 power supplies, 70 optical nodes, 1,800 hubs, 300 headends and 70,000 miles of fiber. That's coming back to one network operations center (NOC)," he said.

That's just the start of the management headache. "We've got a whole bunch of servers, managing 100 terabytes or so of digital content. We've got a bunch of packet switches, circuit-based switches, muxes and demuxes, and mods and demods—probably tens of thousands of those across the network," he added.

If you're not dizzy from the scope of the network, you haven't considered client devices. "You've probably got 22 million households. Inside those households, there's not just our set-tops; now we've got net-tops—all those appliances attached to the network like the toaster, microwave, palmtop, the cable modem, etc.," Luddington speculated.

"Our networks are not going to get less complicated. We're going to have to figure out a way to manage the ever-growing complexity of network pieces," he concluded.

End-to-end management, a must

The cable industry must come to agreement on a common framework for end-to-end management of both network elements and services. Why? Such a platform will integrate multivendor network and customer premise equipment (CPE), enable automated provisioning and service activation, provide mobile dispatch of technicians to speed installation, supply proactive quality of service (QoS), isolate faults, and improve billing capabilities, explained Preston Gilmer, senior product manager for Tellabs.

Two models exist to help cable operators manage networks with equipment from multiple vendors—The Telecommunications Management Network (TMN) model and the Common Object Request Broker Architecture (CORBA). TMN is familiar to the telecommunications industry, although incumbent operators have been slow to integrate the TMN framework, said Gilmer. CORBA, on the other hand, is accepted by the information technology (IT) community and is now gaining recognition in communications circles.

Why is a unified framework for end-to-end management important? "If we can come up with common information models, we can take market share from incumbents with integrated service offerings," said Gilmer.

"We're looking for five to seven key players in the industry to build the legal agreements and get together to work on a common model. The SCTE's (Hybrid Management Sub-Layer) subcommittee might be a place to do that work," he added.

Quality of service essential

Managing network elements is just one issue. You've also got to make sure the traffic you send reaches its destination. "The cable networks are one of the first platforms that are going to provide really convergent applications in the way of data, video, telephony features and audio. In order to support that, you need to provide quality of service," said Pablo Martinez, solutions manager at Lucent Technologies.

That means your networks must be aware of the applications they carry so that programmers can develop intelligent applications that signal the network of their bandwidth and priority requirements. With such awareness, networks can dynamically adapt to the needs of users, Martinez said.

Remember that elements at the network's edge and core perform different QoS functions. Edge devices classify, mark and police ingress traffic, and they also shape egress traffic. Network elements apply queuing and scheduling to traffic. Martinez advised that before you configure your network elements for QoS, you profile the traffic types generated by different applications to decide which QoS treatments are right for each application.

Keep in mind that with the rapid growth of Internet protocol (IP) services, it's a sure bet that your customers' traffic eventually will leave your network, and off-net traffic will need to reach your subscribers. "In order to have end-to-end QoS, you will need a policy management strategy," advised Martinez. "A policy server can talk to other providers' policy servers so they can negotiate QoS as traffic moves from one network to another."

Until such capabilities become ubiquitous, consider using QoS-based processing in those network spots that tend toward congestion. You can gradually expand the reach of those systems for end-to-end coverage as QoS techniques become more widely deployed, he added. CT

Jennifer Whalen is editor of "Communications Technology." She can be reached via e-mail at jwhalen@phillips.com.

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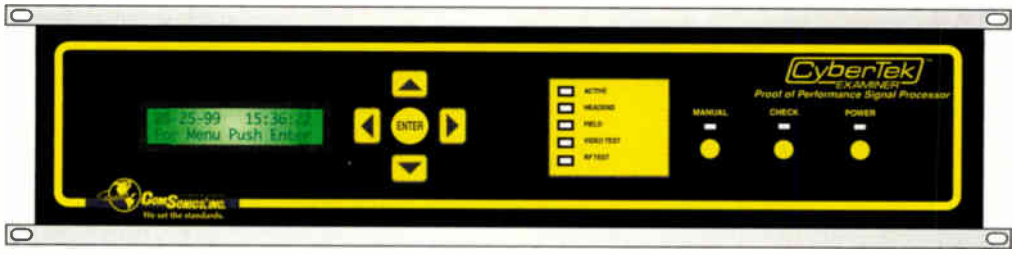

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By Ted Woo

DOCSIS on Its Way to ANSI

Upon approval by the Society of Cable Telecommunications Engineers Standards Board (the Engineering Committee), SCTE will submit two Data Over Cable Service Interface Specification (DOCSIS) standards documents to the American National Standards Institute for recognition as new American National Standards this year.

The Data Standards Subcommittee recently balloted DSS 994, titled "DOCSIS Radio Frequency Interface Specification SP-RFI-105-99110," and DSS 995, titled "DOCSIS Radio Frequency Interface Specification SP-RFv1.1-103-991105." These standards also are known as the DOCSIS 1.0 final version and the DOCSIS 1.1 draft version, respectively. Both reached consensus-adopted status on Dec. 14, 1999.

The DOCSIS high-speed data interface specifications are designed to permit early definition, design, development and deployment of high-speed data systems on a uniform, consistent, open, nonproprietary, multisupplier interoperable basis. DOCSIS service itself is intended to allow transparent two-way transfer of Internet protocol (IP) traffic between the cable system headend and customer locations, over an all-coaxial or hybrid fiber/coax (HFC) cable network.

Here follow some of the particulars of each standard.

DSS 994, aka DOCSIS 1.0

An overview of the specification in DSS 994 defines the electrical characteristics and protocol for a cable modem and cable modem termination system (CMTS). It also defines an interoperable condition, so that any implementation of a cable modem can work with any CMTS. The upstream physical media-dependent (PMD) sub-layer uses a time division multiple access (TDMA) or an option of frequency division multiple access (FDMA) burst modulation format, which provides five symbol rates and two modulation formats, quadrature phase shift keying (QPSK) and 16-QAM (quadrature amplitude modulation). The modulation format includes pulse shaping for spectral efficiency. It is carrier-frequency agile and has a selectable output power level.

> "The prime objective of quality of service is to define transmission ordering and scheduling on the RF interface."

The PMD sub-layer format includes a variable-length modulated burst with precise timing, beginning at boundaries spaced at integer multiples of 6.25 microseconds apart (which is 16 symbols at the highest data rate). Each burst supports a flexible modulation, symbols rate, preamble, randomization of the payload and programmable forward error correction (FEC) encoding. All of the upstream transmission parameters associated with burst transmission outputs from the cable modem are configurable by the CMTS through media access control (MAC) messaging.

The downstream bitstream is defined as a continuous series of 188-byte Moving Picture Experts Group (MPEG) packets. To improve demodulation robustness, it facilitates receiving hardware for video and data with provision of the possibility for future multiplexing of video and data over the PMD sub-layer bitstream. Each one of these packets consists of a four-byte header followed by 184 bytes of payload. The header identifies the payload as belonging to the data-over-cable MAC. The mixture of MAC payloads and those of other services is optional and is controlled by the CMTS.

DSS 995, aka DOCSIS 1.1

The significant factors of the specifications in DSS 995 have to do with quality of service (QoS) and fragmentation. They include packet classification and flow identification, service flow QoS scheduling, dynamic service establishment, fragmentation and the two-phase activation model. Protocol mechanisms through cable modem and CMTS described in this document are for both upstream and downstream traffic.

The principle mechanism for providing enhanced QoS is to classify packets traversing the RF MAC interface into a service flow. A service flow is a unidirectional flow of packets that is provided to a particular QoS. The cable modem and CMTS provide this QoS by shaping, policing and prioritizing traffic according to the QoS parameter set defined for the service flow. The prime objective of QoS is to define transmission ordering and scheduling on the RF interface.

Fragmentation is an upstream cable modem capability. The CMTS must enable or disable this capability on a per-modem basis with a tag length value (TLV) in the registration response. Once fragmentation is enabled for a DOCSIS 1.1 modem, fragmentation is enabled on a per-service flow basis through the request/transmission policy configuration settings. ➤

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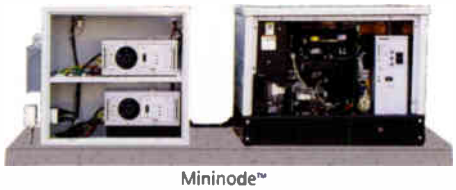

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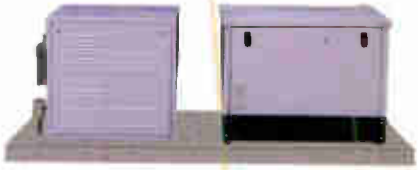

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encapsulation of a portion of a MAC frame within a fixed-sized fragmentation header and a fragmentation cyclic redundancy check (CRC). Concatenated protocol data units (PDUs), as well as single PDUs, are encapsulated in the same manner. Baseline privacy, if enabled, is performed on each fragment, as opposed to the complete original MAC frame.

European differences

European DOCSIS also is mentioned in DSS 995. It will not affect North American DOCSIS 1.1 modem certification. Its general concept is that a cable network (HFC or all coax) uses a shared-medium, tree-and-branch architecture with analog transmission. Functions include two-way transmission with maximum electrical or fiber-optical spacing between the CMTS and the most distant customer terminal of 100 miles, although typical maximum separation may be 10-15 miles. Similar rules apply to the differential fiber-optical or electrical spacing.

For the downstream frequency plan the cable is assumed to have a passband with a lower edge at 96 MHz and an upper edge that typically is between 300 and 864 MHz. Within that passband, analog TV signals in 8 MHz channels are assumed to be present, as well as other narrowband and wideband digital signals. For upstream, the cable system is assumed to have a passband of 5-65 MHz. Analog signals in 8 MHz channels may be present, as well as other signals.

Wrap-up

So that's what SCTE plans to send to ANSI. Clearly, ANSI adoption of these standards will go far toward making true interoperability and retail modem sales a reality. It also will help pave the way for other standards in development. CT

Ted S. Woo, Ph.D. is director of standards for the Society of Cable Telecommunications Engineers. He can be reached at (610) 363-6888 or twoo@scte.org.

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Mystified by Return Path

You just received the memo from corporate this morning. It says your system is to have its reverse path activated and enter the world of two-way services. First on the schedule is high-speed Internet access using cable modems.

By Ron Hranac

"No problem," you think. "Our system was designed to be two-way capable. The amplifiers and nodes already have diplex filters, so all we need to do is drop in the reverse amp modules, set levels, and we're off to the high-speed races."

If you think it's that easy, you're in store for some real surprises.

Back to school

First, you'd better get up to speed on reverse path concepts. Several good articles and other references have been written on the subject. Gather a few back issues of *Communications Technology* and read those articles you were saving for a rainy day. Now that corporate has told you to fire up the reverse, that rainy day has arrived. For a list of other references that can help, see the sidebar "Getting Started" (on page 46).

In-house vs. "outhouse"

Now you must decide whether to use in-house staff or hire a contractor. Either way, you'll spend somewhere around $1,500 to $2,500 per mile of plant to fire up the reverse. If you choose a

Activation?

Get Your Upstream Fiber Links Aligned

contractor, realize the going rate for reverse activation and sweep (which often includes forward sweep at the same time) is in the $0.20 to $0.30 or more per foot range, plus time and materials to fix problems. That $0.20 to $0.30 per foot equals $1,056 to $1,584 per mile.

Plus, you'll need to add the reverse amplifier hybrids, boards or modules, which may cost from as little as $30 or $40 each to $100 or so. Assuming an average of five actives per mile, the reverse actives could cost another $150 to $500 per mile. Don't forget pads and equalizers, plug-in diplex filters (if applicable), and other odds and ends.

If you do the activation yourself, remember test equipment. I'm an advocate of sweep alignment, which is the best way to get things running. Multicarrier generators are great for rough balance during initial alignment, but you can see what's going on only at the carrier frequencies. How do you know there aren't frequency response problems in between the carriers? If the response isn't flat, group delay will be a problem, which increases data carrier bit error rate (BER).

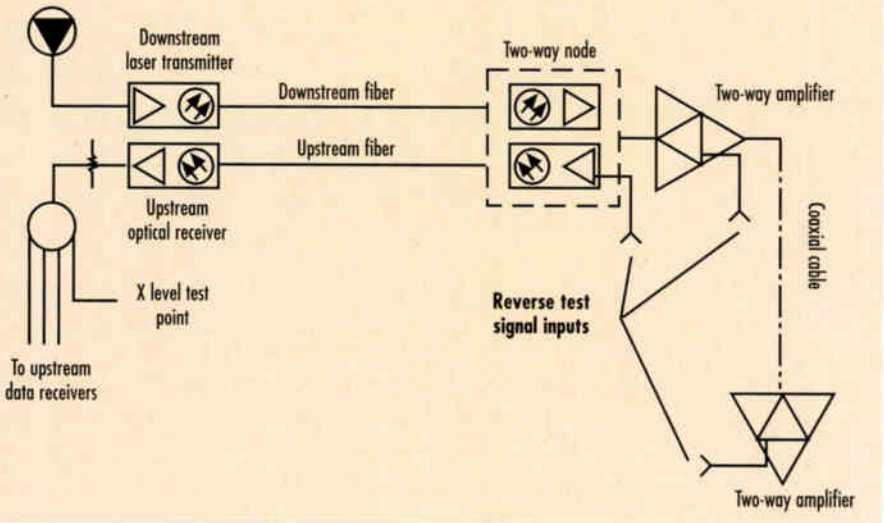
Know your vendors

Let's assume you're activating the reverse yourself. You've got all the parts and test equipment, so where do you begin?

First, develop a close relationship with the manufacturer of your upstream optical and RF transmission equipment. You're probably going to be on a first-name basis with that company's applications engineers. Obtain detailed block diagrams of the node and headend equipment. Do the same for the amplifiers in your coax plant.

Become familiar with upstream test points and test signal insertion points, as well as design and operating specs. If you're using vintage upstream gear, operational specs likely are based on one to perhaps four analog visual carriers. Because you probably won't be transmitting analog TV channels through your reverse plant, you need the operating specs translated to something based on total power, information the manufacturer will be able to provide. Ideally, the manufacturer will have characterized the performance of the upstream laser and receiver combination (and also the coax plant actives), but if not,

Figure 1: Simplified two-way HFC network



review the procedure detailed in the NCTA's "Supplement on Upstream Transport Issues."

Fiber link alignment

Figure 1 shows a simplified two-way hybrid fiber/coax (HFC) network. Before you activate the upstream optical equipment, it's important to create a headend "X level" test point. This will serve as the upstream alignment reference point for both the fiber link and the coax distribution actives. Here's how the X level idea works.

After the optical link is properly aligned, insert a reverse test signal at a level known to be correct into the node's upstream test signal insertion point. Measure the resulting signal level at the headend X level test point. Write this number down; this is your reference for all subsequent measurements.

Move to the next downstream amp location from the node, and insert a reverse test signal into the amp's upstream test signal insertion point at a level known to be correct for that type of amplifier. This should result in the same level at the X level test point as before. If it's different, install the appropriate value pad and equalizer at the amp's upstream output. This will result in the correct input at the node, which gives you the proper levels at the headend.

Go to the next downstream amp, and do the same thing. You ought to get the same level at your X level test point as before; if not, set that amp's output with the proper value pad and equalizer. This will result in the correct input and output at the first amp out of the node, as well as correct levels through the link and back in the headend.

Got your X level test point ready to go? Good. Now activate the upstream optical path. Install the reverse lasers and other actives in the node and the upstream optical receivers in the headend. Next, verify optical loss for each upstream fiber (shoot these fibers with an optical time domain reflectometer, or OTDR, and save the traces), and measure optical power levels at the upstream transmitter outputs and headend receiver inputs.

Compare these measured power levels to transmitter output and receiver input voltage test points, and record and save for future reference. Permanently connect the fibers to the upstream transmitters and receivers, and again check test points to confirm proper operation.

Install optical attenuators

If you find the measured receiver optical input levels too high for any of the headend receivers—greater than the manufacturer's recommended input level—install optical attenuators at the receiver inputs. Excessive optical levels may overload the receiver (generally the output RF stage) and cause unwanted distortions that may be incorrectly attributed to laser or coax plant problems.

Many alternatives are available when it comes to optical attenuators. I like the low-cost ones available from Fotec (www.fotec.com/attn.htm) and Telonix (www.telonix.ca/fova.html). These are small rectangular plastic blocks that provide controlled bends in standard 3 mm diameter jacketed fiber jumpers to achieve the desired attenuation (up to 5 dB at

BOTTOM • LINE

Ins and Outs of Reverse Activation

Activating and aligning the reverse path often is easier said than done. When you get the green light to fire up the reverse, there's more involved than simply plugging in reverse amplifier modules and setting levels.

You can choose to have contractors activate and align your system's reverse plant, or you can do it yourself. Assuming you elect to do it with in-house resources, it's important to understand the basics of two-way system operation.

Next, you need to establish a close relationship with your equipment manufacturers. Obtain block diagrams of your optical link and coax plant distribution equipment, and understand operating specifications as they relate to total average power. Align the upstream fiber links relative to the laser manufacturer's maximum recommended total input power, using a headend "X level" test point as your reference measurement point.

When aligning the upstream fiber link, it's important to understand the difference between the laser manufacturer's maximum recommended total input power and day-to-day operating levels. The day-to-day operating levels will be less than the total power spec, requiring you to understand how to calculate what they should be. Don't set the operating level of a single upstream data carrier equal to the total power level. This will eliminate valuable operating headroom, increasing the risk of laser clipping.

Once the fiber links have been properly aligned, then you can move on to configuring the headend reverse combining and splitting network, and setting levels throughout the coax distribution plant.

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Figure 2: Reverse fiber link setup based on total power

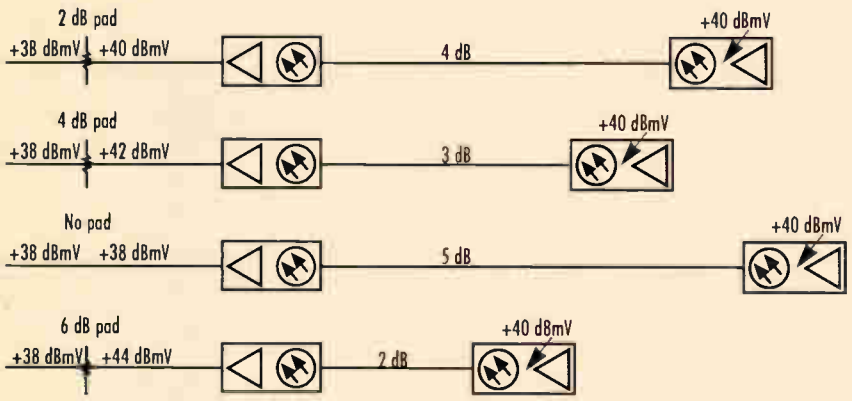


Figure 3: Reverse fiber link setup based on data carrier optical levels

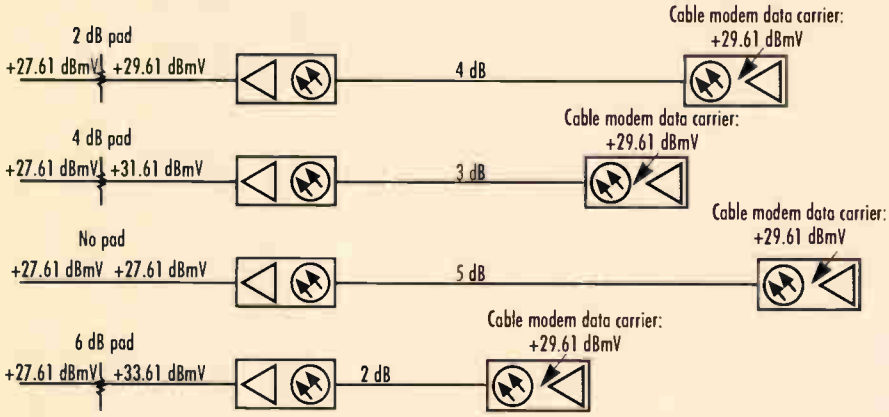
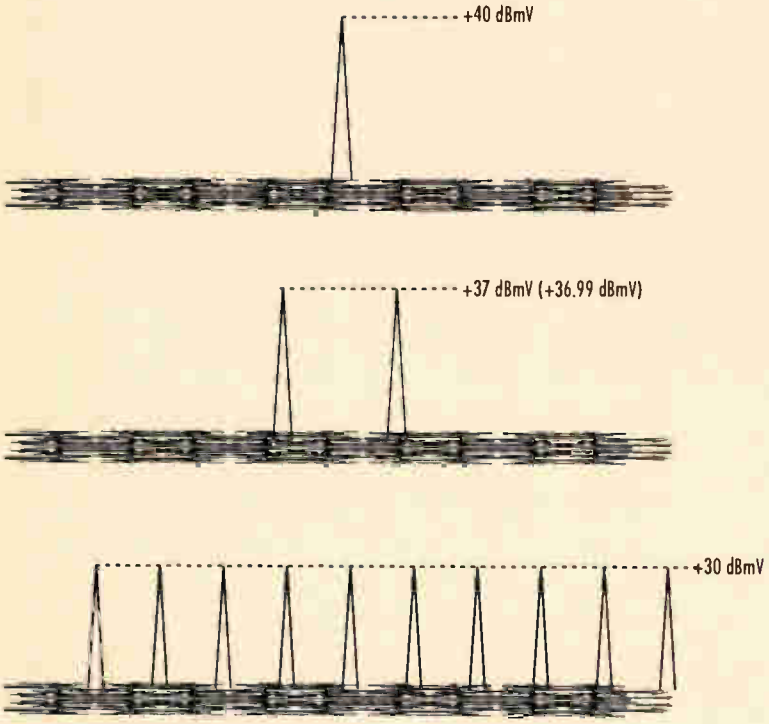


Figure 4: Total power examples



1,310 nm). The plastic blocks have molded sine wave-shaped channels in them. If you need 1 dB of attenuation, simply route the fiber through one sine wave channel. Need 2 dB? Route the fiber through two sine wave channels, and so on—no connectors or splices to worry about.

Now it's time to plug in some test signals at the node and see what you get in the headend. But first, install a high value pad at the reverse output of all of the first-in-cascade amplifiers out of the node. This will maintain a reasonable input impedance to the node's reverse stages and reduce the ingress and other interference that may affect your fiber alignment process.

If reverse actives are installed before the alignment process, every reverse amp should have a high value pad on its output. This will prevent active device overload and potential damage. The high value pads can be replaced when you begin aligning the coax reverse plant later.

"Uh, fine, Hranac, but what should those test signal levels be?" Good question. Remember that suggestion to become friends with your optical equipment manufacturer's applications engineers? Now's the time to take advantage of that friendship.

Calculating total power

One place you might want to start is with the manufacturer's maximum recommended total power. (See the accompanying sidebar on page 50 for more information. See also Figure 2.) Assume your applications engineering buddy told you the maximum recommended total power at the upstream laser's input is +40 dBmV. The input to the node probably will be some other value, say +20 dBmV, because the node or maybe the laser module likely has an RF gain stage that amplifies the reverse spectrum before applying it to the laser input. Use the number provided by the manufacturer, but for the sake of discussion, we'll assume the laser input's total power spec is +40 dBmV.

If you align the links with this method, you can use a single continuous wave (CW) carrier whose amplitude is +40 dBmV, a pair of carriers at +37 dBmV each, or even four carriers at +34 dBmV each. To keep things simple, stick with the single +40 dBmV carrier for now.

I'm assuming you've got several identical older model headend receivers that

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don't have output level controls. (You'll see why in a moment.) The top link in Figure 2 is what I'll call an ideal optical link for a given transmitter-receiver pair. That is, for a specific link loss—in this case 4 dB—the headend receiver output is the same (or some other specified value, depending on optical equipment circuitry design) as the laser input. Let's call this the "zero dB link gain condition."

In the real world, it's unlikely that your links will have the same loss, let alone be of an ideal value. The second link in Figure 2 has 3 dB of loss. This means the fixed-gain receiver output will be 2 dB greater than the first link because of a 2:1 relationship between RF and optical power. The third link has 5 dB of loss, resulting in a receiver output that is 2 dB less than the zero dB link gain condition, and the fourth link has only 2 dB of loss, yielding 4 dB greater output than the first link.

Because the receivers in this example have a fixed gain with no output level controls, you need to use external pads to attenuate the outputs to the same value as the output of the receiver with the lowest signal level. That is, adjust your receiver outputs to be the same as that of your longest optical path.

An exception might be where you have a couple of long paths that result in lower than typical signal levels. If so, spring for higher power lasers for the nodes of the affected links. As a last resort, use a high quality post amplifier at the headend receiver output on each of the longest links or combine the outputs from the very long links and use one post amplifier. (Be careful here, and pay attention to carrier-to-noise, or C/N, and distortion performance.)

Because the longest path in Figure 2 is 5 dB and its corresponding receiver output is +38 dBmV, the remaining receivers must have their levels padded down to +38 dBmV. So the first receiver gets a 2 dB pad, the second a 4 dB pad, and the last a 6 dB pad.

If you have receivers that incorporate output level controls, in most cases you

Getting Started

Congratulations, you're activating your reverse path. Before you do, be sure to review the following publications.

- National Cable Television Association's *Recommended Practices for Measurements on Cable Television Systems*, 2nd Edition, and the October 1997 "Supplement on Upstream Transport Issues." Contact NCTA at (202) 775-3637.
- *Broadband Return Systems for Hybrid Fiber/Coax Cable TV Networks*, by Donald Raskin and Dean Stoneback
- *Modern Cable Television Technology*, by Walter Ciciora, James Farmer and David Large
- Society of Cable Telecommunications Engineers' return path packages, which include videotaped seminars covering two-way basics. Contact SCTE at (610) 363-6888 or www.scte.org.

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can use those controls instead of fixed pads to set receiver output levels. Be certain you don't set receiver outputs higher than the manufacturer's maximum recommended specs because of the distortions that may be generated in the receivers' RF output stages. Conversely, don't set levels too low because you may affect C/N performance.

Now crank up your reverse sweep equipment, setting the sweep to a level around 10 or 15 dB below the laser's maximum input power spec. You will find the recovered sweep signal at the headend to be at a level comparable to where you set the transmitter—that is, 10 or 15 dB below what the maximum level would have been with a CW carrier. The difference is that now you can see the entire reverse spectrum's frequency response.

Checking day-to-day operation

So far, we've been going through an alignment process using maximum recommended total power as the upstream laser input. This is not the same as your day-to-day operating levels, or even your reverse sweep transmitter level. They will in most cases be quite a bit lower. You can determine what the levels of specific upstream carriers must be by using a couple methods.

Arguably, the most accurate method involves calculating levels based on probability density function, a mathematically intense process. If you use Scientific-Atlanta equipment, your rep can get you a copy of the company's Windows-based software that will do the math for you. The software is a nifty tool because you can define different types of lasers, upstream traffic and so on, and get some very accurate results.

Another method that's not as accurate, but will get you in the ballpark, is the power per Hertz (Hz) method. It involves two equations you can perform on your scientific calculator. Let's go through an example using the optical links in Figure 2.

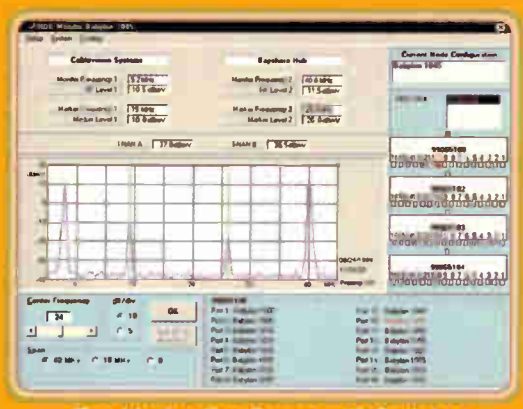
Assuming the maximum recommended total input to the upstream laser is +40 dBmV and the reverse path bandwidth is 35 MHz (5-40 MHz), what is the allocated power for a 3.2 MHz-wide quadrature phase shift keying (QPSK) data carrier at the input to the same laser? First calculate power per Hz using the formula:

Power per Hz =
total power - 10log(total bandwidth in Hz)
= +40 dBmV - 10log(35,000,000 Hz)
= +40 dBmV - 10(7.54)
= +40 dBmV - 75.44
= -35.44 dBmV per Hz

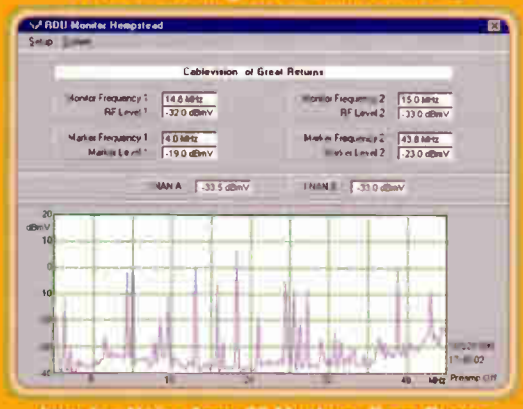
Next, calculate the allocated power for the 3.2 MHz wide digitally modulated carrier using the formula:

Channel power = power per Hz + 10log(channel bandwidth or channel spacing in Hz)
= -35.44 dBmV per Hz + 10log(3,200,000 Hz)
= -35.44 + 10(6.51)
= -35.44 + 65.05
= +29.61 dBmV

You can see that if the upstream laser's maximum recommended total input power is +40 dBmV, then a 3.2 MHz wide QPSK



Troubleshooting Screen with Switches



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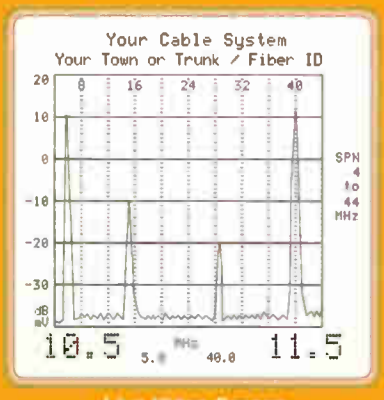

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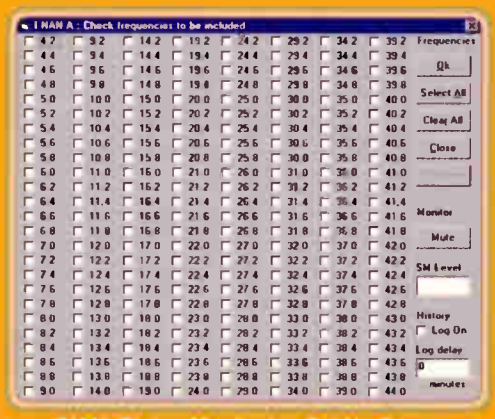

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Understanding Total Power

In the world of cable, we're used to measuring the amplitude of individual carriers, be they analog TV channels or continuous wave (CW) carriers. Consider a single CW carrier whose amplitude is +40 dBmV as shown in Figure 4 (on page 44). If the +40 dBmV carrier is the only signal in the spectrum (ignoring the effect of the noise floor), we can say its total average power is +40 dBmV.

What happens if two carriers are present, each with an amplitude of +40 dBmV? Well, the total average power in the spectrum has doubled, so it's now 3.01 dB greater, or +43.01 dBmV, even though the average power of each individual carrier is +40 dBmV. Here's the math:

Total power = $10\log(10^{+40/10} + 10^{+40/10})$
= $10\log(10^4 + 10^4)$
= $10\log(10{,}000 + 10{,}000)$
= $10\log(20{,}000)$
= $10(4.301)$
= 43.01 dBmV

In order to maintain a total average power of +40 dBmV when two identical amplitude CW carriers are present, we must reduce the amplitude of each carrier to +37 dBmV (actually 36.99 dBmV, a 3.01 dB reduction). Follow along with your scientific calculator (if you want to minimize rounding errors, use 36.9897000434 instead of 36.99):

Total power = $10\log(10^{+36.99/10} + 10^{+36.99/10})$
= $10\log(10^{3.699} + 10^{3.699})$
= $10\log(5{,}000 + 5{,}000)$
= $10\log(10{,}000)$
= $10(4)$
= 40 dBmV

What happens when we have 10 carriers present? Well, if the average power of each of the 10 is +40 dBmV, the total average power will be +50 dBmV. In order to maintain a total average power of +40 dBmV when 10 identical CW carriers are present, each carrier's amplitude must be reduced by 10 dB to +30 dBmV.

Total power = $10\log(10^{+30/10} + 10^{+30/10} + 10^{+30/10} + 10^{+30/10} + 10^{+30/10} + 10^{+30/10} + 10^{+30/10} + 10^{+30/10} + 10^{+30/10} + 10^{+30/10})$
= $10\log(10^3 + 10^3 + 10^3 + 10^3 + 10^3 + 10^3 + 10^3 + 10^3 + 10^3 + 10^3)$
= $10\log(1{,}000 + 1{,}000 + 1{,}000 + 1{,}000 + 1{,}000 + 1{,}000 + 1{,}000 + 1{,}000 + 1{,}000 + 1{,}000)$
= $10\log(10{,}000)$
= $10(4)$
= 40 dBmV

This is fine and dandy for discrete carriers. But when you have, say, a 6 MHz-wide digitally modulated carrier, things get a bit tricky. I'll not go into the involved math of "integrating power under the curve." (This is one way I've heard used to describe the process.) Instead, think of a whole bunch of discrete carriers squeezed together in the digitally modulated carrier's bandwidth. If you could measure each carrier separately, then you could use the previous power addition formula to calculate the approximate total average power. The point is, when referring to the average power level of a digitally modulated carrier, the reference is to the power within the digitally modulated carrier's entire bandwidth.

digitally modulated carrier's input power to the same laser is supposed to be +29.61 dBmV. Keep in mind this is the level at the laser input. The data carrier's input to the node will be even less, assuming RF gain stages are present before the laser. For example, if the maximum input to the node is +20 dBmV (and this produces a total power of +40 dBmV at the laser input), then the data carrier level at the node input would be +9.61 dBmV.

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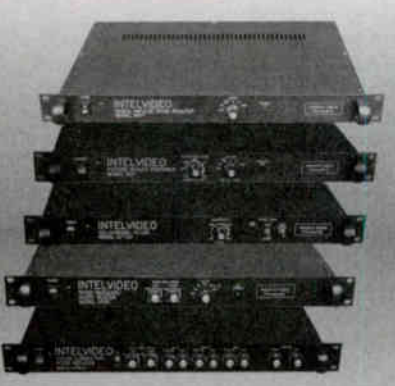

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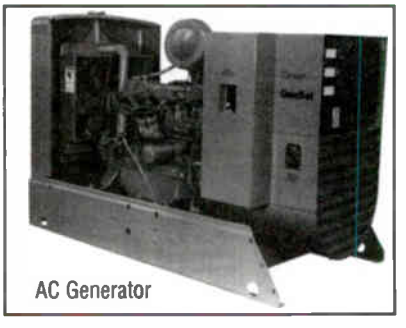
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carrier levels at the laser's maximum recommended total input power? It might give you nice C/N performance, but it also would place the data signal too close to the laser's clipping threshold. You'd be consuming headroom for the one carrier, leaving nothing for future services, let alone "safe" headroom for ingress and impulse noise. Remember, when the laser clips, nothing gets through for the duration of the clipping event because the laser effectively has no light output when it clips. So run signal levels where they belong.

Now look at Figure 3 (on page 44). Here I've replaced the levels of Figure 2 with the data carrier's levels. When you have +29.61 dBmV at each laser input, you can see what the operating levels are in relation to maximum recommended total power. Don't forget: Your actual levels will be different from the examples I've been using in this article.

Now you're ready

Only when you've gone through this exercise can you move on to headend reverse signal splitting and combining, otherwise known as RF management. You need to know what the operating levels are relative to maximum levels. This will allow you to design the splitting and combining network (or properly configure a commercially manufactured splitting and combining network) to give you the correct inputs to various upstream headend equipment. Don't design the headend reverse splitting and combining network based on maximum levels. It must be based on the correct operating levels.

Going the other direction, this exercise will allow you to properly align the coax plant amplifiers. When setting up the reverse, you have to start at the node and work your way out from there. The process is very similar to aligning the upstream optical links. You first need to know the amplifier manufacturer's maximum recommended operating levels and then set normal operating levels relative to that.

Follow these steps, and you're on your way to a trouble-free return path. CT

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

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ET 2000

Dr. Henry Nicholas, III, president and CEO of Broadcom Corp., discusses the future of customer premise products such as advanced set-tops and cable modems during his keynote address at Emerging Technologies 2000. Photos courtesy of SCTE.

Technologies Race Ahead

Helps Engineers Prepare

By Jennifer Whalen and Doug Larson

As you grapple with the launch of bandwidth-intensive services such as video-on-demand (VOD) and the emergence of video streaming over the Internet, you may be wondering how your network will be able to carry all that traffic. What's more, how will your customers ever distribute these new multimedia services throughout their homes?

If these issues keep you up at night, then the recent Society of Cable Telecommunications Engineers' Conference on Emerging Technologies was the place to be. Some of the best minds in the industry illuminated where technology is headed in these critical areas.

New compression algorithms such as wavelets and fractals will enable you to squeeze more content down your pipe. Plus changes are in progress to that old favorite, Moving Picture Experts Group (MPEG), which will enable your networks to handle an influx of multimedia services at a variety of low and high bit rates.

The most common form of video compression is, of course, MPEG, which is based on the Discrete Cosine Transform (DCT) encoding algorithm. This algorithm breaks MPEG video images into 8-pixel by 8-pixel squares, which then are combined to form macroblocks.

MPEG's compression efficiency comes from its predictive abilities. "Where you really save with compression is looking from one picture to the next. You don't want to compress each frame separately, but you want to look at the difference between them," explained Yvette Gordon, vice president of interactive technology for SeaChange International.

MPEG uses predictive frames (P-frames) to compare the current frame to the past and determine how much change there has been from previous frames. "Likewise, there's something called the bi-directional predictive frame or B-frame, which does the same thing forward and backward. With that, we can get really high compression rates," she explained.

If MPEG performs so well, why is anyone interested in Internet protocol (IP) streaming? "The reason IP streaming is really good is that there are algorithms that provide a lot more compression with the same video quality as MPEG-2 does for use today. We can take a wavelet algorithm and keep the same video quality and use 1 Mbps for a very nice high-quality movie that would take us over 3 Mbps today. It's just a matter of which is better, cheaper and more effective to stream with—IP or MPEG."

within your subscriber's home? The experts at ET 2000 weren't short of answers there, either, and—you guessed it—their answers involved learning yet another new vocabulary.

Bluetooth. LonMark. HiperLAN. Sounds like a bunch of gibberish, huh? Well, this terminology, which today is new to the cable TV industry, soon will be thrown around as haphazardly as our good friends DOCSIS (for Data Over Cable Service Interface Specification) and PacketCable if the pundits are on target. Along with hundreds of other technologies—or combinations of technologies—these promise to lay part of the foundation of tomorrow's networked homes.

And what are these predictions? Well, one forecast to which several speakers referred was a Yankee Group study that placed the current number of installed home networks at 650,000, a figure projected to skyrocket to 10 million by 2003. Others referred to a Cahners In-Stat Group report that estimated multiple personal computer (PC) households to be 21 million, 12 percent of which are connected by some form of home network.

What is it, and what's it look like?

OK, so home networks are a reality, but what is a home network, you ask? "A system of interconnections among a variety of devices in the home," explained panelist Rich Annibaldi, senior manager of technical research for Pioneer New Media Technologies in a preconference tutorial. Today, these networks mostly take the form of interconnections among PCs and peripheral devices, such as printers or fax machines, using existing phone or power lines or emerging wireless technologies.

But tomorrow will be a whole different ballgame. So, what exactly will tomorrow's home network look like? Well, that's anyone's guess, but *CT*'s Justin Junkus offered the audience one possible scenario for what he dubs the "media mediator" home network. "This is where the phone and the entertainment center are under supervision of a centralized controller," said Junkus, "and it works something like this: The phone rings, and a message flashes across the TV set that says that you have a phone call. You answer the phone call via the remote. The TV program goes to storage so that you can pick it up right from where you were before. And, by the way, the dishwasher also stops because it's too noisy in the background."

Rich Annibaldi, senior manager of technical research for Pioneer New Media Technologies, provides the audience with an overview of some of the evolving standards in home networking arena.

Junkus described home networking technology as a rose bush, which tends to creep all over the place if left to grow on its own. "We've got a number of technology options, and we've got a number of applications options, and operators are going to have to be somewhat careful in choosing which options they want to go with and what they want to support," he said.

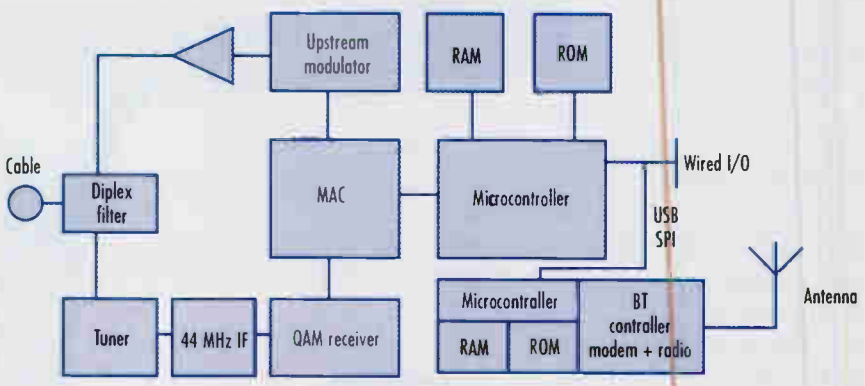
The reason for this can perhaps best be illustrated by the example of a home network that uses electrical power distribution. "It's a highly unbalanced topology," explained Junkus. "Every time you turn off the light switch, the network changes." Moreover, you have security considerations as well. What happens to data on your network once it leaves the fuse box—the common termination point in the network—and moves into the rest of the grid? "You can have filters on the network, but who's going to put those filters down on that electrical distribution system? Are we going to depend on the consumer having done it correctly? Are we going to go out there and do that?"

The choices you make . . .

While panelists took different approaches to the subject, all agreed that diversity will be the order of the day in the home networking market.

"I don't think there will ever be a single standard for home networking," said Annibaldi. "You're always going to have some clusters of equipment within the home." ➤

Bluetooth integrated with cable modem



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The question then arises, how do you connect those clusters without causing interference on other clusters? "A cluster needs to be like the perfect mother-in-law," said Annibaldi. "It needs to not interfere and needs to be there when you need to communicate."

In the existing wiring area, Annibaldi focused on two iterations of the HomePNA specification for telephone wiring—HomePNA 1.0 based upon Tut Systems' work and 2.0 based on Epigram's activity—which he called the "dominant approach" to home networking using existing telephone wiring.

Both approaches use frequency division multiplexing (FDM) to divide the channel over the twisted-pair phone line into three parts. "The lowest part, from 0 to 3.4 kHz, handles the plain old telephone services (POTS)," explained Annibaldi. "The midrange of 25 kHz to 1.1 MHz is reserved for ADSL (asymmetric digital subscriber line). And the top area, 5.5-9.5 MHz for the 1.0 spec and +-10 MHz for the 2.0 spec are both used for home networking."

HomePNA 1.0, which is available today from a number of manufacturers, provides speeds up to 1 Mbps, while the yet-to-be-finalized 2.0 version will provide up to 10 Mbps.

> "I don't think there will ever be a single standard for home networking."
>
> —Rich Annibaldi, Pioneer New Media Technologies

Annibaldi's advice for cable operators sizing up the home network market? "You should really try to avoid obsolescence in spite of the fact that these are rapidly evolving standards," said Annibaldi. "You need to minimize truck rolls by allowing subscribers to buy the equipment themselves," he added, while cautioning the audience not to support every technology and standard under the sun—a daunting, if not impossible, task.

Who needs wires

One home networking approach garnering a lot of press coverage these days is wireless, in particular the Bluetooth standard, which Silicon Wave's Vice President of Broadband Access Products Chuck Merk discussed at length.

The Bluetooth specification is targeted at short-range networking applications and utilizes the 2.4 GHz Industrial Scientific Medical (ISM) unlicensed band.

"Bluetooth employs a frequency-hopping spread-spectrum (FHSS) technique and hops very quickly—1,600 hops per

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second using short data packets," explained Merk, adding that it uses a binary Gaussian frequency shift keying (FSK) modulation. "So it's not high enough for video, but certainly supports good speed data and radiates 1 mW with an optional 100 mW."

Today, Bluetooth competes primarily with HomeRF Working Group's Shared Wireless Access Protocol (SWAP) and the Institute of Electrical and Electronics Engineers' (IEEE's) 802.11 standard. But Merk said the advantage goes to Bluetooth for its fast hopping and short packets, which make it less vulnerable to interference and reduces data transmission latency.

The single-chip solution

Merk, who touted the benefits of wireless personal area networks (PANs), also focused on some of the enabling RF integrated chip (IC) technologies addressing radio circuits and interfaces into cable networks.

"The challenges with any of these ICs will be power consumption, the size as

Left: CT's telephony editor Justin Junkus, also president of KnowledgeLink, cautions engineers to carefully choose which home networking technologies to support.

Below: (l-r) Session moderator Doug Semon, Time Warner Cable; Chuck Merk, Silicon Wave; Richard Annibaldi, Pioneer New Media Technologies; and Justin Junkus, KnowledgeLink, answer questions on home networking.

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well as the parasitics," said Merk. Silicon-on-insulator (SOI) BiCMOS (complementary metal-oxide semiconductor) technology promises to solve these challenges. SOI BiCMOS adds a layer of silicon dioxide (glass) insulation between circuits and the silicon substrate of a circuit board, which creates isolation as low as –92 dB at 1GHz and –79.5 dB at 2 GHz, at 200 µm spacing. "BiCMOS allows us to have both bipolar devices for all of the RF linear circuits as well as CMOS devices for the standard digital," explained Merk.

Where does this technology come into play in cable home networking arena? Well, today, cable modems use discrete-component tuners to select a desired channel from the 862 MHz broadband spectrum. The remainder of the modem functionality resides in digital ICs. The goal is to create a completely integrated modem, which eliminates the discrete component tuner and replaces it with an IC solution. Using SOI BiCMOS technology, Silicon Wave is developing a single-chip tuner that consumes about 750 mW and supports all DOCSIS modem parameters.

Employing SOI BiCMOS technology, Bluetooth PANs could be embedded in cable modems to enable wireless, two-way data transfer at speeds up to 721 kbps per module, which would allow for multiple phone lines or moderate-speed data connections to devices within the home without the requirement for Category 5 (CAT 5) cable. (See the accompanying figure on page 58.)

Yikes, I missed it!

If you weren't able to join SCTE in Anaheim, Calif., for the conference, don't worry. The Emerging Technologies 2000 Proceedings Manual is filled with detailed information on these topics as well as a host of others that were discussed at the conference. Simply contact the SCTE at (610) 363-6888 to purchase a copy. Or watch the pages of future issues of *Communications Technology* as we bring you some of the papers from ET 2000. CT

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Are Your Data Customers HAPPY?

Do You Have the Tools to Know?

By Bruce Balhmann

Running an Internet information service requires a high degree of technical expertise and—most importantly—consistency. As the Internet rushes into an increasing number of customer homes, the demand to sustain the load generated by new customers will require substantial attention of Internet service providers (ISPs).

The case where the Internet service supplied to customers is essentially an always-on connection provides the most challenging aspect of maintaining the performance and scalability of core Internet services.

Core Internet services for always-on connection providers are indicated in Table 1 (on page 70). Internet services such as dynamic host configuration protocol (DHCP), boot protocol (Bootp), trivial file transfer protocol (TFTP), and network time protocol (NTP) provide the basis for a cable modem to function and are of the infrastructure service type.

Other services such as domain name system (DNS), file transfer protocol (FTP), hypertext transfer protocol (HTTP), network news transport protocol (NNTP), ping, simple mail transfer protocol (SMTP), and Traceroute are all client service types.

The remaining services are used by the ISP's operations staff to monitor, sustain and troubleshoot the previous services.

Who does what?

A relationship exists between ISPs and their affiliates. Affiliates provide information services to customers, of which Internet information service is but one component. Internet providers supply the facilities to enable an affiliate to provide Internet services to its customers. This relationship is governed by a contract called a service level agreement (SLA), among other agreements. The SLA binds the affiliate to the Internet provider and defines the level of service the affiliate expects.

Within the SLA are several points of interest. Notably, the "Key Performance Indicators" and the "Network Services Conformance" sections provide the operational parameters that the Internet provider has committed to supplying. Key performance indicators are focused on response to outages or escalations whereas network services conformance is concerned with availability. And availability is key to the customer experience.

Understanding availability

Internet providers use the word availability to signify the level of reliability they intend to provide in various services they supply. Availability typically is defined in terms of percent, with higher percentages equating to higher reliability.

The availability projections within the SLA usually are based on the Internet provider's "best effort" to measure the accessibility of the services provided. One of the most common tools in use today to measure availability is ping. The ping application communicates with Internet hosts to determine their operational status. For example, if a host is operational (or "up") the ping application reports it as "alive." If the host is not operational (or "down"), ping reports "no response" or "request time out."

Although ping is a useful operational tool on the Internet, it is not a very reliable means of measuring availability. For example, the host may be up, but the application (or service) supplied by the host could be down. In this case, the availability is reported incorrectly. As a result, there is a difference between application availability (measured via the application's client) and host availability (measured via ping). Table 2 (on page 72) shows an example of this difference based on an actual

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Monitor the High-Speed Experience

The customer demand for quality Internet access is prompting a change in the way high-speed data services will be marketed in the future. Traditional methods for measuring Internet service performance will give rise to sophisticated applications that focus on customer experience and quality.

Monitoring client experience has the potential to provide affiliates with the information they need to quantify the level of service they receive from Internet providers and guide future agreements for continued service.

Because the customer sees the affiliate ultimately as responsible for providing reliable Internet service, the affiliate must seek ways to provide the highest quality service possible. One of the best ways to provide reliable service would be to pass along these requirements to the ISP. The following suggests some ways to accomplish this:

- Establish some means of confirming the quality and reliability of the service supplied by the Internet provider
- Establish motivations for the Internet provider to seek the highest availability possible
- Provide customers with access to current status of various applications, scheduled outage windows and so on
- Provide the data needed to make more informed decisions on handling trouble calls and coordinating requested upgrades by the Internet provider

sampling performed at MediaOne.

Surprisingly, the ISP often does the only monitoring of availability levels to measure its compliance with the SLA, generally because the affiliate lacks the means to do so. However, SLAs typically do not stipulate the type of monitoring (application availability or host availability) required. Without a specific request for monitoring method, host availability often is the default because it's the easiest to obtain. As a result, the monitoring data reported by the ISP does not always reflect the actual availability from a customer's perspective.

Because the affiliate ultimately is responsible for providing the service, it must seek ways to provide the highest quality service possible. One of the best ways to provide reliable service would be to pass along these requirements to the ISP. Here are some ways to accomplish this:

- Establish means of confirming the quality and reliability of the service supplied by the Internet provider
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- Provide customers with access to current status of various applications, scheduled outage windows and so on
- Provide the data to make informed decisions about trouble calls and coordinating requested upgrades by the ISP ➤

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Providing reliable Internet service helps the affiliate in several ways. Increased availability (higher reliability) means fewer trouble calls and potentially fewer truck rolls. Every trouble-related complaint cuts into sales calls. Increased availability means higher customer confidence in Internet service via cable, thus opening doors to sales in new markets. Increased availability also means more satisfied customers, which translates into greater demand.

Table 1: Internet application chart

Application	Protocol	Protocol	Service Type
BOOTP	Bootstrap protocol	UDP	Infrastructure
DHCP	Bootstrap protocol	UDP	Infrastructure
DNS	Domain name system	UDP/TCP	Client
FTP	File transfer	TCP	Client
HTTP	The Web	TCP	Client
NFS	Network file system	UDP/TCP	Ops
NNTP	Network news	TCP	Client
NTP	Time protocol	UDP	Infrastructure
Ping		ICMP	Client/Ops
SMTP	Electronic mail	TCP	Client
	POP3	---	
	IMAP	---	
SNMP	Network Management	UDP	Ops
Telnet	Remote login	TCP	Ops
TFTP	Trivial FTP	UDP	Infrastructure
Traceroute		ICMP/UDP	Client/Ops

Source: MediaOne

Create a tool

The impact that availability has on things such as call volume, truck rolls and higher sales is not known at this time. However, a tool that allows one to measure availability to the minute could be used to track call volume, look for trends and establish some relationships between the two.

It is reasonable to expect a relationship between call volume and availability. Further analysis could potentially derive a cost factor per customer that is absorbed by the affiliate as a result of reduced availability. The cost calculated could in turn be used to establish minimum availability levels an affiliate will accept.

Thus, having a tool to provide affiliates with up-to-the-minute calculations on availability could help them understand the relationships between availability and support costs and reduce the burden of poor service.

Providing motivation to ISPs is a key to establishing realistic minimum application service levels. By obtaining the history of an ISP's performance, you can establish the average service availability level provided. This average could then be used to drive the affiliate's required service availability levels. Combined with the impact studies, this could let the affiliate provide incentives for

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Table 2: Availability snapshot

	Ping availability (%)				Application availability (%)			
Service	Day	Month	Year	Overall	Day	Month	Year	Overall
dns1	100	100	100	100	99.14	99.31	99.33	99.33
dns2	100	100	100	100	100	99.86	99.86	99.86
dns3	100	99.99	99.99	99.99	100	99.92	99.92	99.92
dns4	100	99.96	99.97	99.97	100	99.97	99.98	99.98
news	100	99.99	99.99	99.99	100	99.94	99.93	99.93
ntp1	100	100	100	100	100	100	100	100
pop3	99.83	99.18	99.17	99.17	97.96	98.62	98.62	98.62
tftp	100	99.99	99.99	99.99	100	100	100	100
web2	100	100	100	100	100	100	100	100

Source: MediaOne

the ISP to perform above its required service availability, such as a kick-back premium per customer.

Likewise, service availability levels below the minimums could result in discounts per customer to let the affiliate recover the added support costs that resulted from customer calls. Such incentives would allow availability to be treated equally with other methods of evaluating an Internet service provider's performance.

Informed execution

Having the application availability information provides affiliates with the means to make informed decisions regarding escalation of calls to the ISP's tier two services, scheduling of service calls and acceptance of system upgrades. This information could drive affiliate requests for specific application performance upgrades.

Making informed decisions is a key to cost savings and reduced outages from unnecessary upgrades. Targeting capital expenditures to areas of need (a "scratch where it itches" approach) provides Internet providers with a means of controlling costs and increasing operational efficiency.

The shape of things to come

Consideration of client performance as a driving factor for application availability levels has not yet reached the mainstream, and "quality" features such as availability and reliability play a limited role in today's customer selection of an Internet information service. However, as customer's choices of Internet access become more equal in terms of speed, capability, price and flexibility, quality will differentiate one Internet information service from another.

"Increased availability means higher customer confidence in Internet service via cable, thus opening doors to sales in new markets."

As the market for Internet service shifts gears to begin focusing on quality, affiliates need to be ready to quantify the service levels they want to provide. Work-at-home customers will be among the first to demand high service levels and will compare options before buying.

Having access to up-to-the-minute service levels will enable marketing to target these demanding customers. Thus, such a tool can help drive up service availability and empower affiliates' continued growth in the future.

Bruce Bahlmann is senior systems engineer for MediaOne's Internet Services Group. He can be reached at bbahlmann@mediaone.com.

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DBS Reaches

Competition for Digital Video Subs Heats Up

By Arthur Cole

1999 was a banner year for the direct broadcast satellite (DBS) industry. The subscriber base continued to expand at a healthy clip, and it got some very welcome regulatory relief (from its own perspective) in the amended Satellite Home Viewer Act.

That's the bad news. Now here's the good. The cable TV industry, for the most part, is doing everything it should be doing to meet the threat and continue with healthy cash flows into the foreseeable future.

First some numbers: Analysts tracking the industry put the number of U.S. satellite viewers between 11 million and 12 million at the end of 1999, compared to a bit more than 9 million in 1998. That may seem like a pittance compared to the 67 million cable subscribers, but consider this: DBS's growth rate for 1999 was on the order of 20 to 30 percent last year, and it is likely to continue the upward trend in 2000. (See graph on page 78.)

"DBS has now reached a point of critical mass," says Michael Alpert, president of market tracking firm Alpert and Associates. "It is poised to make a major impact."

Alpert and others predict that by the end of 2000, DBS subscribership will have grown to between 14 million and 16 million.

DBS gets local

The reason for this optimism? Changes to the Satellite Home Viewer Act last November essentially removed regulatory restrictions against satellite providers' delivering broadcast signals to the broadcaster's local market, provided they get the station's consent.

Other changes include:

- Provisions for must-carry regulations on DBS providers beginning in 2002, but only where DBS providers have chosen to provide local signals
- Permission for DBS providers to continue delivering nonlocal broadcast signals, even to households receiving local signals; expires at the end of 2004
- Requirement that the Federal Communications Commission ensure that DBS operators are not excluding rural or underserved areas from receiving local signals

Immediately after the Act became law, the leading U.S. DBS players, DirecTV and EchoStar, shifted local retransmission plans into high gear.

As of this writing, EchoStar had completed local retransmission agreements in 20 top markets across the country, including New York, Los Angeles, Chicago, San Francisco, Boston, Kansas City, Houston and Washington, D.C. Negotiations were underway for another 30 cities, with final deals expected by late spring.

DirecTV, meanwhile, has inked deals in 10 major markets, including New York, L.A., San Francisco, Miami and Denver. The company has reached agreements with all 13 of NBC's owned and operated stations, all 10 of ABC's and all 22 of Fox's. ➤

Critical Mass

According to DBS executives, all of this activity was in direct response to the new law.

"(Amending the Act) lifted a barrier for many customers who previously chose not to buy a satellite dish system because they could not get local channels," says Marc Lumpkin, EchoStar's spokesman.

Going to the birds

Of course, agreements are one thing, and delivering a product is another. To actually get a local signal, the DBS providers will have to tweak their delivery services or get new hardware into the hands of customers.

> "DBS has now reached a point of critical mass. It is poised to make a major impact."
>
> —Michael Alpert
> Alpert and Associates

The immediate answer is to put all local stations on a continental U.S. (CONUS) satellite feed and then program the home receivers to pick up only the local channels. EchoStar and DirecTV already have done this. In EchoStar's case, customers outside of New York will need new dishes with a second receiver to pick up local signals beamed from EchoStar 5 at 110°W. The main channel lineup still will come from ES 1 and 2, located at 119°W.

DirecTV is likely to pursue a similar strategy in the short term, but ultimately, it will support local service with a new satellite, the DirecTV-4S, a Hughes HS-601HP bird. (Hughes owns DirecTV.) The bird will spot beam local signals from its berth at 101°W. A launch is expected at the end of 2001. (*Editor's note: As "CT" was going to press, Hughes announced the sale of its satellite systems businesses to the Boeing Company in an all-cash transaction valued at $3.75 billion.*) ➤

DBS Local Carriage Agreements

Agreements as of Jan. 10 (New agreements were emerging daily as CT went to press):

DirecTV and EchoStar

	ABC	CBS	Fox	NBC
Atlanta	WSB	WGNX	WAGA	WXIA
Boston	WCVB	WBZ	WFXT	WHDH
Chicago	WLS	WBBM	WFLD	WMAQ
Dallas	WFAA*	KTVT	KXAS	KDFW
Denver	KMGH	KCNC	KDVR	KUSA
Detroit	WXYZ	WWJ	WTBK	WDIV
Los Angeles	KABC	KCBS	KTTV	KNBC
Miami/Ft. Lauderdale	WPLG	WFOR	WSVN	WTVJ
New York	WABC	WCBS	WNYW	WNBC
Philadelphia	WPVI	KYW	WTXF	WCAU
Phoenix	KNXV	KPHO	KSAZ	KPNX
San Francisco/Oakland/San Jose	KGO	KPIX	KTVU	KRON
Washington, D.C.	WJLA	WUSA	WTTG	WRC

* pending

DirecTV

DirecTV has cut deals with all 13 NBC owned and operated stations (O&Os), all 10 ABC O&Os and all 22 Fox O&Os. In addition, they have signed:

Cleveland	WEWS	WOIO	WJW	WYKC
Greenville/Spartanburg, NC	WLOS*	WSPA	WHNS	WYFF
Houston	KTRK	KHOU*	KRIV	KPRC
Raleigh/Durham	WTVD	WRAL	WRAZ	WNCN

* pending

EchoStar

Minneapolis/St. Paul	KSTP	WCCO	WFTC	KARE
Nashville	WSMV	WKRN	WTVF	WZTV
Pittsburgh	WTAE	KDKA	WPGH	WPXI
Salt Lake City	KTUX	KUTV	KSTU	KSL
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Diversify or Die

No doubt about it: Direct broadcast satellite (DBS) is making major inroads into the video market, pulling precious cash flow away from operators just as they need it most to unleash their own digital operations. But while analysts expect DBS to capture a significant chunk of the TV market in the next decade, it by no means that cable TV is going the way of the mastodon.

In fact, the cable future looks bright when you consider that video delivery will be only one of many services to be carried over the wire within the next few years. True, it probably will continue as the most significant revenue source, but the cable industry won't live or die based on its video operations. Interactivity, telephony, data services and others will help diversify cable's bottom line so that success or failure in one business won't kill an entire operation.

That, of course, is if the cable leadership takes the right step today to protect its interests in the future. Laying the hybrid fiber/coax (HFC) groundwork for the network of the future was the first step. Now it's time to roll out services to the customer in a way that is both easy to understand and adopt and easy on the household budget.

In short, if DBS builds its business on TV subscribers, let them. Cable already will have expanded its horizons by then.

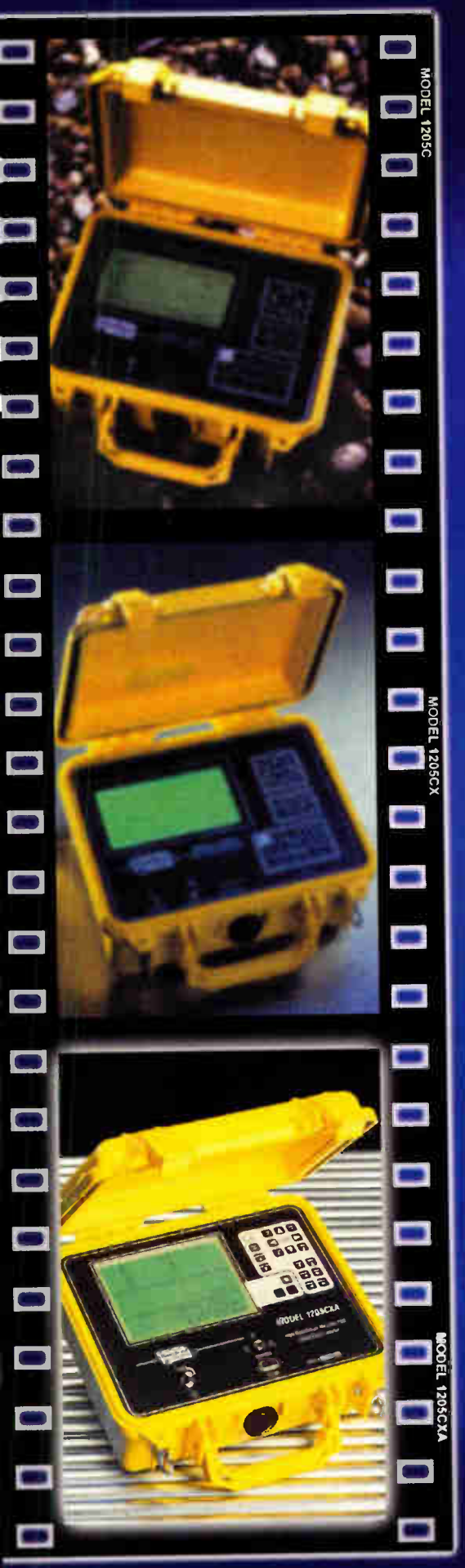

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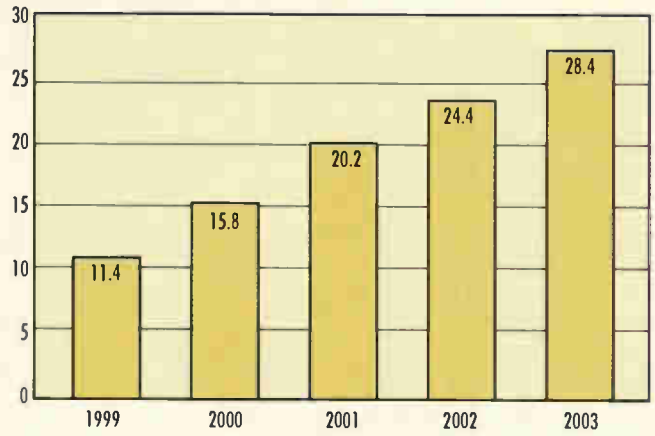
Figure 1: U.S. DBS growth projections (millions of subscribers)



Source: Cahners In-Stat Group

How bad is it?

So does this mean the end for cable? Fun while it lasted, but now's the time to get while the gettin's good? Hardly. Cable still is the dominant player in the TV game, and it will likely hold the most viewers for some years to come. In the meantime, there are a number of steps that the industry needs to take if it ultimately is to come out on top.

The first is to recognize that DBS does pose a serious threat to your TV business. DBS offers more channels, a cleaner signal and now local programming, all for a lower monthly cost than most basic packages. This realization finally is hitting home in the front offices of leading multiple system operators (MSOs), even though there is still some wishful thinking out there.

"We're concerned about DBS competition," said Jerald Kent, president and chief executive officer of Charter Communications at December's Western Cable Show. "But local-into-local I don't see as a threat to the business. Even in major markets, there are still capacity constraints."

Leo Hindery, formerly of TCI and now CEO of GlobalCenter, was less optimistic at the Western Show. "Satellite will threaten cable," said Hindery. "Those satellite subscribers (who also have cable) that are displeased with cable will not stay in that state. They will migrate from cable to satellite."

People power

And this brings us to step one in the fight against DBS erosion: Clean up your system by putting more effort into customer service. The days of rapid expansion are over. Business models no longer stand on wiring new communities. Aside from new subdivisions, just about every

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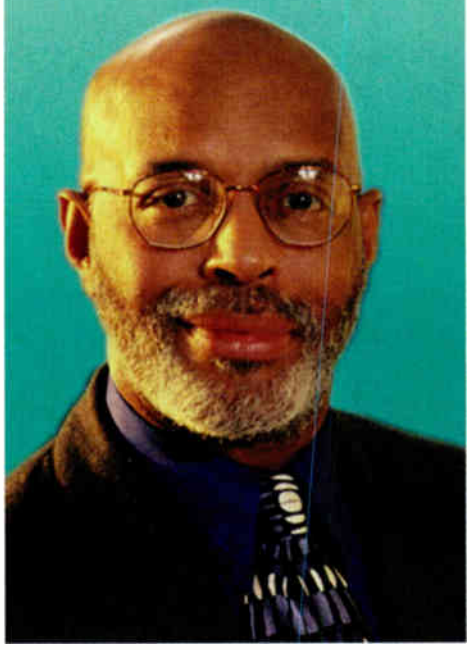

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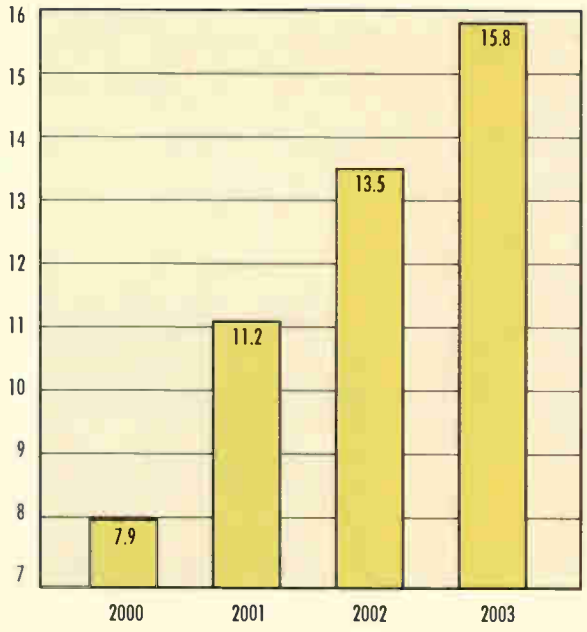
Figure 2: North American digital cable subscriber projections (millions of subscribers)



Source: Cahners In-Stat Group

community that can feasibly be wired already is. Instead, more resources must be devoted to customer service to overcome the impression that cable operators are sloppy and arrogant.

"There certainly does seem to be a lot of animosity with some customers on the part of the cable industry," says Michele Abrahams, senior analyst at Cahners In-Stat Group.

With expectations of poor cable service already in people's minds, coupled with the belief that the grass will be greener with a satellite dish, it takes only one blown call to lose a customer these days. That's why investment in technical personnel and equipment, such as mobile dispatching, will be crucial in the coming years.

Hand in hand with customer service, of course, is simplifying the move to digital cable. Not only must it be cost-competitive with satellite, it also must be easy to install. DBS customers who try to align their own dishes quickly find out that saving a hundred bucks on a professional installation is not worth the cost of a blown weekend. The cable industry has an opportunity to provide a plug-and-play installation procedure with such digital self-provisioning platforms that allow users of retail boxes to access a Web page to program their device and choose their level of service. If this can be made so simple that even Grandma can figure it out, that will be a major advantage for new customers.

Diversity is your friend

Neither of these measures, of course, will protect your video business 100 percent from satellite erosion. There always will be

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DBS subscribers are expected to grow to 28.4 million by the end of 2003. Digital cable subs are pegged at 15.8 million for the same period.

some dishes in your service area. That's why it is incumbent upon the cable industry to broaden its horizons beyond mere video delivery. Telephony, data services, interactivity—all these things will help diversify the industry so that we don't win or lose over a single service.

"The cable industry has got to be concerned with what DBS is doing," Alpert says. "The only response can be to hype the Internet connection and provide as many digital channels as possible to provide more choices."

If anything, now is a unique time in history, where all segments of the telecommunications industry hold their destinies in their own hands. CT

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

CableConnect Solutions

Lucent Technologies
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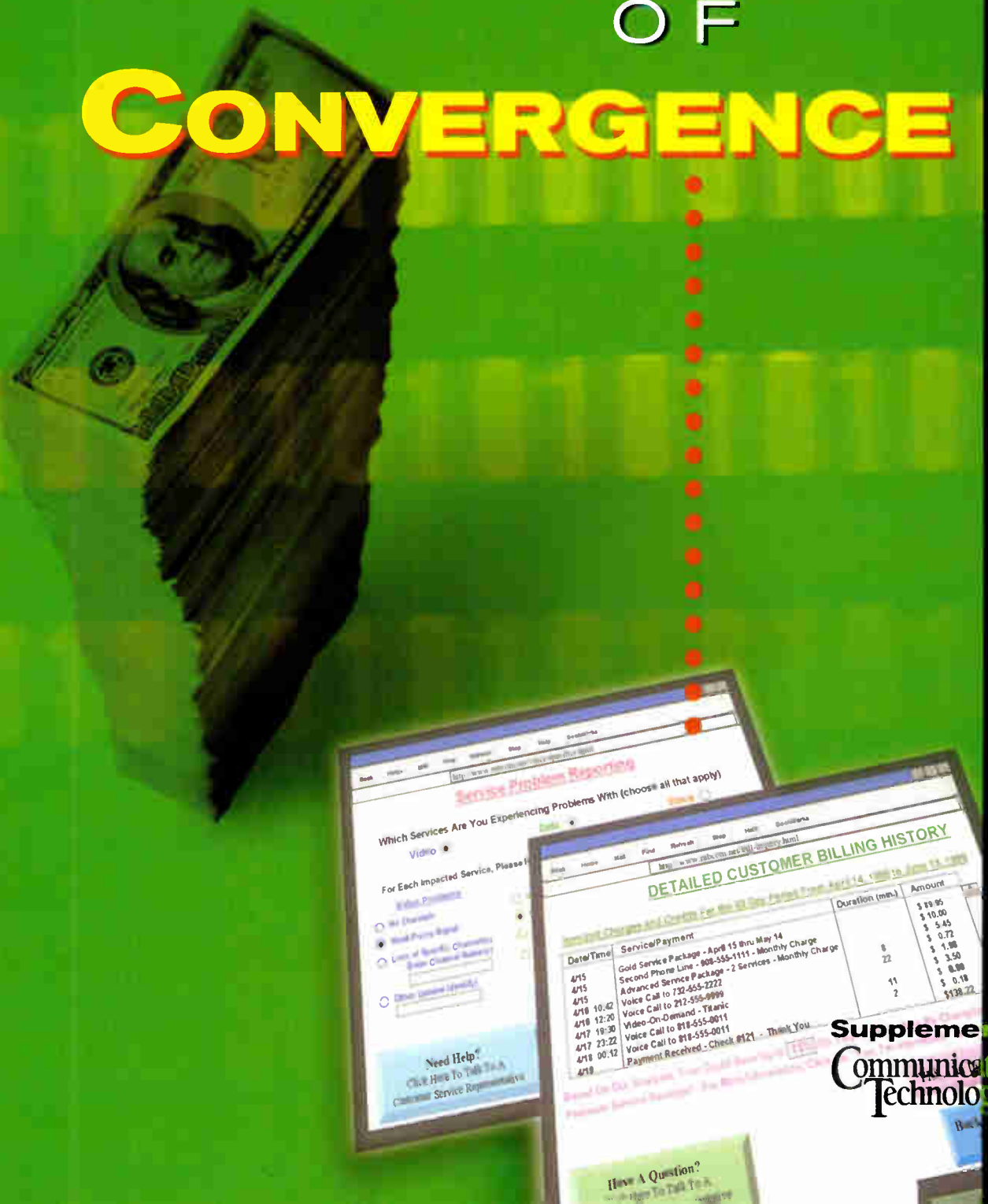
SIMPLIFYING THE BUSINESS OF CONVERGENCE



Supplement to Communications Technology

Editor's Letter

The Converged Network Of the 21st Century

By Rex Porter

The 1900s went out with a bang, but not the kind we worried about. Y2K didn't shut down the world. Terrorism didn't ravage U.S. cities. Stock markets rose to unexpected heights. And then the tech stocks took a beating. High definition TV (HDTV) was on everyone's mind, but didn't pan out. Rebuilds and upgrades helped digital TV, but high-speed Internet service stumbled for want of U.S. standards—then worldwide haggling between U.S. and international engineers.

Now hybrid fiber/coax (HFC) network owners and operators have to look for new revenue opportunities. New services need to repay the costs of system redesign, fiber cables, advanced network centers and additional equipment required for digital TV and Internet services. And it has to interface with our present networks.

By deploying a converged Internet protocol (IP) network, you can capture those revenues by offering new services such as telephony, high-speed data, virtual private networking, integrated messaging and video telephony. However, providing enhanced IP services over cable has been as perplexing to cable engineers as providing enhanced video has been for phone system engineers.

What's the solution? Cable operators need converged solutions that include telephony, data, operations support systems (OSSs), service and training from companies familiar with traditional HFC networks and circuit-switched telephone systems, plus IP networks. Not many cover all these bases. But Lucent is at the forefront of IP's development and on the cutting edge of its changes.

Lucent's R&D labs continue to generate new products for converged IP networks. For example, Lucent has developed its OSS around several services, which will emanate from the headend, network operations center (NOC) or home office. Lucent has seen the need for centralized monitoring in HFC networks, unlike the traditional sub-stations designed into switch-circuit telephone plants. These solutions will allow status monitoring of digital signals, pay-per-view (PPV), telephony, commercial data and residential high-speed Internet services—without redesigning the headend.

Integrating services allows savings in line equipment and creates an easier method of status monitoring of the complete system. And the OSS allows the operator to grow the business by simply adding more modules at the headend or central control location as needed. In effect, adding the OSS can improve other services while introducing IP telephony to HFC network customers.

Not only is Lucent delivering new system designs, but its introduction of a new optical cross-connect that switches light in a dense wavelength division multiplexing (DWDM) system offers new vistas toward switching times and bandwidth allocations.

Lucent's CentreVu Network Reporting software provides complete virtual call routing and other services. Its PathStar access server can replace a digital subscriber line access multiplexer (DSLAM), an H.323 gatekeeper, an edge router and a Class 5 switch. Its Text to Speech solution lets people read text in upwards of nine languages in both male and female vocal types. A Microsoft product, soon to be available through Lucent, is Unified Messenger for Service Providers, which allows voice, fax and e-mail messages to be received at one inbox, using one directory.

How will networks change in the future? If the past taught us anything, it's that "technology-change" feeds on itself, and converged IP networks will replace traditional overlays for voice and data services. NOCs probably will replace headends. NOCs will monitor the status of powering, laser transmissions, service interruptions and immediate switching before equipment failure.

The discovery of light tapping will lead to fiber-to-the-home (FTTH), and we won't have HFC networks anymore—just fiber! I expect Lucent to deliver a device to remove coaxial cable altogether. After all, it invented fiber. Who knows what device that fiber will connect into? It may not be a TV set, a computer or any other device we recognize today. But those fibers will transport all forms of IP traffic whether they be voice, video or data. Efficiencies gained from that converged network will probably pay the "cost of transport" for them all. •

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Interview With a Leader

IP Networking: Conduit to Cash

By Jennifer Whalen

Much of the discussion of Internet protocol (IP) thus far has been focused on delivering voice services over our cable plant. In so doing, we have ignored an even more compelling argument for IP, that of a converged IP voice and data platform. In the interview that follows, Marty Glapa, chief technical officer for Lucent's Cable Communications Business Unit, considers the technical and operational efficiencies inherent in a converged network.

J. Whalen: What are the economic advantages of deploying Lucent's CableConnect IP solution for voice and data services vs. circuit overlays?

M. Glapa: Building a converged telephony/data network raises the common layer for voice and data services from a physical coax layer to an IP layer. In doing so you gain efficiencies in capital equipment by sharing equipment and tightly integrating equipment on both the network side as well as on the consumer side.

The advantages that we've seen from a purely capital perspective range anywhere from 30 percent to 50 percent savings to build a converged network that carries IP telephony and high-speed data cable modem service.

J. Whalen: Where specifically do you gain equipment efficiencies with an integrated IP platform?

M. Glapa: With traditional circuit telephony and cable modem service, you have two different devices in the consumer's home: the cable modem to provide data service and the network interface unit (NIU) to provide telephony service. With a converged IP network, a multimedia terminal adapter (MTA) in the home provides both the IP telephony and the cable data modem service via a single device. You achieve a tremendous cost savings right there, because you've gone from two devices to one.

By using the common IP transport layer, you gain additional capital savings in the network as well. You can now share routing/switching equipment, so the same equipment that transports cable data modem service also transports IP telephony service.

J. Whalen: What kinds of operational savings can Lucent's CableConnect Solution help you achieve?

M. Glapa: Because telephony and data are sharing common infrastructure, it's easier to have a common operational approach. Savings come from having an integrated operation support system (OSS) that can administer, maintain, provision and monitor the infrastructure, rather than having multiple OSSs as is required for today's circuit telephony and cable data modem deployments.

An integrated IP platform also enables auto-provisioning of the devices. This achieves further savings because it requires less human intervention than is needed today. The winners in this business will be able to automate operations and minimize the personnel involved in turning up a service.

Finally, given that you've reduced the amount of equipment needed in the network and at the customer premise, it means there is less equipment that you need to maintain. So you save there as well.

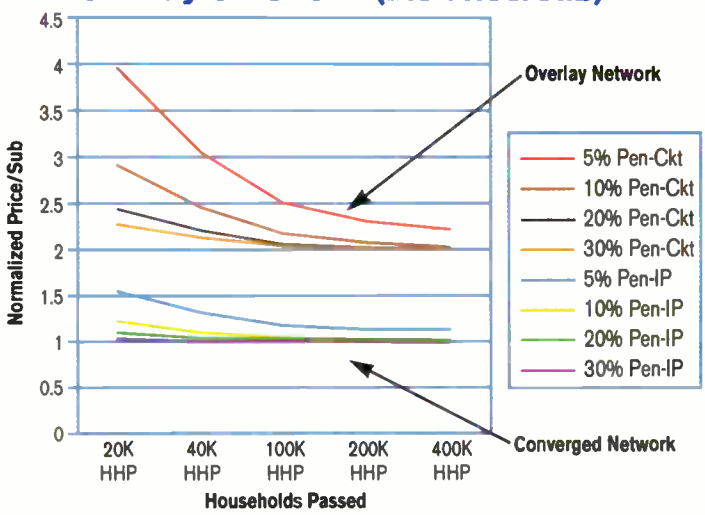
J. Whalen: What new revenue-generating services can you offer as a result of building a converged IP network?

M. Glapa: The fact that we've integrated data and telephony together at the common logical layer affords the ability to provide more robust services that can leverage features from both. IP is the way to achieve this. Circuit-switched solutions will not be able to deliver integrated broadband services.

You'll be able to offer services like Web integration and voice messaging services that allow you to receive e-mail to voicemail and e-mail to fax. You can provide virtual private networks (VPNs) to offer work-at-home types of services that allow users to appear as though they are at work and have access to the kinds of telephone, data and messaging services they have at work. Streaming video will be available for video teleconferencing services.

The converged IP network opens up a whole host of new service potential that can leverage the fact that we've got a common IP layer, and the highest bandwidth pipe in the industry. Such new services hold significant revenue potential for the cable operator. •

Normalized Price/Sub: IP Telephony vs. HSD Overlay on Circuit (2.5 lines/sub)



Source: Lucent

Comcast and Lucent Deliver IP Telephony

Successful Field Trial Confirms Real World Viability of VoIP

By Arthur Cole

Of all the new digital services that cable TV operators are rolling out this year, the most complex is Internet protocol (IP) telephony. Not only is the two-way delivery of packetized data a more challenging technical feat compared to what most cable engineers are used to—one-way delivery of massive amounts of information—the network requirements for such things as powering and emergency service is much more rigid. Besides, your plant now has to interface to the public switched telephone network (PSTN) allowing your customers to dial any number in the world at any time.

And yet cable TV is charging forward into the telephony world because, well, because it's so darn lucrative. AT&T and Bell Atlantic didn't become billion dollar companies selling flowers, you know.

The Case for IP

Of all the advanced services, telephony will probably be the last to roll out, most likely hitting the streets after the public has embraced interactive TV, cable modems and the rest. But make no mistake: just because IP telephony is last out of the gate doesn't mean the public won't be hammering for a new and cheaper way to reach out and touch someone. In fact, customer surveys suggest IP telephony is one of the most eagerly anticipated services cable has to offer, particularly if it's available in a flat-fee, unlimited use program like most Internet services.

In addition, IP telephony is the most cost-effective solution for cable because, unlike circuit-switched telephony, it can be delivered on the same network as that used for digital video and data. It's not necessary to build a separate network to get into the voice business.

Lucent Technologies is one of the companies leading the way to cable-based IP telephony. The company's long history in telephone service (it was the original hardware subsidiary of AT&T) makes it an ideal partner for cable systems looking to break into the telephony market. Already, a number of leading multiple system operators (MSOs) are examining Lucent's CableConnect IP telephony system. Most notable is Comcast Corp.'s CableConnect trial in its Union City, N.J., system, the first field test of a system that is fully compliant with CableLab's PacketCable 1.0 specification.

Anatomy of a Trial

The Comcast system utilizes Lucent's PathStar Access Server tied to a Cable Router cable modem termination system (CMTS) provided by Motorola, which also is providing the multimedia terminal adapter (MTA) in subscribers' homes. Lucent and Motorola have an ongoing agreement to offer the CMTS and MTA products in conjunction with the CableConnect Solutions line.

About 25 subscribers are taking part in the trial, with expectations that 100 or more could be hooked up soon. Eventually, the system will be scaled up to 1,000 or more subscribers before a full commercial launch in 2001.

The service delivers high-quality voice and the familiarity of traditional telephone service. Customers simply pick up the phone, dial and talk. In addition, the service supports local and long distance calling, both within the Comcast plant and "off-network" over the public telephone network. As well, there are emergency services such as 911, and standard telephone features such as operator assistance, directory assistance and others. More advanced phone services also are available, such as call waiting, call forwarding and caller ID.

That's not the end of it. Because IP telephony service is part and parcel to the digital voice, video and data network, possibilities abound through the convergence of these services. Notification of incoming calls or email, along with caller ID, can be delivered to the TV set.

One Switch Does It All

The heart of the system is the PathStar Access Server, a packet switch that integrates a number of separate functions into a single device. PathStar provides access, telephony, voice over IP gateway, edge routing and other functions on a single 23-inch shelf.

PathStar can be viewed as Lucent's entry-level server for IP telephony. Scaleable to 10,000 customers, it provides a quick way in for customers looking to build an IP network from the ground up. Lucent is in the process of developing the 7R/E packet switch scaleable to 100,000 customers. The 7R/E is the next generation voice switch for the competitive local exchange carrier (CLEC) market, which already has a substantial voice network in place. Once a cable operator is pushing the limits of the PathStar system, it is an easy migration to the 7R/E.

So if the CableConnect system is based on such proven technology, what knowledge is to be gained from the Comcast trial? Surprisingly little, except to determine that the system works in a real world environment.

One key factor in the installation was determining the proper RF tuning to support voice communications. The correct RF will vary from plant to plant so it's best to run a sweep of the plant locally to make sure the network is calibrated to the proper frequency. After that, it's pretty much a question of putting the system through the paces. All indications are that the Comcast system passes with flying colors and is ready to be deployed as the primary phone system. The only real question for cable operators is exactly how they want to deploy IP telephony.

Plan First, Deploy Later

One of the first things to determine is whether a solid business plan will support IP telephony in your particular system. It's important to crunch the numbers first to see what impact the building of the service will have on your cash flow and capital budget, and then determine if there is enough revenue potential to justify the expense.

Another major concern is exactly how to deploy and market IP telephony. Companies like Comcast are looking ahead to converged services where there are all sorts of cross-promotion and tie-in potential between voice, video and data. Other systems might take a slower approach, maybe getting comfortable with the two-way aspect of a data service before jumping ahead to telephony. Still others might want to pitch their infant telephony service as a secondary line. Whichever the approach, Lucent's CableConnect system will fit the bill. Not only is it fully scaleable, but it is engineered to build on and integrate with other systems that may already be in place.

One-Stop Solution

This ability to provide a single, integrated package for voice, video and data is one of the strengths of the CableConnect system. The system's Operations Support Solution outfits the headend with vital management and support tools designed to work across all services. Instead of having separate systems for each service, there is one platform for billing, security, fault detection and correction and even Web-based customer service and support.

The package conforms to the Data Over Cable Service Interface Specification (DOCSIS), OpenCable and PacketCable specifications, allowing it to work with compliant third-party hardware and software. This allows CableConnect to fit comfortably with existing systems so cable operators do not have to reinvent the wheel to introduce new services.

The Power of Partnership

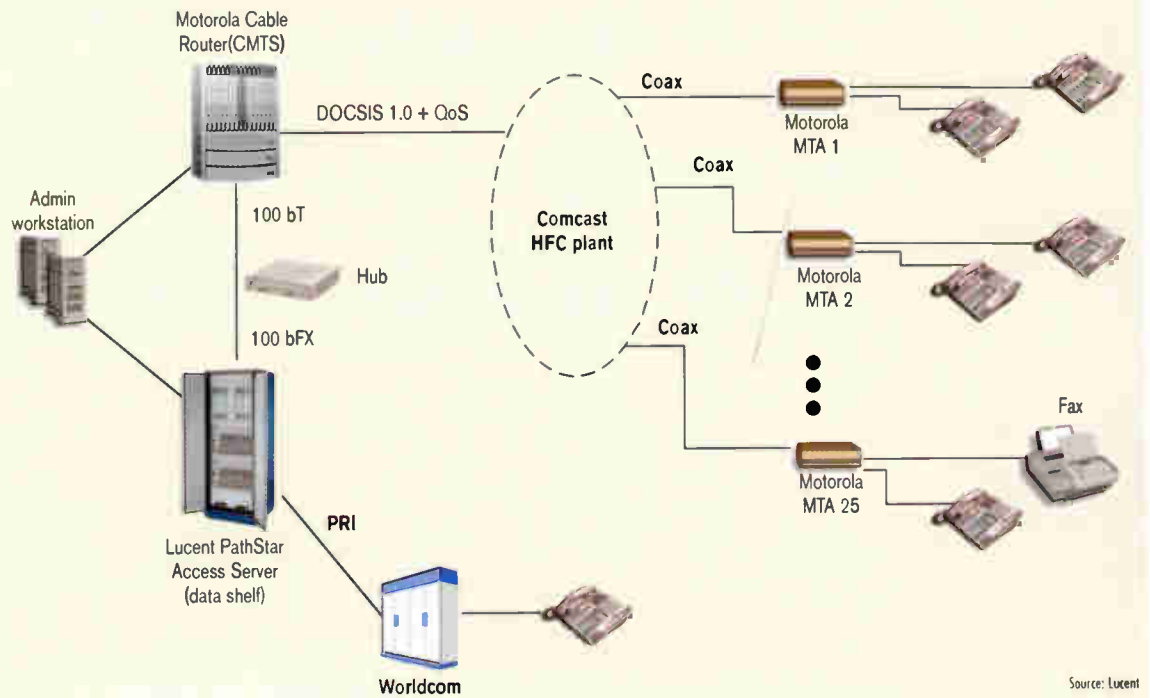
In developing its digital voice, video and data systems, Lucent is committed to providing the most cutting edge solutions, even if that means bringing in the expertise of other manufacturers. As a leader in digital data network solutions, Lucent has consistently led the field in the development of timely, cost-effective and innovative products. But there are times when it makes more sense to forge alliances with leaders in other fields rather than place the burden on in-house development.

Such was the thinking behind the recent agreement between Lucent and General Instrument announced at the Western Cable Show last December. The agreement calls for the two companies to jointly develop and market compatible systems designed to bridge the gap between Lucent's cable network technology and GI's customer premises products. The result will be a complete end-to-end IP telephony solution centered around the PathStar and 7R/E systems and the IQ Smart Access family of products from GI, namely the IQ Smart SURFboard SB3500 cable modem and the CentriQ 1000 communications gateway. As well, the GI NETsentry software management system will integrate with the Lucent OSS package to form a powerful network management system to provision, manage and monitor the system.

The combined might of the two companies draws cable operators and customers alike. Cable operators receive the advanced network technology of the CableConnect solution, while end users benefit from the CentriQ 1000's four separate telephone lines and support for advanced features like call waiting, DOCSIS-based data and single distribution point for digital video.

Whatever the future holds, whatever new as-yet undreamed of services take hold on the cable pipeline, there is little doubt that Lucent will be at the forefront of the digital communications revolution. •

Comcast Trial Configuration—Phase I



Source: Lucent

Lucent Simplifies Day-to-Day Operations for Cable Systems

By Arthur Cole

Internet. Television. Interactivity. Telephony. It doesn't take a rocket scientist to see that the cable system of the future is going to be radically different from what we see today. An abundance of new services and new technologies is poised to significantly complicate the way you do business.

The single most difficult challenge facing the cable operator of the future will be managing this burgeoning operation in a way that delivers top-notch quality to the consumer. For many years the cable business model has focused on growth: signing up new subscribers was job No. 1 for most systems, even if it meant skimping on customer service. But in today's competitive marketplace, where customers will be drawn to the least expensive, most reliable communications provider, delivering a rock-solid set of services will emerge as the primary task.

And here lies the conundrum. The more services you add, the more complicated your system becomes and the more difficult it is to deliver a smooth-running, dynamic package to your customers. Think about it: one system overseeing digital video, another running telephony, several racks of boxes delivering interactivity, Web service and whatever else comes down the pike. All tied into traffic and billing units that are trying to keep up with service requests, system orders, pay-per-view (PPV) and all the rest.

Clearly what is needed in the headend is an integrated operations solution that ties all of these elements together, one that works across all of the emerging digital standards governing video, data and telephony.

Lucent Technologies has developed the CableConnect Operations Support Solution (OSS), a modular end-to-end software solution that brings control of the various cable offerings under one set of applications. The system is modular to afford cable operators the flexibility of adding components as they expand their operations as voice and data carriers. The OSS solution is being designed as an "open" architecture, with each interface using a documented, open application programming interface (API) that third-party developers can utilize to integrate their solutions into the Lucent architecture. The Lucent CableConnect OSS architecture is illustrated below.

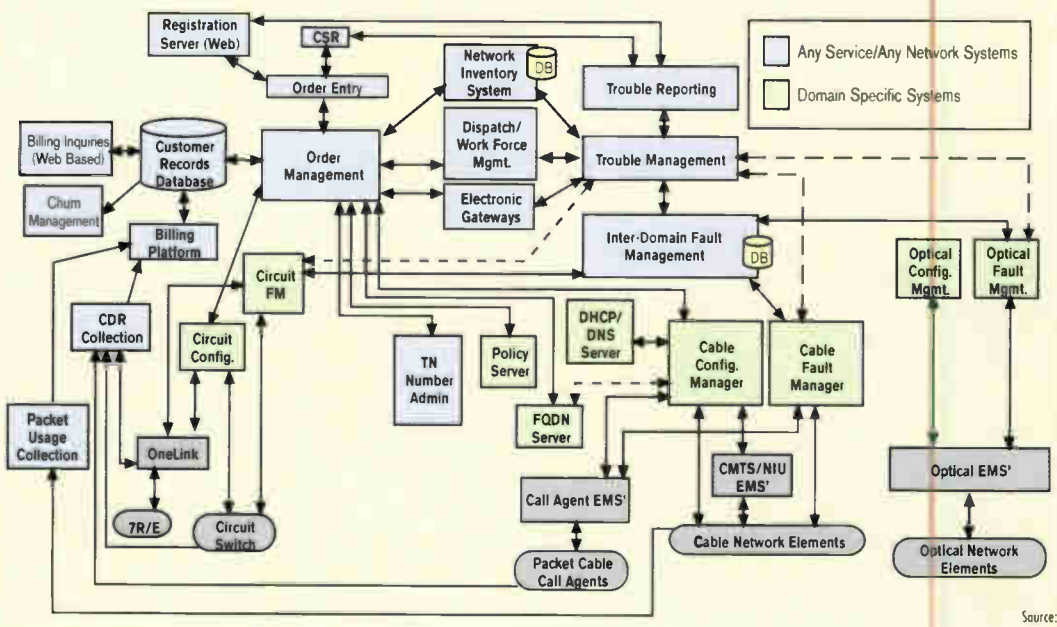
In developing the OSS system, Lucent has drawn on its many years as a system provider for the telephone industry, where reliable service has been a major consideration throughout its history. The OSS solution is composed of five key modules:

Service Activation And Billing

An integrated set of systems that works with all services is the ideal platform to allow customer service professionals to order new service, update customer information, schedule service visits and perform a host of other functions. By integrating the control aspect of all your various services—voice, video and data—you eliminate virtually all of the complexity of an environment in which each service had its own set of applications and data requirements.

The benefits of an integrated system are numerous. First, you now have a single customer database that can be easily mined for usage patterns and profiles to deliver more

Multi-Service Cable OS Architecture (Baseline)



Source: Lucent

tailored services. You also can more easily develop package-based discounts and specials and devise flat rate or usage-based billing offerings. The OSS also offers end-to-end flow-through service provisioning that quickly activates new customers and gets revenue flowing in quickly.

Another key component is integrated workforce management/dispatch functionality that reduces truck rolls and provides connectivity to technicians in the field. Lucent is working closely with MDSI Mobile Data Solutions Inc. to integrate that company's workforce management system with the Lucent OSS.

Fault Management

As customer service and support emerges as a key factor in modern cable systems, the ability to detect and correct problems in the headend and the plant will become paramount, especially with the introduction of telephony services. But again, with multiple services being carried under an array of network technologies and standards, keeping track of all the data on your system could become a monumental task.

The OSS Fault Management module provides advanced fault detection and isolation across all services. Not only will this deliver a more streamlined service to the customer, it cuts costs by eliminating the need to send a technician into the field to determine the source of the problem. Faults are tracked down, and in many cases repaired, from the headend. And 24-hour monitoring will often locate and repair faults before the customer is even aware of them.

Web-Based Customer Self-Care

Retail sales of digital cable boxes, cable modems and cable telephony devices will be a tremendous boon to the industry. It will end the standard practice of leasing the ever-depreciating box to the customer and it will provide more choice and flexibility to the subscriber. But to truly simplify matters, wouldn't it be great if subscribers could purchase and install the box on their own and program it to receive the level of service they desire. Under the OSS's Customer Self Care module, they can.

The system provides Web access to subscribers, allowing them to sign on and modify their service profiles, report problems and check on the status of their complaints, review billing records and inquire about charges, and complete a host of other functions. With the end users now in control of their service, they are more likely to select higher tiers of service and increase the amount of impulse purchases made by customers.

This is the advent of plug-and-play service management. Subscribers bring home the box of their choice, plug it in and follow the online guide to their desired level of service.

Improved Inventory Management

This module acts as a centralized database of network information, providing operating details and performance data on all system components from the headend to the home. The database has an open interface that allows third-party systems to easily retrieve data for support functions, such as service availability and alarm correlation.

This is a key consideration for the cable system of the future, because operators are going to have a broad range of vendors and service providers to choose from. It is vitally important that all of these systems be able to communicate with the central operating system (OS) to ensure peak performance.

New Service Creation

The New Service Creation module is based on advanced intelligent services platforms that allow the introduction of new services operating across all voice, video and data networks. Among the potential applications are unified messaging, in which voicemail, e-mail and fax messages are integrated into one messaging center, follow-me services and television-based caller ID systems.

Easy Installation

One of the key design concepts behind the OSS is its ability to smoothly integrate into an existing plant. At the outset of Internet protocol (IP) telephony, data and other services, it would be impractical to retrofit and entire headend. Instead, the OSS builds on what is already in place by adhering to the emerging Data Over Cable Service Interface Specification (DOCSIS), OpenCable and PacketCable standards. Not only will this ensure compatibility across a wide range of professional cable equipment, but will give subscribers the peace of mind that off-the-shelf retail products will not be met with a brick wall of incompatibility.

Modularity is another important factor in the development of the OSS system. Capital budgets are not bottomless pits, and it is vitally important that the transition from video-only to an integrated service offering be a smooth one. For these reasons, the OSS modules can be installed and put into operation individually as network requirements expand and budgets allow.

Another design consideration comes from the realization that Lucent is not the only source of innovative products in the marketplace. In the drive to develop the most advanced system, the company is turning to other manufacturers to compile a broad range of techniques and technologies.

A prime example is a recent agreement with General Instrument that will combine that company's NETsentry management system with the OSS. The result will be a complete end-to-end provisioning, monitoring and management system. And as mentioned earlier, Lucent also has teamed up with MDSI Mobile Data Solutions Inc. to integrate that company's workforce management system into the OSS, providing the ability automatically to generate work orders and manage field crews via a wireless data connection.

Clearly, cable is poised to become a significant, even dominant, player in the telecommunications industry. But that will only come about if the industry is willing to step up the reliability of its networks and streamline its operations to the point where hooking up a cable box or modem is no more difficult that plugging in a telephone.

Yes, the cable business is growing more complicated with each passing day and there are significant challenges ahead. But solutions like Lucent's OSS are primed and ready to bring the industry into the 21st Century. •

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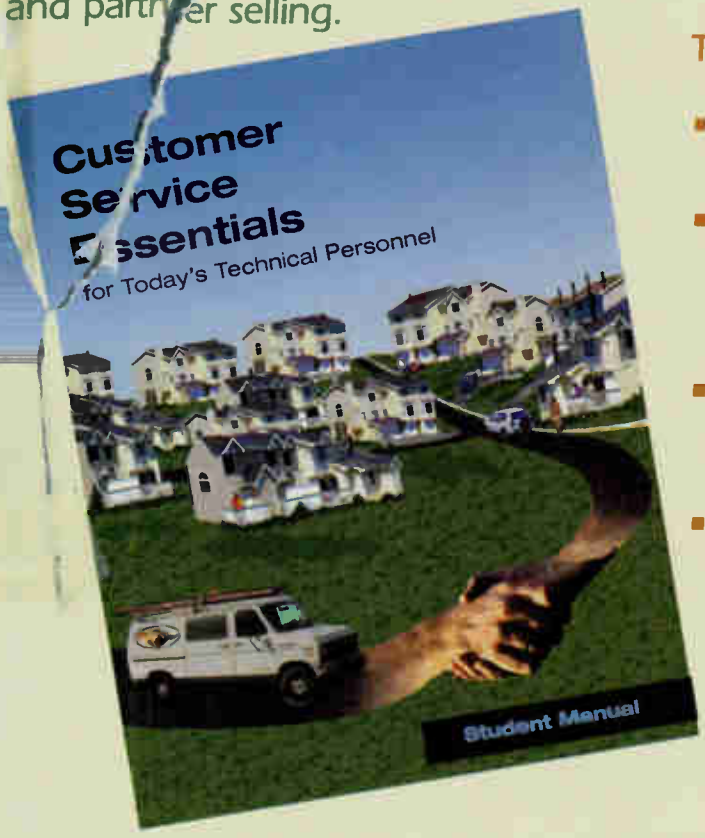

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(Editor's note: "Communications Technology" continues its series on cable telephony. For a look at how to plan your telephony network and what equipment is available to support your service, see our January 2000 issue, pages 102-122.)

Field of Telephony

Build it so They Will Come

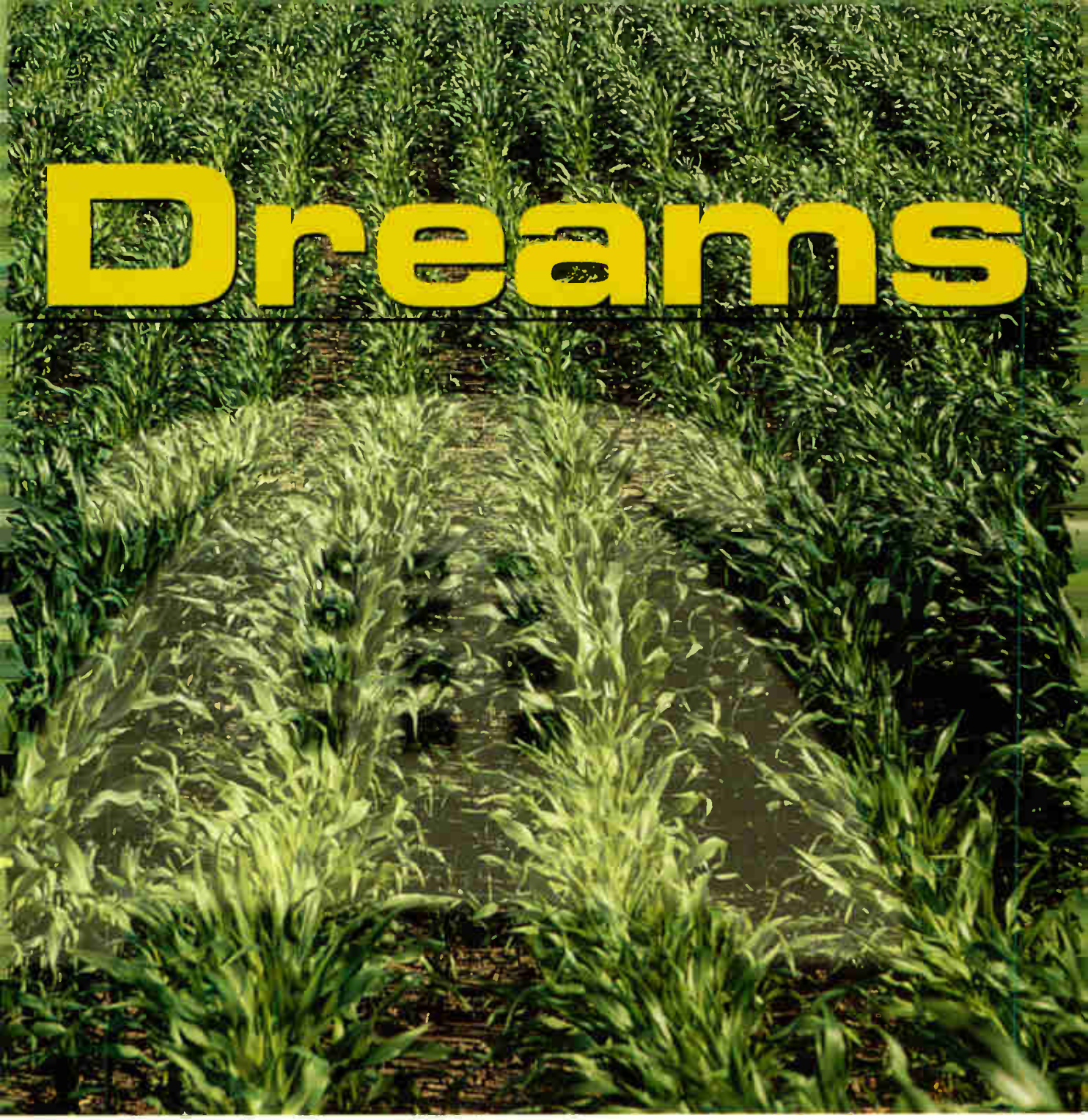
By Justin J. Junkus

Last month, you discovered that multiple system operators (MSOs) can successfully launch telephony services. Now that you've decided to take the plunge, let's use the final installment in our series to review the steps you'll need to take to upgrade your network and the generic equipment you'll need to capture telephony revenues.

Two-way or no way

Operational two-way is a prerequisite for any telephony offering, so a plant upgrade is a "must do" item. As any operator knows, this type of upgrade is not trivial, but is necessary for many other revenue-generating broadband services, including high-speed data and interactive digital TV (DTV).

In many cases, the upgrade has been a complete redefinition of the distribution system, such as the one done by MediaOne in Atlanta in th mid-1990s. In addition to increasin the upper bandwidth of the system 750 MHz by changing the active components of the network, MediaOne added fiber hubs and node and consolidated headends. Specif cally for telephony, it created a se rate synchronous optical network (SONET)-based fiber ring to conr to 5ESS telephony switches at the new headends.



While not all upgrades involve as much redefinition of the distribution network, several other operators already have completed the extensions of fiber, addition of fiber nodes, and amplifier swaps needed for 750 MHz operation. Increasingly, many operators are adding even more bandwidth by upgrading to 870 MHz. Once the basic network upgrade is completed, it may be possible to increase bandwidth in the future by changing the active lightwave components. Fiber-optic system vendors already are discussing migrations to Gigahertz-capable systems.

Whether the plant is new or redesigned, a complete prequalification of the reverse path is a good practice before adding any two-way service. It's possible to verify reverse path operation by service area as new services are being brought online, but many operators who have taken this approach have found that unexpected problems with ingress are more likely when the system has not been fully tested.

Equipment requirements

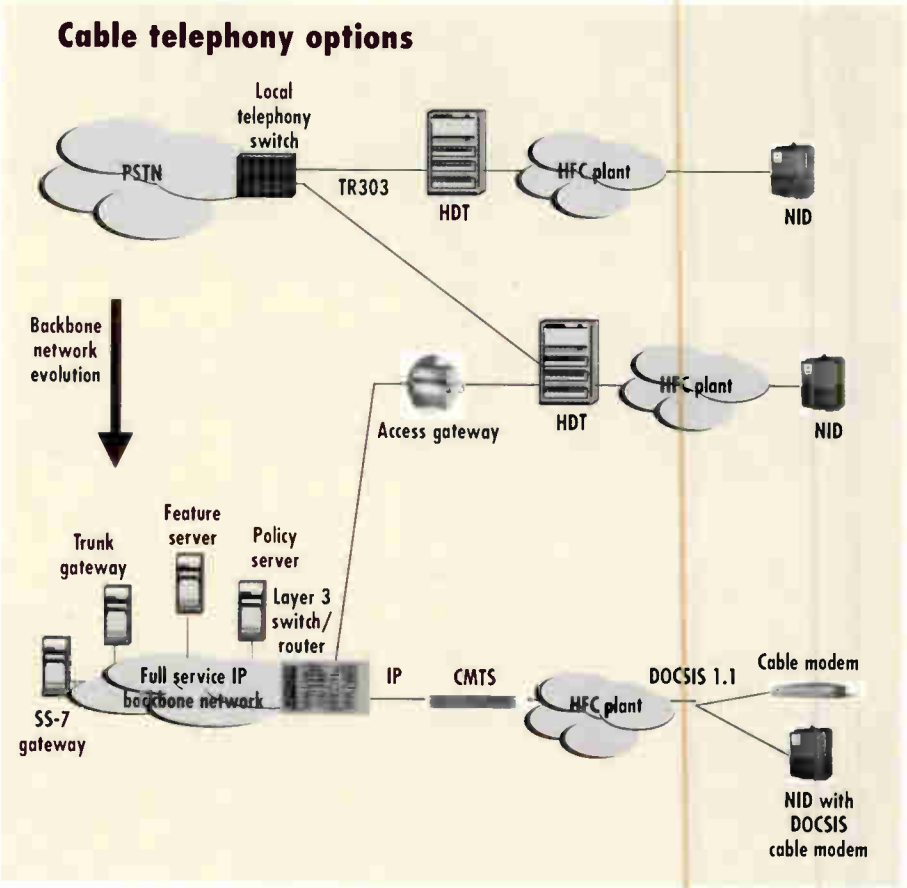
Once reverse capability has been installed and tested, the system can activate the hardware that actually provides the telephony service. The equipment suite will depend on the operator's choice of telephony technology.

All the offerings will require a digitally capable network interface device (NID) at the subscriber premises. Circuit-switched solutions also will require a host digital terminal (HDT) at the headend or hub

and a connection to a circuit switch. Voice over Internet protocol (VoIP) solutions substitute a cable modem termination system (CMTS) and Internet gateway for the HDT and circuit switch. Circuit-switched solutions that also offer some type of data capability, perhaps for early adopters of VoIP technology, may need both. (See the accompanying figure.)

The cable telephony NID is no longer just a passive termination point for coaxial distribution. It is essentially an extension of the line card that used to live in the digital telecommunications switch at the telephone company central office. Functions collectively known as BORSCHT must now reside at the NID, rather than within a remote telephony switch. BORSCHT stands for battery, overvoltage protection, ringing, supervision, codec, hybrid and testing.

Telephony signals as well as voice information must be converted to a form that can be transported on RF plant, so the NID must include at least some form of RF modem. In early implementations, the RF modem was a proprietary implementation of basic cable modem technology. The trend is to make it fully conform to the Data Over Cable Service Interface Specification (DOCSIS), thus opening the door to a NID that can serve IP telephony as well as other high-speed data applications.



Powering options

Powering the NID is a major consideration for telephony. The NID and the subscribers' telephone sets need to be supplied with appropriate operating voltages. Providing power over the center conductor of the coaxial cable is one option, as is a separate "Siamese" conductor that is in the same jacket as the coaxial conductor.

In both cases, the operator needs to develop a powering plan that specifies the required outputs of centralized power sources to feed the total power needs of all the NIDs. Because electrical power requires a copper conductor for distribution, the deepest in the network that power sources can be located without a separate conductor is at fiber nodes or hubs.

With a separate conductor, power could be provided at the headend, but this requires extra cabling, adding to distribution plant expense. Yet another alternative is to power the NID and subscriber sets locally, from battery or commercial AC at the subscriber location.

Most operators are electing to market their telephony solutions as primary line applications, which means they displace the incumbent telephone company as the service provider. Because subscribers expect the primary telephone line to be available virtually all the time, power to the NID must have this same level of reliability.

Backup power, in the form of battery banks or diesel generators, can be provided

> "Operational two-way is a prerequisite for any telephony offering, so a plant upgrade is a 'must do' item."

BOTTOM • LINE

Walk the Telephony Walk

Offering telephony service begins with a commitment to two-way capability and support processes. Equipment that must be added will depend on whether the operator is building a circuit-switched or Internet protocol (IP) telephony solution. Both offerings need a digitally capable network interface device (NID) and reliable power.

Circuit-switched implementations include a host digital terminal (HDT) at the hub or headend, while IP telephony solutions depend on a cable modem termination system (CMTS). Some systems allow migration to IP technology by using the HDT to route data packets. For IP telephony, software at servers is a critical system component, both for managing cable modems and providing telephony features.

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at the source of centralized power. Another alternative is to have a backup battery at the subscriber's location; however, this battery must be replaced periodically and maintained at full charge during normal operation.

HDT functions

For a circuit-switched system, one or more HDTs must be installed at a hub or headend. The HDT consists of two subsystems: the next generation digital loop carrier (NGDLC) and an RF modem. The term "next generation" in NGDLC refers to the addition of several features to the DLC that occurred in the mid-1990s. These features substantially increased its capacity, input and output rates, reliability, and operations management interfaces. The RF modem recovers the digital information from the modulated signal originating at the NID.

The NGDLC system is the switch-side interface of the HDT. It is a digital multiplexer, generally providing T1 or E1 links to the switch at 1.544 Mbps (for T1), and accepting 64 kbps digital signals from lines on the subscriber side, usually in a T1 or E1 format.

> "Operators cannot afford to minimize the value of adding support processes and conducting personnel training."

The NGDLC part of the HDT has a standard TR-303/GR-303 or TR-008 interface toward the digital switch, allowing the service operator to choose different vendors for the switch and HDT. Part of the TR-303 standard defines the level of call blocking that may be allowed at the HDT under heavy call conditions. This traffic parameter determines how many circuit packs need to be equipped—called "engineering," which is a reference to the traffic engineering theory that determines blocking levels.

Having an open interface toward the digital switch also allows an operator to obtain telephony switching from another company through alliances or a leasing arrangement, alleviating the need to purchase a digital switch in the early stages of telephony offerings.

On the subscriber side, however, both the interface to the RF modem within the HDT and the interface from the RF modem to the subscriber's NID are proprietary, requiring the operator to purchase HDTs and NIDs from the same vendor.

"Grooming" is another feature of NGDLC systems that has been incorporated into HDTs. It refers to the ability to split off special service circuits, such as private line T1s, to the public switched telephone network (PSTN) without going through a switch. A variation of this capability allows the HDT to route data packets from specially optioned NIDs to the service provider's data access or an Internet gateway without going through the circuit switch. This gateway access is a way to provide VoIP to subscriber early adopters of packet telephony.

IP telephony differences

A system for providing IP telephony capability requires a cable modem at the subscriber location, a CMTS at the headend, a gateway to the PSTN and some form of feature server.

The subscriber cable modem may be embedded in the NID, or it may be an external unit. Although it is possible to provide a separate termination device that interfaces standard telephone sets to a cable modem, it's better to have an RJ-11 interface built into the cable modem, so that the subscriber has a single piece of equipment as the interface to the operator's telephony service.

Providing IP telephony service via cable modems that are embedded in the NID has the advantage of being completely transparent to the subscriber, who only needs to plug a standard phone into the usual RJ-11 wall jack.

The CMTS is equipment at the headend that communicates with the subscriber's cable modem and processes packets for routing on a data network. CMTSs are not unique to IP telephony; they also are an integral part of high-speed data service offerings. The cable telecommunications industry is rapidly moving toward installation of only DOCSIS-capable CMTS equipment.

Software: a critical piece

The CMTS also will require a set of servers to manage the subscriber cable modems. Three types of servers are needed: a dynamic host configuration protocol (DHCP) server to assign and manage Internet addresses, a time of day (ToD) server to provide time reference, and a trivial file transfer protocol (TFTP) server to send configuration files to the cable modems. All the CMTS-related servers are software that can reside on one personal computer (PC) at the headend.

Feature servers are the software that makes VoIP into IP telephony. Call agents define a feature server's capability, which at minimum is the custom local area signaling services (CLASS) features such as call waiting.

The PSTN gateway is another software component that resides in headend equipment, typically on a router or PC. PacketCable specifications define the way PSTN gateways link IP-based calls to the PSTN. The feature server, call agent and PSTN gateway all can reside on one piece of hardware in the headend.

Plan it, then do it

There are several options in the implementations of telephony service. Although circuit-switched vs. IP telephony is a major decision, each technology has its own alternatives and migrations to next-generation offerings. In addition, operators cannot afford to minimize the value of adding support processes and conducting personnel training. The key to success in telephony is to first develop the plan, and then plan the hardware and software implementations. CT

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

Power Cor

But Regular Maintenance Keeps Supplies Standing By

By Stephen Skoufalos

It's all about power. In order to provide enhanced services, cable TV system operators are either upgrading or rebuilding their broadband networks. Depending on the architecture, this could in some cases mean as many as 3 to 10 times the number of power supplies will be needed. New data or telephony services will require a much higher level of network reliability, which means standby power supplies will have to work without fail.

In addition to meeting Federal Communications Commission requirements, getting the reverse path working, keeping the network fully operational, and keeping up with new installations, disconnects, service calls and other customer issues, technicians now will have to maintain significantly more standby power supplies than ever before—not an easy task, considering that qualified technicians are as hard to find as the proverbial needle in the haystack.

Powering systems

Advanced cable TV networks carrying voice and data traffic as well as video programming still are emerging. To meet the their dynamic needs, standby power supply manufacturers have become very creative in providing solutions. Today's powering systems can range from a conventional nonstandby power supply to multiple power modules in a ground-mount enclosure with multiple battery strings and a backup propane or natural gas-fueled generator. Regardless of the configuration, all standby powering systems need periodic maintenance.

Every standby power system has at least three components: the utility company providing input AC, the power module that provides the power to the network, and the backup system (batteries, generators or both) that keep the network powered in the event of a power company brownout or blackout.

Blackouts are far less common than brownouts. In a study by Bell Labs several years ago, it was found that 90 percent of all power company disturbances were most likely to be brownouts or power sags. The remaining 10 percent were either surges (power spikes substantially above normal) or blackouts (complete loss of power). Clearly, brownouts are a more significant threat.

The utility company

Utility power usually is delivered to neighborhoods as three-phase power. This means there are essentially three power systems, each capable of delivering 120 VAC. There is a 33.33-percent chance that the standby power supply and the subscriber power will be connected to the same phase, which means there is a 66.66-percent chance that they won't be connected to the same phase. Therefore, there is a higher probability that the cable network could experience a power problem but the subscriber would not experience the same problem.

If the standby power supply is not capable of working in standby mode, the subscriber experiences an interruption of network services, but doesn't experience a power outage. As a result, a service call is generated, which will create poor customer satisfaction. In many cases, the power is restored to its proper level soon

RUPTS

after the subscriber calls and before the system technician can respond. This phenomenon results in a "no problem found" (NPF) resolution to the outage, which increases the operational costs of the system.

Consistent preventive maintenance will substantially reduce NPF trouble calls as they relate to power disturbances, which ultimately will improve network reliability and help to improve the bottom line.

The power module

The basic job of the power module is to convert utility power to a power level needed by the network components. Modern standby supplies in some cases provide three output voltage levels—60 VAC, 75 VAC or 90 VAC—which are field-selectable, depending on the application. The power module also can provide line isolation, self-test, number and time of standby events. Another function performed by the power module is to charge the batteries that will be used in the event standby is needed. This is the tricky part.

Most power modules are designed to operate within some +/- range of nominal input AC. If there is a sag or surge outside the design limits, the power supply will go to standby operation and remain there until the proper input voltages are restored. A properly working charger will fully charge

the batteries, which will be ready to deliver power to the network until the power supply cutoff voltage is reached.

The standby time of the power supply is determined by the number, age and condition of the batteries, the load connected to the power supply, and the temperature inside the enclosure. Assuming all is well with the batteries, the output of the power module is maintained, and the network is powered until the battery charge is depleted or until utility power is restored.

However, if the charger has not been working, the batteries will not have sufficient charge to sustain any kind of power company anomaly, and the standby power supply will fail to power the network, causing an interruption in services.

Batteries are the emergency power source—and the most misunderstood part of any standby power supply. The network can deliver services only if the actives have power, and without utility power the batteries are it. Debates continually arise as to which battery is best for the grueling broadband network environment. As each case is presented pro and con—about the plate structure, electrolyte and case material (liquid or gel)—system decision-makers are left to decide which batteries to install in their standby power supplies. In truth, there is no perfect battery for every system in the country, and if there were, few systems could afford to buy them.

Wearing the required safety equipment, a technician tests the operation of an aerial standby power supply.

Each system makes compromises on the battery of choice. Regardless of the battery chosen, certain precautions can ensure maximum life for batteries.

Care and feeding of batteries

The care of batteries in broadband network applications begins long before they are installed in any standby power supply. Battery care begins by knowing how many to order in the first place. A comprehensive preventive standby power supply maintenance program that uses statistical analysis to predict needs will prevent the unnecessary storage of batteries.

Self-discharge is a phenomenon that begins once a battery is permitted to be stored for extended periods of time without the benefit of a freshening charge. Once a battery begins to self-discharge, the plates begin to sulfate. With no freshening charge applied, this process continues unchecked and cannot be reversed. The sulfates deposited during this

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A technician measures individual battery voltage to verify proper voltage levels.

process will reduce the capacity (amount of charge stored) of the battery. Once this occurs, no matter how long you apply a charge to the damaged battery, it is unable to attain the maximum charge.

Once these abused batteries are installed, the standby time is compromised, and less than ideal performance is obtained from the standby power supply—all because someone didn't know that batteries stored for extended periods are supposed to be charged regularly.

This begs the question: How long can a battery be stored before a charge needs to be applied? Different battery types have different requirements. The rule of thumb, however, is that batteries need to be recharged when the open circuit terminal voltage is around 12.5 volts or after four months, whichever occurs first. The charger can be a spare standby power supply with three batteries connected in series.

Detecting the damage of storage

What are the long-term effects of installing batteries that have started to sulfate? At first, there are no external indications that a problem exists, but the damage has already begun.

Over time, a battery string that contains a sulfated battery will cause the other batteries in that string to swell. The power supply charger is attempting to fully charge the battery string, but the sulfated battery has less charge acceptance than the other batteries in that string. Therefore, the other two batteries become overcharged and swollen. So a sulfated battery can cause the premature failure of two otherwise good batteries. ➤

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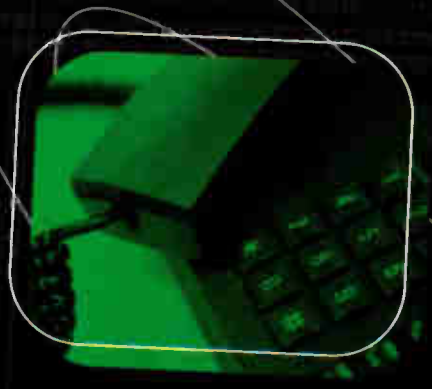

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Furthermore, higher levels of hydrogen gas are present with swollen batteries, which increases the possibility of an explosion and clearly presents a safety hazard to any service technician who may open the enclosure. Battery manufacturers have improved the venting of the hydrogen, but the danger of an explosion still is present in power systems that have been neglected for extended periods. Extreme caution is imperative when introducing standby power supply maintenance into any network that has not had regular maintenance.

Program particulars

Now, what does all this have to do with power supply maintenance? It has everything to do with it. A periodic standby power supply maintenance program will improve the overall reliability of your broadband network. A maintenance program will virtually eliminate the causes of standby power supply failure. A periodic maintenance program will:

1) Check the operation of every standby power supply quarterly

2) Create reports to help manage the maintenance process, such as:

A) Battery age report—The batteries are grouped by age so that proper quantities of batteries are ordered for the next maintenance cycle.

B) Parts needed report—The required spare parts needed to repair the power supplies during the next maintenance cycle are listed in this report.

3) Provide weekly progress reports

4) Provide quarterly summary reports ➤

BOTTOM • LINE

Maintain Your Backup Power

Standby power supply manufacturers have become very creative in providing solutions for advanced cable TV networks carrying voice and data traffic as well as video programming. Today's powering systems can range from a conventional nonstandby power supply to multiple power modules in a ground-mount enclosure with multiple battery strings and a backup propane or natural gas-fueled generator. Regardless of the configuration, all standby powering systems need periodic maintenance.

A successful in-house network powering maintenance program needs a few key elements, which also are useful when evaluating outsource partners for network powering maintenance. The elements are:

- Periodic maintenance, preferably quarterly
- Dedicated maintenance team
- Database of accurate power supply information for easy access and reporting
- Battery age and parts needed reports
- Adequate funding
- Management report review

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There are a few key elements that can be used to structure a successful in-house network powering maintenance program. These same elements are useful when evaluating outsource partners for network powering maintenance. The key elements are:

- Periodic maintenance—preferably quarterly, to prevent sulfated batteries from adversely affecting an entire battery string.
- Dedicated maintenance team—especially important for larger networks. The lack of a dedicated maintenance team is one of the main causes of failed in-house maintenance programs.
- Database of accurate power supply information for easy access and reporting—updates to the database ought to be made within two days after the last visit.
- Reports—battery age and parts needed reports that are based on statistical failure analysis.
- Adequate funding—to cover both labor and the startup costs of spare parts. This is especially true for systems that have not had an ongoing maintenance program. Parts costs could be 20 percent to 30 percent of the costs the first year.
- Management report review—frequent review of the reports created from the data gathered will prove invaluable in evaluating the maintenance program.

Get started today

A periodic maintenance program will make sure the power module is working properly by checking the charger and inverter. If every power supply is checked quarterly and all nonworking supplies are repaired or replaced, then the reliability of the powering system is greatly increased. Furthermore, because the maintenance reports predict which spare parts and batteries are needed and when, they will be installed in the standby power supplies long before any premature deterioration or abuse can take place.

> "Higher levels of hydrogen gas are present with swollen batteries, which increases the possibility of an explosion."

Now the utility company can experience any number of anomalies, and the broadband network powering system will continue to be reliable and ready to provide the subscribers with the services they need and expect. CT

Stephen Skoufalos is vice president of sales and marketing for Supply Performance Testers Inc. He can be reached via e-mail at sskoufalos@sptnetpower.com.

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THE RIGHT MATERIAL AT THE RIGHT PLACE AT THE RIGHT TIME

Using Powers of Numbers, Part 3

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

Last month's installment on using powers of numbers covered determining square roots. This installment continues with using powers of 10.

Using powers of 10

In electronics-related work, we use very small and very large numbers. You will commonly see electrical current values of a few millionths of an ampere and resistances of several million ohms. Scientific notation uses powers of 10 to conveniently express and do calculations with these numbers.

The accompanying table lists some numbers and their equivalent power of 10 expression. The exponent indicates the number of places left or right to move the decimal point. For example,

$1 \times 10^3 = 1{,}000$ (The decimal point is three places right of the value 1.)

$1 \times 10^{-3} = 0.001$ (The decimal point is three places left of the value 1.)

Remember, $10^0 = 1$

Complete the following expressions by selecting the proper power of 10. (The answers are upside down at the end of the text.)

(a) $85{,}000 = 85 \times 10^{?}$
(b) $3{,}000{,}000 = 3 \times 10^{?}$
(c) $0.00063 = 0.63 \times 10^{?}$
(d) $0.000015 = 15 \times 10^{?}$

Convert each of the following to the power of 10 indicated. (The answers are upside down at the end of the text.)

(e) $0.005 \times 10^6 = ? \times 10^3$
(f) $0.2 \times 10^{-1} = ? \times 10^{-3}$
(g) $0.25 \times 10^{-3} = ? \times 10^{-6}$
(h) $5{,}000 \times 10^{-6} = ? \times 10^{-3}$

The greatest convenience of powers of 10 is in addition, subtraction, multiplication and division.

Applying rules for adding

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

1) Change the numbers to be added to the same power of 10.
2) Add the numbers directly to get their sum.
3) Use the common power of 10 (determined in step 1) as the power for the sum.

Example: Add 4×10^6 and 8×10^7

(Convert both numbers to the same power of 10)

$$\begin{array}{r} 4 \times 10^6 \\ +\ 80 \times 10^6 \\ \hline 84 \times 10^6 \end{array} \quad \text{or} \quad \begin{array}{r} 0.4 \times 10^7 \\ +\ 8.0 \times 10^7 \\ \hline 8.4 \times 10^7 \end{array}$$

Applying rules for subtracting

Observe the following rules for subtracting to the same power of 10:

1) Change the numbers to be subtracted to the same power of 10.
2) Subtract the numbers directly to get their difference.
3) Use the common power of 10 (determined in step 1) as the power for the difference.

Example: Subtract 23×10^{-12} from 58×10^{-11}

(Convert both numbers to the same power of 10)

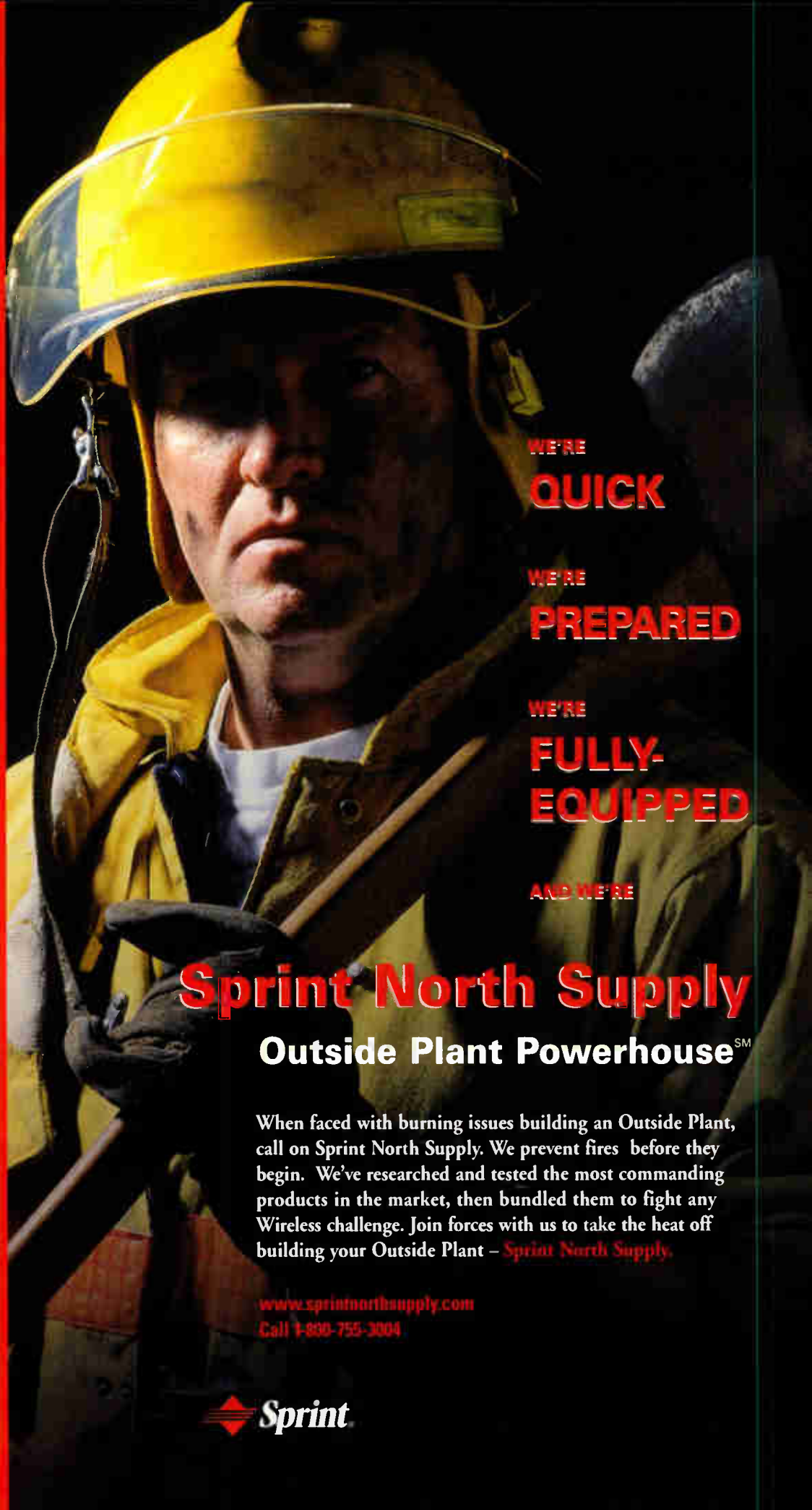
$$\begin{array}{r} 580 \times 10^{-12} \\ -\ 23 \times 10^{-12} \\ \hline 557 \times 10^{-12} \end{array} \quad \text{or} \quad \begin{array}{r} 58.0 \times 10^{-11} \\ -\ 2.3 \times 10^{-11} \\ \hline 55.7 \times 10^{-11} \end{array}$$

Next month's installment will continue with applying rules for multiplying and dividing using powers of 10 and understanding metric prefixes.

Positive and negative powers of 10

1,000,000	=	1×10^6	0.000001	=	1×10^{-6}
100,000	=	1×10^5	0.00001	=	1×10^{-5}
10,000	=	1×10^4	0.0001	=	1×10^{-4}
1,000	=	1×10^3	0.001	=	1×10^{-3}
100	=	1×10^2	0.01	=	1×10^{-2}
10	=	1×10^1	0.1	=	1×10^{-1}

Answers:
(a) 10^3 (b) 10^6 (c) 10^{-3} (d) 10^{-6}
(e) 5×10^3 (f) 20×10^{-3} (g) 250×10^{-6} (h) 5×10^{-3}



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Waterproof Accessories' High Intensity Krypton Lamp is intended for hard-hat or forehead mounting. The Krypton lamp offers bright, battery-powered light and is designed to withstand corrosion and malfunction in wet environments. A unique barrel design allows 90-degree vertical adjustment and easy on-off function with gloved hands. The lamp is secured with a grip-tight rubber headband that features a sponge cushion forehead pad. The four AA battery power source makes the lamp as economical as a flashlight.

For more information, contact Work Accessories at (440) 842-7816.

Blade Amp Fuses

Pudenz is now offering a series of slow blowing, automotive type blade fuses for cable TV system amplifiers. The TF, or Time-delay Fuse, series is designed to eliminate premature fuse blowing and nuisance outages that result from surge protection module firing and lighting. The TF series is a dual-voltage fuse (compatible with 60 V or 90 V systems) that uses a multi-material construction, spiral-wound element and a fiberglass reinforced housing. The TF series is available in 4, 8, 10 and 15 A ratings.

For more information, contact Pudenz at (800) 374-5969 or on the Web at www.pudenz.com.

Modjacks With Lightpipes

Molex's modjacks with lightpipes are intended to maintain signal integrity while reducing costs. The stacked, multi-port modjacks use lightpipes to direct light from printed circuit board (PCB)-mounted light emitting diodes (LEDs) to the front of the modjack to indicate system activity. Combining the lightpipes with customer-supplied surface-mount LEDs reduces antenna effect noise by 50 percent as compared to modjacks with integral LEDs. The design also reduces replacement costs, as there are no LEDs on the modjacks to fail. These modjacks are designed for networking systems, including hubs, routers, Ethernet switches, bridges and asynchronous transfer mode (ATM) transmission equipment.

For more information, contact Molex at (630) 969-4550 or on the Web at www.molex.com.

Underground Fabric Conduit

TVC Communications' MaxCell is designed to maximize the number of cables that can be introduced into an underground conduit structure. A flexible engineered fabric conduit, MaxCell uses up to 80 percent of conduit space without affecting cable-pulling tension. MaxCell takes the shape of the cable placed into the conduit and also can be placed into occupied conduit space with existing cable. MaxCell is lightweight and does not spiral.

For more information, contact TVC Communications at (800) 345-8454 or on the Web at www.tvcinc.com.

Cable Raceway

Panduit Corp.'s PAN-WAY T-45 Surface Raceway is designed to route up to 34 Category 5 (CAT 5) cables within a 2-inch footprint. The Raceway can be used to route, protect and conceal data, voice, video, fiber-optic or power cabling. A divider wall snaps into the base to separate power and data cabling. The Raceway's cover features a multi-directional hinge allowing access from either side. Fittings incorporate a minimum 1-inch bend radius for high-performance cabling systems.

For more information, contact Panduit at (888) 506-5400 or on the Web at www.panduit.com.

Power Amps

Vertex Electronics Products is offering a solid-state power amplifier system (SSPA) for satellite earth stations. The ModuMAX 1,000 W C-band modular SSPA is designed to eliminate the need for a spare amplifier and to facilitate servicing with hot-swappable modules. Enhancements include eight RF plug-in modules, integral forced-air cooling with eight replaceable modular fans, and three identical power supply modules with an N + 1 configuration designed to maintain 100 percent of required load current even if a module fails. ModuMAX also is available in 750, 500 or 350 W configurations.

For more information, contact Vertex at (814) 238-2700 or on the Web at www.vertexepi.com.

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Stream Processing Family

THOMCAST Communications' Amber line remultiplexer and processor platform supports remultiplexing of multiple input streams for service customization and program system information protocol (PSIP) processing for the filtering, injection or extraction of PSIP tables within Moving Picture Experts Group (MPEG-2) ATSC transport streams. The processor can receive up to eight input transport streams, with a payload bit rate of up to 50 Mbps each. The Amber remultiplexer creates MPEG-2 digital video broadcast (DVB) or ATSC-compliant output multiplex and has scrambling capabilities.

For more information, contact THOMCAST at (570) 403-5220 or on the Web at www.thomcast.com.

Removable Aerial Lifts

AmeriQuip's Eagle T-30S line of removable aerial lifts is designed for mounting on pick-up trucks. When not mounted on a truck, the lifts can be stored on their own outrigger systems. The lifts are mounted by backing a minimum 9,900-lb. pick-up truck under the stored lift and then lowering the lift down to the bed of the truck. The lifts feature 360-degree continuous rotation and are available in telescoping and articulated models, with working heights of 31 and 34 feet, respectively.

For more information, contact AmeriQuip at (301) 620-7242.

Two-Way Combiner/Divider

Bird Component Products' Model 30-AD-FFN-2 two-way divider/combiner provides matching with less than 2-degree phase (typical 0.5 degree) and less than 0.5 dB amplitude. The 30 W unit has a frequency range of 800 MHz to 2.4 GHz with insertion loss of less than 0.5 dB, isolation of less than –25 dB minimum (for J2 and J3 ports) and voltage standing wave ratio (VSWR) of 1.20:1 maximum. The device features a Wilkinson weather-proof housing.

For more information, contact BCP at (727) 547-8826 or on the Web at www.birdfla.com.

Fiber-Optic Field Test Kit

A field test kit from Rifocs Corporations is designed to measure insertion and link loss on fiber optic-network and premises installations that incorporate the MT-RJ small form factor (SFF) duplex connector. The dual 1,300 nm light emitting diode (LED) source and the optical power meter provide a MT-RJ interface for connection of MT-RJ fiber patch cords. The 255MT source facilitates testing of both connector channels. The detector interface uses a detector capable of capturing light from both MT-RJ fibers.

For more information, contact Rifocs at (805) 389-9800 or on the Web at www.rifocs.com.

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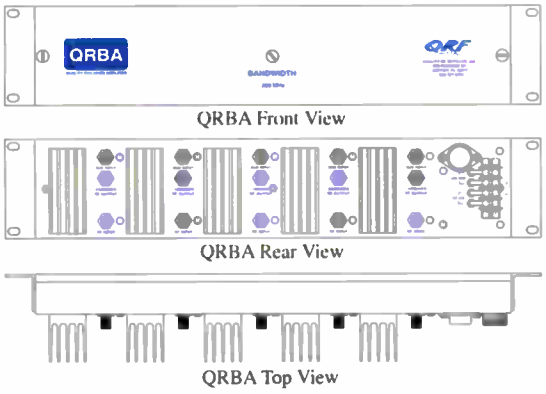

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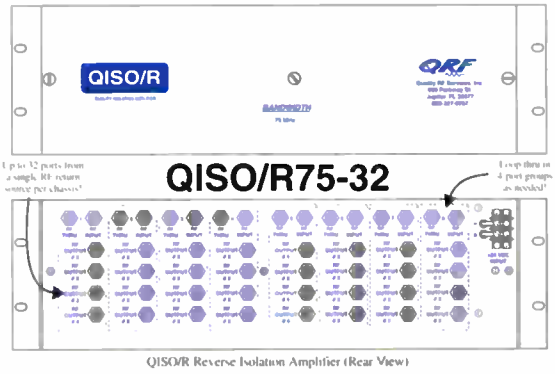

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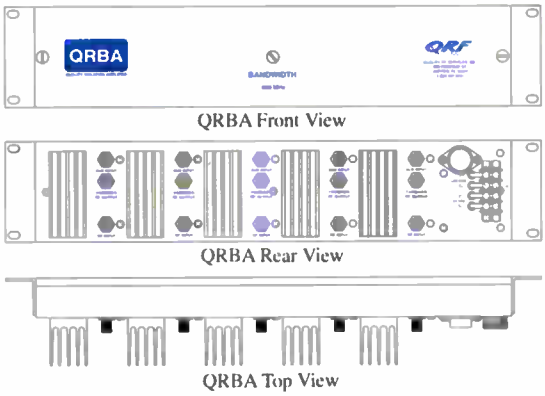

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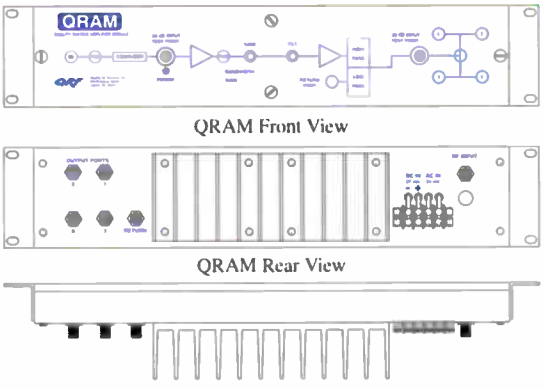

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Fiber Singlers

Canoga Perkins's fiber singlers are designed to allow two 1,310 nm devices to communicate bidirectionally over a single fiber, at speeds from T1 to Gigabit Ethernet. The L650 is a fiber-optic converter/transponder module with an integrated wavelength division multiplexer (WDM). The 6001 single-channel WDM is a completely passive device that optically multiplexes and demultiplexes signal streams over a single fiber at the remote end. The products initially will be available for deployment in Canoga Perkins' EdgeAccess Universal Chassis System.

For more information, contact Canoga Perkins at (818) 718-6300 or on the Web at www.canoga.com.

Frequency Agile Demodulator

Videotek's DDM-500 8-VSB (vestigial sideband) demodulator is designed for operators receiving digital TV (DTV) over-the-air transmissions where data outputs are desired. The unit demodulates 8-VSB over-the-air signal to Society of Motion Picture & Television Engineers 310M serial and synchronous, parallel low voltage differential supply (LVDS) transport streams. Transport stream data are used for retransmission or bit stream analysis. The DDM-500 can be controlled either through the front panel or remotely.

For more information, contact Videotek at (610) 327-2292 or on the Web at www.videotek.com.

MDU Access Solution

Foxcom's SDTVplus allows service providers to access the multiple dwelling unit (MDU) market via fiber optics. The SDTVplus single-wire, fiber-optic platform supports the delivery of direct broadcast satellite (DBS), Internet and traditional cable services, yet uses the MDU property's existing coaxial cable infrastructure. From a single wire, SDTVplus allows providers to deliver more than 2.4 GHz to each tenant.

For more information, contact Foxcom at (609) 514-1800 or on the Web at www.foxcom.com.

Integrated Access Device

An integrated access device (IAD) from Adtran converges voice, data, video and Internet traffic for transmission over various network types. The ATLAS 550 combines voice switching, time division multiplexing (TDM) access and packet switching in a compact modular form geared toward small and medium-sized businesses. The IAD comes with frame relay and support for analog voice interfaces and offers the ability to migrate to additional packet technologies. The ATLAS 550 is a lower capacity, six-slot version of Adtran's 800 PLUS.

For more information, contact Adtran at (205) 971-8000 or on the Web at www.adtran.com.

Mobile Workforce Application

iM:Work is a Web-based application suite designed for mobile workforces. This product from iMedeon shares wireless and Web technologies with existing front and back-office systems. Systems integration provides a unified view of work to be done by external or internal field resources. iM:Work's architecture employs advances in field appliances and global positioning systems (GPS). iMedeon's initial release is for pilot customers wanting the benefits of Web-based systems.

For more information, contact iMedeon at (770) 777-8100 or on the Web at www.idmedeon.com.

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Optical Services Toolkit

Ciena Corp.'s LightWorks Toolkit is designed to let Ciena's carrier customers provide on-demand delivery of any-size bandwidths and to increase their range of service qualities. The limitations of synchronous optical network (SONET)/synchronous digital hierarchy (SDH) made such service previously impossible to deliver, claims Ciena. The Toolkit's optics-, silicon- and software-based service enablers will allow carriers to build networks to Ciena's LightWorks architecture, introduced last year.

For more information, contact Ciena at (800) 921-1144 or on the Web at www.ciena.com.

VCR Enhancement

The Video Browser from Danmere enables advanced control of videocassette recorders (VCRs) and other recording media. The Video Browser is a software-based technology that runs on a set-top box. It offers digital versatile disk (DVD)-style functions for existing VCRs, such as scene-by-scene thumbnail pictures for quickly locating recorded material. It also enables viewers to program the VCR from within an electronic program guide (EPG).

Video Browser is designed to integrate the VCR into the interactive home entertainment experience.

For more information, contact Danmere at +44 1606 74330 or on the Web at www.danmere.com.

COMING SOON.

BOOKSHELF

The following is a listing of some of the resources currently available by mail order through the Society of Cable Telecommunications Engineers. The prices listed are for SCTE members only. Nonmembers should contact the Society for additional pricing information.

- *Delivering Voice Over IP Networks* by Daniel Minoli and Emma Minoli—Develop cost-effective, long-term solutions for packetized voice. This book explores the problems posed by running voice over a connectionless network. Hardcover, 276 pp., 1998. Order TR-37 $50.
- *A Guide to the TCP/IP Protocol Suite* by Floyd Wilder—This book details how the Internet and TCP/IP suites work.

Chapters deal with layers, links, transport layer protocols, utility protocols and dynamic routing protocols. Softcover, 494 pp., 1998. Order TR-38, $73.

- *Principles of Digital Audio and Video* (2nd ed.) by Arch Luther—Strengthen your grasp of the underlying principles and practical applications of digital audio and video with this clear description of analog/digital (A/D) conversion, video cameras, digital transmission, processing and compression. Hardcover, 405 pp., 1997. Order TR-24, $79.
- *Installer Certification Manual Leader Guide*—Teach your staff how to deliver top-quality service, safely and efficiently. This 17-module guide parallels the new third edition of the *Installer Certification Manual*, keeping students and instructors in sync. Notebook bound, 560 pp., 1998. Order TM-13, $395.

- *Electronic Communications Systems, Fundamentals Through Advanced* (3rd ed.) by Wayne Tomasi—Technology basics and important concepts of digital and data communication systems are covered in this book. Hardcover, 880 pp., 1998. Order TR-31, $96.
- *Voice and Data Communications Handbook* by Regis "Bud" Bates and Donald Gregory—Training for nontechnical personnel on LANS, Gigabit Ethernet and networked videoconferencing is covered in this reference. Softcover, 904 pp., 1998. Order TR-39, $65. CT

To order: All orders must be prepaid. Shipping and handling costs are included in the continental U.S. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. To qualify for SCTE member prices, a valid SCTE identification number is required, or a complete membership application with dues payment must accompany your order. Orders without full and proper payment will be returned. Send orders to: SCTE, 140 Philips Rd., Exton, PA 19341-1318 or fax with credit card information to (610) 363-5898.

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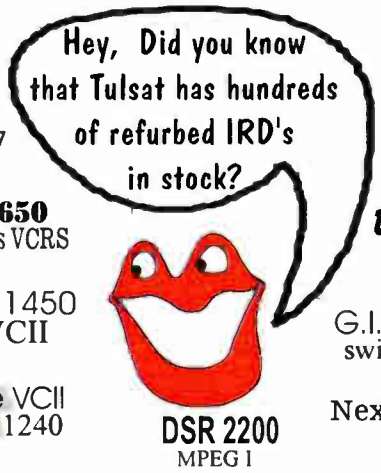

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CALENDAR

March

1: SCTE standards meeting, Data Standards Subcommittee, CableLabs Winter Conference site, Atlanta. Contact Dr. Ted Woo, SCTE director of standards, at (610) 363-6888, e-mail twoo@scte.org or visit the SCTE Web site at www.scte.org.

9: Penn-Ohio SCTE Chapter technical seminar. Topic: Fiber. Contact Linda Strobert at (717) 263-7571.

14: SCTE regional seminar, "DOCSIS Deployment," Holiday Inn Metrodome, Minneapolis. Contact Jessica Dattis in the SCTE National Conferences Department at (800) 542-5040, ext. 239, or jdattis@scte.org.

Planning Ahead

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

April 8-13: National Association of Broadcasters Show, Las Vegas. Call (202) 429-5300.

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

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

14: Cascade Range SCTE Chapter technical seminar, Holiday Inn, Wilsonville, Ore. Contact Chris Johnson at (503) 245-0603 or johnson.chris@tci.com.

15: Bluegrass SCTE Chapter technical seminar, Frankfort, Ky. Topic: Two-Way RF Problems. Contact Max Henry at (270) 435-4433 or max.henry@twcable.com.

16: SCTE regional seminar, "DOCSIS Deployment," Adam's Mark, Kansas City, Mo. Contact Jessica Dattis in the SCTE National Conferences Department at (800) 542-5040, ext. 239, or jdattis@scte.org.

16: Lake Michigan SCTE Chapter technical seminar, Days Inn Downtown, Grand Rapids, Mich. Topic: Construction. Contact Bill Anderson at (734) 973-0507 or wanderson2@mediaone.com.

16: Rocky Mountain SCTE Chapter technical seminar. Topic: DWDM and Fiber. Contact Gary Morton at (303) 797-9393 or www.scte.org/rockymtn/home/htm.

16: Ohio Valley SCTE Chapter Vendor Show, Columbus, Ohio. Contact Frank Adams at fadams@cablevision.com.

22: Great Plains SCTE Chapter Vendor Show, Harvey's Casino, Council Bluffs, Iowa. Contact Amy Hensley at (402) 466-0933, ahensley@riserbond.com, or Randy Parker at (402) 253-2161.

23: Greater Chicago SCTE Chapter technical seminar, Willowbrook Holiday Inn, Hinsdale, Ill. Topic: Return Path Technologies. Contact Jim Beletti at (630) 871-272 or beletti@att.com.

28: SCTE regional seminar, "Fiber Technologies for Technicians," Embassy Suites Airport, Phoenix. Contact Jessica Dattis in the SCTE National Conferences Department at (800) 542-5040, ext. 239, or jdattis@scte.org. CT

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By Jim Kuhns

Resolve to Participate

By now you have survived the Y2K scare (or fiasco, depending on your point of view). But have you forgotten an important New Year's resolution? Did you resolve to become more active in the Society of Cable Telecommunications Engineers and your local chapter? This month's Chapter Leadership Conference and annual board elections provide you with opportunities to make your voice heard both locally and nationally in your Society. Let's examine these opportunities and issues in more detail.

Chapter Leadership Conference

March 16 marks the Society of Cable Telecommunications Engineers' first Chapter Leadership Conference. It will be held at SCTE headquarters in Exton, Pa., the day after the spring meeting of the board of directors. This one-day, hands-on interactive session will give chapter/meeting group leaders from across the country an opportunity to discuss and share their concerns, successes and ideas with each other and the headquarters staff. Topics such as chapter attendance and participation, finance, headquarters support, vendor shows, and marketing local meetings are on the agenda.

We have asked for a representative from each chapter/meeting group to provide much-needed input. In my travels throughout North America, I have observed each group's unique make-up. Because of this diversity, it is important that your chapter be represented at this event. Your ideas, creativity and concerns are ultimately what drive the direction of the Society. Please encourage and support your chapter leaders to participate in this important meeting.

(Note: This session will not replace the Annual Membership Meeting held at Cable-Tec Expo, which is required by the Society's bylaws.)

> "Are we genuinely too busy, or have we simply become lethargic and said: 'Why bother? Let someone else do it.'"

Make a difference — vote

One of the most disturbing issues I've dealt with during my tenure on the board has been the lack of participation in the annual board of directors election. In recent years, participation has only rarely exceeded 20 percent, and the trend has gone down, not up.

It only takes a minute to open the envelope, check off your choice for your regional director and the at-large candidates, and drop it in the mailbox. In most cases, it takes less time to vote than to read this column.

Get involved

Bolstering participation has become a challenge, too. It's becoming more and more difficult to find qualified candidates willing to run and serve on the board of directors. For this year's election, two board positions went unopposed. The Nominations Subcommittee just could not find enough people and companies willing to participate.

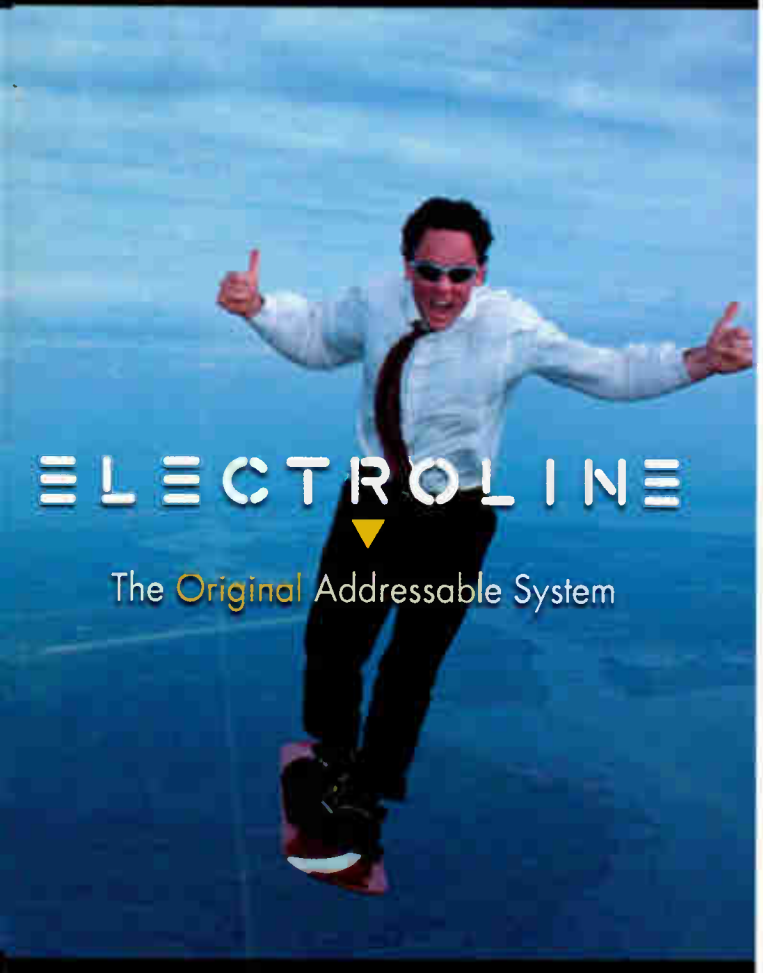
And this is not just an issue for the SCTE board of directors. It's a problem at the local level, too. Some chapter boards have remained unchanged for years. In some instances, the only reason a chapter has survived has been thanks to those few dedicated individuals and vendors willing to soldier on.

No excuses

Why is this happening? Are we genuinely too busy, or have we simply become lethargic and said: "Why bother? Let someone else do it." This attitude runs directly counter to the spirit of volunteerism that built the SCTE into what it is today. We need to remember that we are all volunteers, involved in the Society on a secondary basis relative to our employment and home lives, but volunteers nonetheless.

With more work challenges coming at us each day, we need maximize our efforts if we are to succeed as an organization. I challenge you to become involved. Send a rep to the Leadership Conference. Drop your ballots in the mail by March 15. Support your local organization. The Society cannot be successful without you. Make it your Society. CT

Jim Kuhns is chairman of the Society of Cable Telecommunications Engineers board of directors. He can be reached via e-mail at jkuhns@terayon.com.



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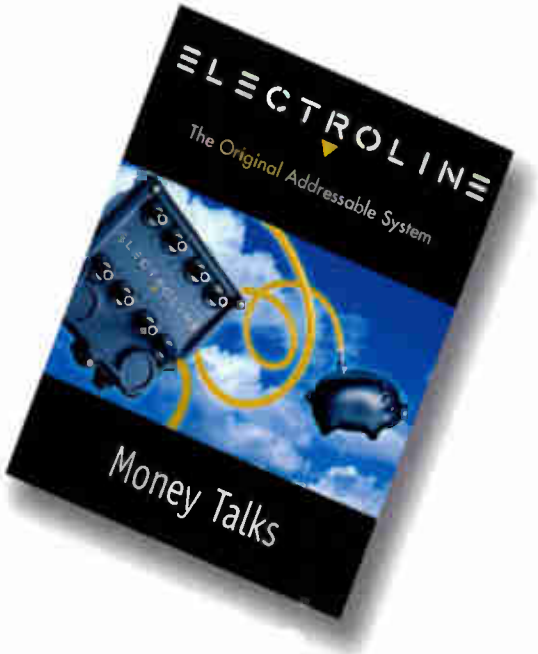

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INTERNATIONAL CABLE OPERATORS SELECT MULTIPOWER: Reliability Is Key

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

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

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

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

Apparently, in th
of develo

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

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