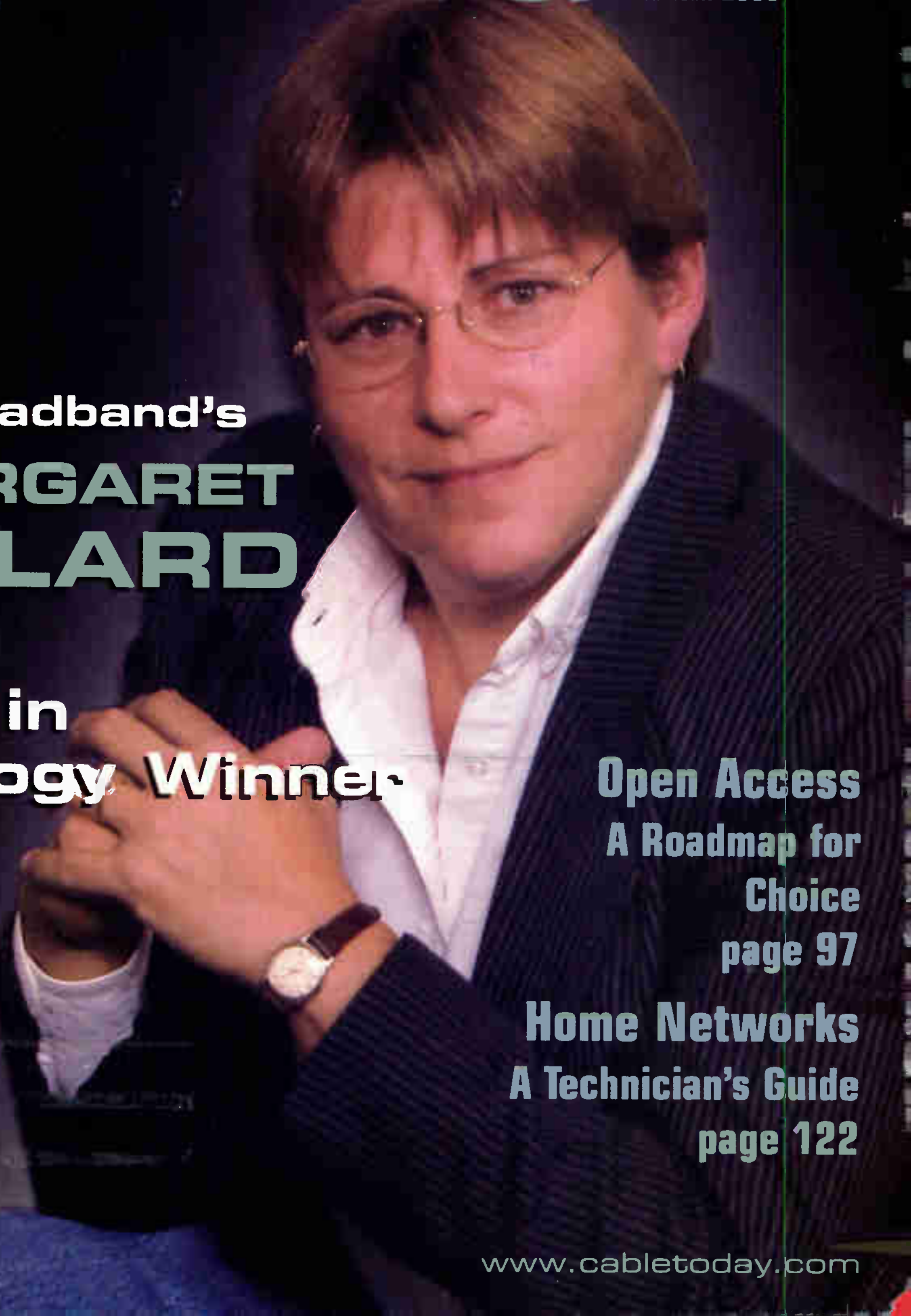
Next Month:
Western Roundup

Communications Technology

Official Trade Journal of the
Society of Cable Telecommunications Engineers

December 2000



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December 2000 **volume 17 number 12**

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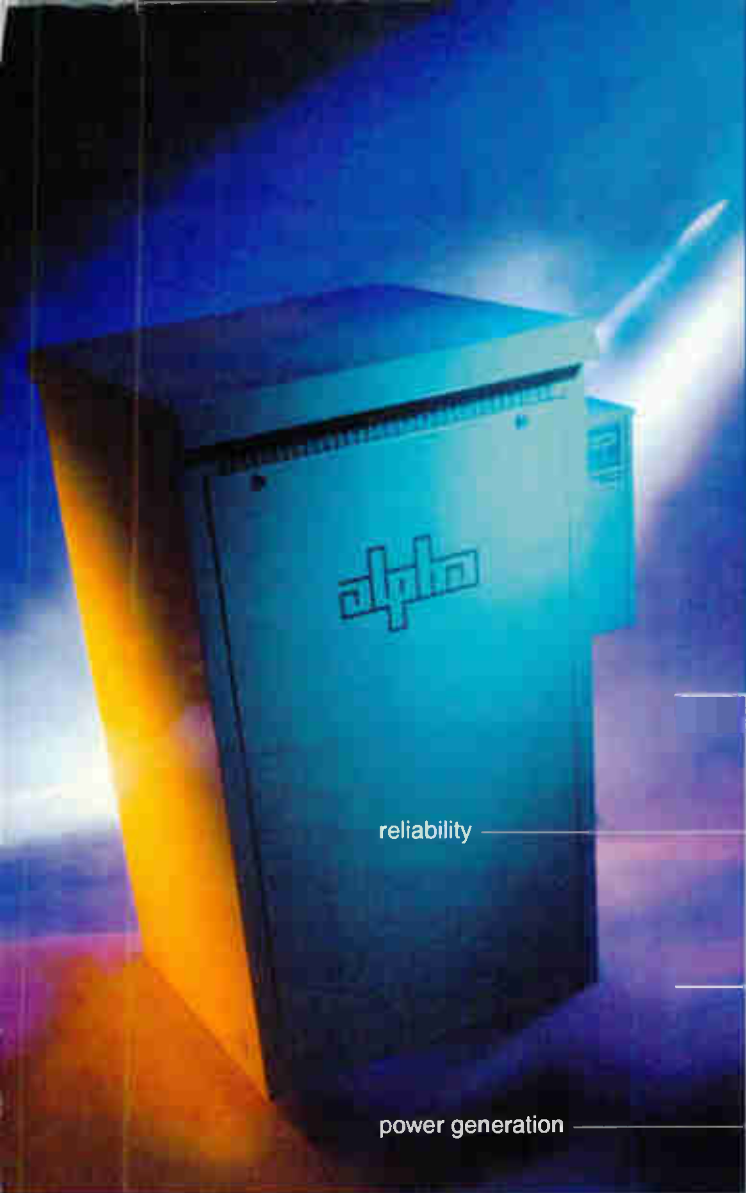

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December 2000 volume 17 number 12

COLUMNS

NEWS & OPINION

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Why The World Is Connecting To

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End-of-the-Year Musings

Well, it will be the year 2001 shortly, making the question of when the 21st century begins moot. It will absolutely be the 21st century in a few days—for everybody.

There are always a few things that continue to bother me throughout the year and this one has been no different—except that it was a year of presidential campaigning and debates. I guess the debates of 2000 aggravated me more than ever before. The broadcasters had moderators who were supposed to be "the men," posing questions to both candidates. I heard both candidates refer to this great economy and how we must never do anything to hurt it. Why would any honest moderator let these two guys get away with that?

Many of my younger engineering friends have invested money in the stock market to build a nest egg for their kids' college. Many of my older engineering friends have invested as a hedge toward retirement. And many of my engineering friends have taken jobs at various manufacturing companies with packages that include stock options.

Back in March and April, as the political campaigns began to heat up, one politician touted the impressive gains of our economy. Suddenly, the stock market began a continuous slide into red ink. Just take a look at the stock market's 52-week charts. The company with the highest market capitalization has gone from a high of nearly $120 per share down to a low of less than $49. Following this company, the second highest market capitalization is a company on which much of the Internet and telecommunications infrastructure depends and their stock fell from a high of $82 to a low of $32 during 2000. One of our best industry manufacturers' stock fell from $61+ down to $20. A darling of the wireless industry has dropped from a high of $200 down to $50+. One of the best engineering-driven leaders has seen it's stock slide from a high of $84+ down to $20. One of the clear earlier winners in the Internet marketplace shows a high of $151 and a low of $10+, and one of our own Internet service providers (ISPs) has dropped from $28+ down to $1+.

Why doesn't this "so-called" moderator simply say to the candidates, "Stop gentlemen. I have these stock charts and, after you look them over, I'd like to ask you where you get off referring to this economy as anything approaching great!"

And, while it's getting close to Christmas and I think I might get something super under the tree, why doesn't that same expert moderator ask each candidate what his views are concerning the possibility of either getting a set of tax forms that the average voter can prepare without the aid of a CPA or requiring that each high school student have a course on income tax preparation as part of their curriculum? After all, we will all have to face tax time in our adult lifetime. Well, there's always next year and new musings!

...for your acceptance and support in 2000.

Here's hoping 2001 will be another great year for all of us.

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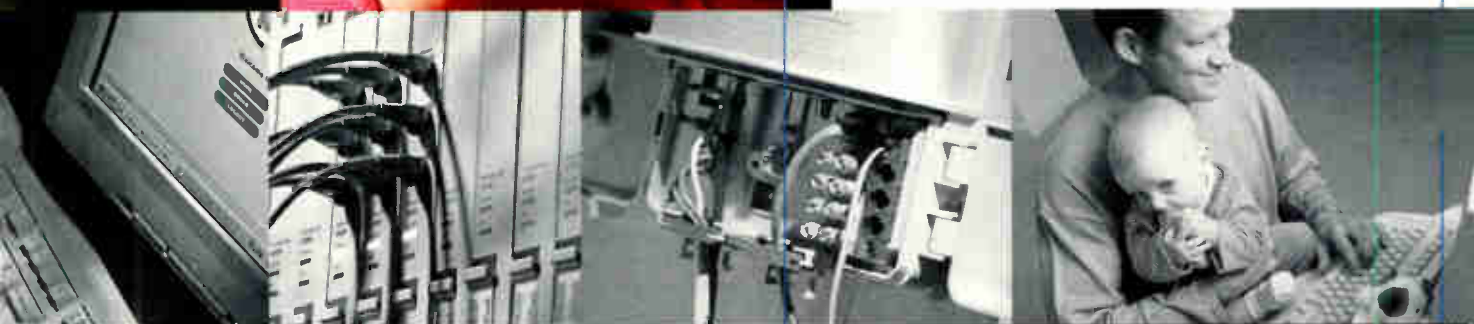

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ESPN Picks DigiCipher

By Jonathan Tombes, Deployment Editor

Sports channel **ESPN** tapped **Motorola's** DigiCipher II technology to help launch its digital transmission system.

Motorola's DigiCipher II uplink digital compression and access control system will reside at ESPN network operations center (NOC) in Bristol, Ct. On the downlink side, ESPN's affiliates will have Motorola's DigiCipher II DSR4500X integrated receiver/decoders (IRDs).

Motorola's DSR 4500X IRD

Behind this deal were the particular programming demands that frame the ESPN network.

"We are the worst-case scenario for any manufacturer out there," ESPN Vice President of Technology, Engineering and Operations Chuck Pagano says.

ESPN Director of Technical Services and Transmission John Eberhard, who is managing this digital launch, emphasized in a statement ESPN's need for equipment that could manage a complex and fluid programming schedule and eliminate the manual switching responsibilities of local affiliates.

The encoding system will handle on-line and backup compression, multiplexing and encryption processing for ESPN, ESPN2, ESPNEWS, and ESPN Classic, and alternate feeds used in the case of regional blackouts of live sporting events. Within the digital uplink is a network of layered control systems that manage the affiliate program authorizations, encoder system health and status monitoring.

Flexible links

The DSR4500X IRD complements the uplink's flexibility with an eight-input radio frequency (RF) selector that enables switching programming from various satellites. It also features a disaster recovery mode.

"If the satellite signal is lost, the IRD will select another port," Marty Stein, Motorola senior marketing director, says. "It has built within it a list of other places to go."

Stein says the IRD is able to connect directly to digital cable headend systems through its digital headend expansion interface (DHEI) and asynchronous serial interface (ASI) output. The IRD also uses Moving Picture Experts Group (MPEG) packets for signaling local affiliates of commercial avails.

"We didn't have to waste one of the audio channels," Stein says.

Mitchell Layton, courtesy of NHL Images

Regional blackouts of live events complicate ESPN programming.

A 10Base/T Ethernet port on the IRD will enable ESPN to deliver Internet protocol (IP) data or streaming IP.

In its overseas operations, ESPN uses digital transmission equipment from **Scientific-Atlanta** that Pagano says is "absolutely fantastic." Domestically, ESPN uses Motorola's VideoCipher II analog distribution network.

Pagano says ESPN's relationship with **General Instrument** (now part of Motorola) goes back to 1986. "They understand our business," he says. "The command and control systems (of DigiCipher II) were integrated within our specs." CT

NEWSBYTES

> ***Lucent Supplies FTTH Gear***
WINfirst and **Lucent Technologies** signed a five-year, $800 million agreement for equipment, software and services to build a fiber-to-the-home (FTTH) residential network.

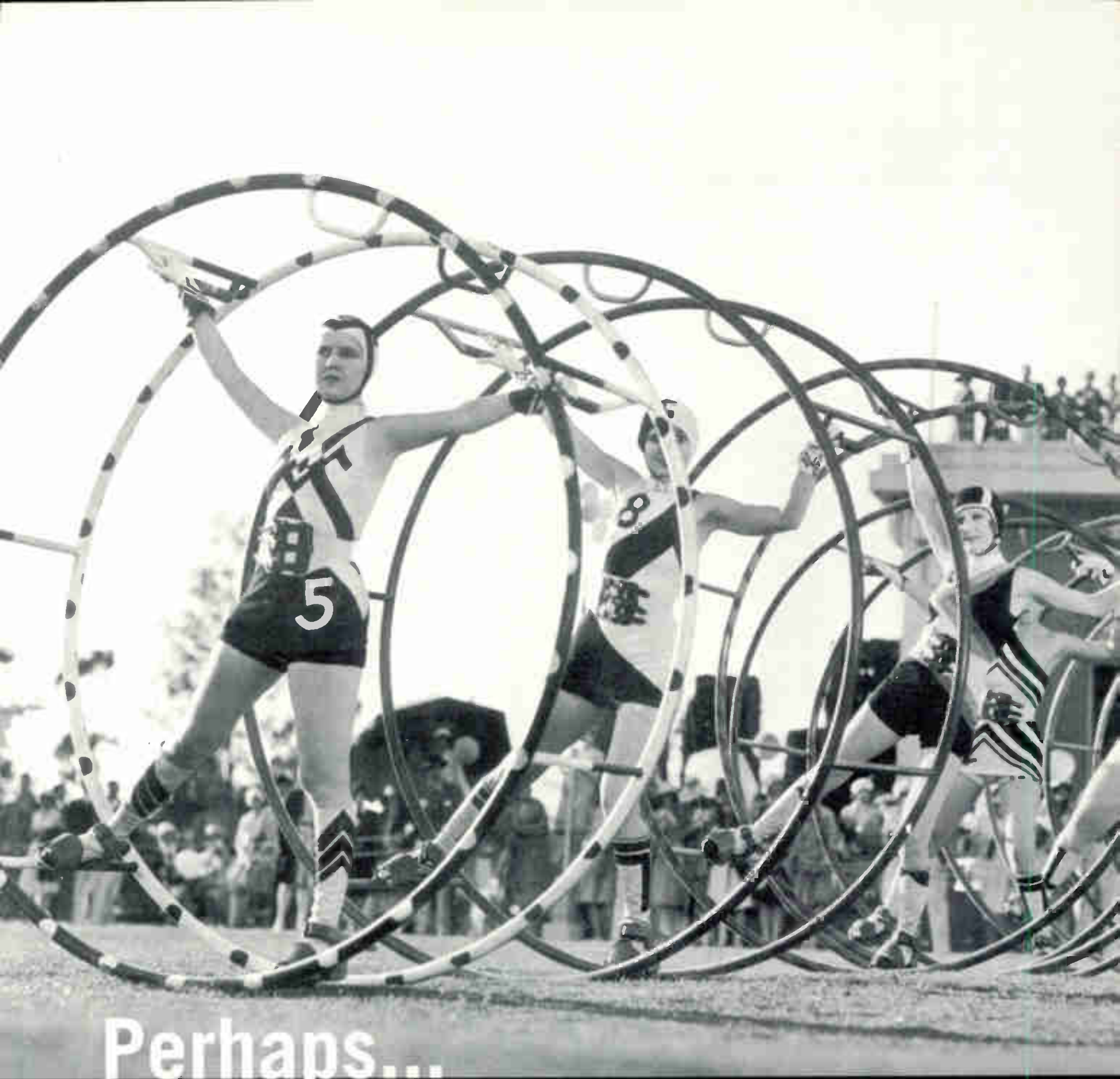
> ***Broadband Services Sells Com21 Products***
In a deal valued at more than $40 million, **Broadband Services** agreed to distribute **Com21's** entire line of broadband access equipment throughout the United States.

> ***ADC Signs HFC Agreement***
ADC signed a three-year, $300 million deal to supply its complete range of hybrid fiber/coax (HFC) network equipment and services to **Everest Connections**, a St. Louis-based broadband cable network builder and alternative services provider.

> ***Redback Gets Turnkey Service***
Redback Networks says **Jabil Circuit** will provide the company with a turnkey manufacturing service for Redback's Subscriber Management Systems.

> ***AT&T Broadband Picks Harmonic***
Harmonic is selling optical nodes and DWDM transmission platforms to **AT&T Broadband** for use in cable plant upgrades throughout the United States.

> ***SCTE Requests Proposals***
The **Society for Cable Telecommunications Engineers** is accepting proposals for technical papers to be presented at **Cable-Tec Expo 2001**, to be held May 8-11 in Orlando, Fla. The deadline for submission is December 18, 2000.



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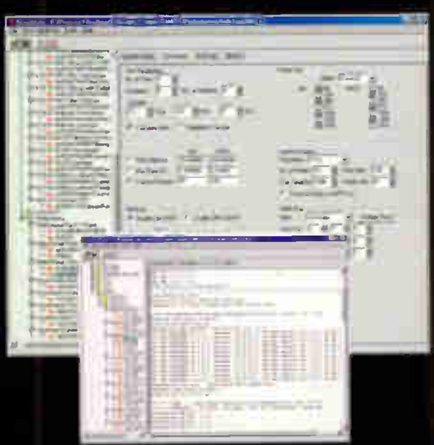

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AT&T Breakup Could Boost Cable

By Natalia A. Feduschak, Senior Editor

Industry insiders say they expect the recently announced breakup of **AT&T** will allow its cable unit, **AT&T Broadband**, to be more focused in its offerings, although they don't foresee any immediate changes in how the company will operate.

"They will still aggressively deploy local telephone service and do cable modem service and try to become a lean-and-mean cable player," says Keith Kennebeck, an analyst with **The Strategis Group**. "But I don't think much is going to change in the near term."

Under the new plan, AT&T will create four new companies, all operating under the AT&T brand. AT&T Broadband and **AT&T Wireless** will be represented by independent, asset-based common stocks. Depending on market conditions, AT&T plans to conduct an initial public offering (IPO) next summer for stock that will track the performance of its broadband unit. As part of the IPO, the company will assume AT&T's ownership interest in high-speed Internet access provider **Excite@Home**.

AT&T Business will manage the company's core enterprise communications and networking products and continue to use AT&T Broadband's cable systems in serving some customers, the company says. **AT&T Consumer** will explore new growth opportunities, and some of its cash flow will be used to invest in technologies like digital subscriber lines (DSL) to provide broadband communications and Internet services.

A welcomed move

Companies doing business with AT&T welcomed the reorganization, saying they believe it will push the company to bring cable products to market sooner.

"It's a huge deal," says Nancy Goguen, vice president of marketing at **Telogy Networks**, which provides AT&T with telephony products. "This should make things better if you're a single (source) company and want to provide cable telephony to the home."

Some industry and Wall Street analysts have criticized AT&T for its sluggish roll out of services, particularly in the wake of its $1 billion purchase of cable operator **Tele-Communications, Inc**.

Steve Lang, an AT&T spokesman, says AT&T Broadband won't be able to deploy services any faster than it is already doing so.

"However, (the reorganization) lets us focus more intently and put all of our energy in deploying products and services," he says.

AT&T Broadband reached a milestone last month when it passed the 400,000-customer mark for its AT&T Digital Phone service.

Dan Somers, president and CEO of AT&T Broadband, says the unit is on track to meeting its year-end target for telephone subscribers. AT&T Broadband added more than 50,000 customers since the end of September, the company says.

The broadband unit generated $9.3 billion over the past 12 months, AT&T says. CT

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Roving Reporter

A Cable Telephony Success Story

By Rex Porter, Editor-in-Chief

While recently visiting with the **Nortel Networks'** folks down in Atlanta, I stopped by **Arris Interactive** to celebrate the shipment of the one millionth Voice Port by the Nortel and Arris team. The shipment represented 2,836,178 lines of Voice Port capacity.

Oscar Rodriguez, president and COO of Arris, noted that 26 different operators in 42 towns and 12 countries have now installed Cornerstone products.

This telephony success story began back in 1996 when Arris introduced its Model One Cornerstone unit, a TR909-compliant, two-line package with 4.9 watts of idle power. Recognizing that it had to solve the power consumption problem, Arris continued its development efforts.

The following year, Arris launched Model Three, and cut idle power to 4.0 watts. By 1998, the Model Four sported an idle power of 2.0 watts. Now, in 2000, the Model Five boasts four-line capacity, and the idle power has been further cut to 1.9 watts.

To better understand the actual growth, let's look at the numbers. In 1999, Arris deployed 172,420 lines of Cornerstone cable telephony. By October 2000, that figure had skyrocketed to 711,950 lines—a 412 percent increase.

Because **Cox Communications** was the first cable operator to enter the telephony market with its systems in Hartford, Conn., and Orange County, Calif., Arris bestowed upon Alex Best, Cox's vice president and chief technology officer, a plaque representing that one millionth Voice Port shipment.

Left to right: Oscar Rodriguez, Arris Interactive president and COO; Rex Porter, *CT* editor-in-chief; Jeff Brooks, ANTEC accounts general manager; Alex Best, Cox Communications vice president and CTO.

I wondered about what Alex would say when he strode to the podium to accept the award and address the audience. His remarks were incisive, and I'm sure Nortel and Arris were appreciative of the accolades he made about their service to Cox's cable telephony program.

"If you haven't launched your cable telephony service yet, take note of what Cox's Alex Best said."

Alex said that Cox does not usually work exclusively with any company in launching an expanded service. But, with cable telephony, Cox decided to depend on the expertise of Arris, and the company was pleased it made that decision. He stopped in the middle of his talk to applaud the whole Arris team.

If you haven't launched your cable telephony service yet, take note of what else Alex said. He noted that Cox had run the numbers on entertainment television service, high-speed cable modem service and cable telephony. The cable operator found that, dollar for dollar, the return-on-investment was higher with cable telephony service. CT

Deployment Watch Monthly Update

Provider/Operator	Service/Feature	Communities	Vendor/Partner
Adelphia	Interactive TV services	Buffalo, NY, and elsewhere	Wink Communications
AT&T Broadband	Interactive TV services	Cedar Falls and Waterloo, Iowa, and Tacoma, Wash.	Worldgate and Motorola
Cablevision	Video-on-demand	New York cluster	SeaChange and Sony
Comcast	Bridge Optical Access System	Select markets	Quantum Bridge Communications
DirecTV	Interactive TV services	Nationwide	Wink Communications
Fiberworks	All-optical fiber network	15 Southeastern cities	Corning
Hilton Hotels	Interactive television	Hilton's U.S. owned, leased and joint venture properties	LodgeNet Entertainment
Hybrid Networks	Fixed broadband wireless systems	Silicon Valley and Oakland, Calif.	Sprint Broadband Direct
Parthus Technologies PLC	Mobile Internet technology	Next generation deployments	Agilent Technologies
Time Warner	Cable-based commercial services	Tampa, Fla. region	Cisco Systems
	High speed Internet access	Within each division nationwide	PowerUP and Road Runner

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Talk about simplicity

What you'll admire most is the architectural simplicity that eliminates scrolling through interminable menus for even the most basic of operations. And how critical parameters such as symbol rate and FEC are determined automatically.

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After two years in development and successful commercial use, the DTE-7100 is now available to cable networks and program providers worldwide. For more information or a demonstration that will make you more fluent in DigiCipher, call 800-756-3147.

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Capturing PC Screens

By Jonathan Tombes, Deployment Editor

Streaming video leaves much to be desired. Good content is scarce and there are those troublesome plug-ins.

Shaumburg Ill.-based, broadband software provider **ClearBand** aims to change that experience. Its system enables broadband network providers to broadcast any real-time video to personal computers (PCs) and provides subscribers with a transparently streamed thin software client.

A Bug's Life broadcast to a PC via ClearBand.

So far ClearBand has licensed its product to European broadband Internet service provider (ISP) **chello**, which tested international Web-casts of **National Football League** games. And its software streams **CNBC** content in a trial over **NBC's** Internet protocol (IP) network at Rockefeller Plaza in New York City.

ClearBand Vice President of Marketing Jeffrey Huppertz emphasizes that ClearBand is a broadband multicast solution.

"As opposed to uni-cast, as in the open Internet, we use multi-cast protocol, so that that one stream can be used by any number of subscribers simultaneously, without increasing bandwidth," Huppertz says.

Private broadband networks are the only practical way to support multicasting across an entire set of users consistently today, he adds.

Huppertz also distinguishes the 200-KB thin-client ClearBand Tuner from alternative methods. "It's not like a plug-in from **Real Networks** or **Microsoft** that's installed on your hard disk and takes up 40 to 50 MB."

Instead, the software automatically is downloaded into a PC's random access memory (RAM) when a subscriber requests a channel. "When you're done watching that channel and you close that window, it goes away," Hubbertz says.

That feature convinced NBC executive Bob Luff to push for a trial at Rockefeller Center.

On the operator side, the ClearBand System can be configured variously. Providers can control picture quality through streaming rates that scale from 300 Kbps to 2 Mbps, with optional encryption. They also can offer essentially a multi-channel video service to PCs through the system's capturing, encoding, storing, scheduling and playback capabilities.

User-friendly

At either end, the product appears to be easy to use.

Hubbertz thinks the product's off-the-shelf performance could appeal to cable operators wary of any service requiring additional on-site tech support.

A cable modem is the only device (apart from a Pentium class PC) that subscribers need. At the headend, the system uses a various number of standard servers. On the network, it requires relatively little space.

"We like it because it conserves bandwidth," says Peter Brickman, senior director of operations and technology at the National Football League.

Huppertz explains that in place of one 6 MHz slot for a single analog channel, you get one Data Over Cable Service Interface Specification (DOCSIS) channel, which at 64 quadrature amplitude modulation (QAM), carries 27 Mbps.

"And if, as we did with the NFL in Amsterdam, you were to use a 1 Mbps stream, that means you could do 27 channels simultaneously." CT

DEALS

> **S-A Invests in BridgeWave**

Scientific-Atlanta made an equity investment of undisclosed value in **BridgeWave Communications**, a wireless broadband technology developer. The technology could enable S-A to expand its customers' data services offerings.

> **Cogeco Buys**

Cogeco Cable, Canada's fourth largest cable operator, agreed to buy all the outstanding shares of **Huntsville Cable Services**, **Muskoka Cable Systems** and **Lakeview Cable**. These three companies serve approximately 13,700 basic service customers in Southern Ontario.

> **Shaw Invests in Internet**

Shaw Communications plans to invest $200 million in its Canada-wide Internet network. The funds are aimed at upgrading and expanding Shaw's cable modem network and delivering improved network performance for **Shaw@Home** service as well as new **Shaw Digital Cable** services.

> **Cisco Buys CAIS**

In a stock and cash deal worth $170 million, **Cisco Systems** acquired **CAIS Software**, whose products enable companies to manage high-speed Internet service in multiple dwelling units.

> **Motorola Joins Round**

Motorola joined **Home Director's** initial $55 million round of financing with an undisclosed investment. The two plan to integrate Motorola's cable modem technology and Home Director's Network Connection Center. Home Director will also develop software applications for Motorola's digital set-top terminals.

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New C-COR.net CTO Speaks

*New chief technology officer at **C-COR.net**, Ken Wright (no relation to his predecessor and former CT columnist, Terry Wright) previously served as CTO for **21e.net** and chief technical officer for **InterMedia Partners**, and has held positions with four additional cable operators. Ken spoke with CT shortly before assuming his new position.*

What brought you to C-COR.net?
Ken Wright: The big driver was meeting Dave Woodle and hearing the vision on the direction that he wants to take the company, as well as what he's been able to do already to execute against that vision.

What's that vision?
The C-COR of yesterday used to be basically an amplifier manufacturer. We will continue to do that, but the vision was really to expand the company and diversify the offerings that they have for cable operators. So they acquired a company that got them into the optics field, **Silicon Valley**; they acquired **WorldBridge**, which got them into the field services. They also bought **Convergence.com**, which got them into the high-speed data area. That, along with some people they got from **Raytheon**, gives them some very solid expertise in the network management area.

How do you see your role at C-COR?
One aspect of my role is to help integrate all of these acquisitions into a seamless mix of offerings and solutions for cable operators. So whether you're after fiber optic gear or amplifiers or network management software or field services or consulting services, C-COR has the whole continuum available. It's going to only get better as we work to integrate those separate businesses.

The second thing that I see going forward is spending a lot of time with the cable operators themselves: identifying the directions they're headed, their architecture, and their service offerings, and then helping to translate that into new product development at C-COR. The third is just to spread the awareness that C-COR has grown beyond just being an amplifier manufacturer.

What's driving the industry today?
As we move to dedicated services, as opposed to broadcast-type services, there's a need to segment the network to a much greater level. And as we move to lifeline services, I think there's a need to have a greater ingress immunity and greater network reliability. Those are two key drivers.

What about network management?
For so many years, cable's network monitoring has been the telephone. In its day, that was appropriate. But it just doesn't cut it in today's business.

At **Jones Intercable**, what we found when we deployed element management is a half a dozen computers running half a dozen software platforms. And they all just sat there and collected dust. But if you've got them all tied into one manager-of-manager system, then suddenly it becomes a very valuable tool. At Jones, we worked with a couple of companies trying to come out with a beyond-prototype, production-level software tool that did just that, but it just really never caught on.

Is the time right now?
The industry is ready for a true network management system, and that's something that C-COR is bringing to the fold. It's one of a number of things that the CEO has done to diversify C-COR...one that holds a lot of promise. CT

PEOPLE

> ### Green Heads Study Group
CableLabs' Dr. Richard Green was chosen to head a study group of the **International Telecommunications Union** (ITU) that has the lead responsibility for preparing standards affecting cable networks.

> ### Schimberg Named Veep and CTO
Frank Schimberg became senior vice president and chief technology officer at **NXTV, Inc.**, a provider of digital broadband services to the hospitality and residential markets. Schimberg hails from **Global Crossing**, where he led development and research of prototype high-speed networks using wavelength technologies and new network protocols.

> ### SCTE Creates Advisory Group
The **SCTE** has created a high-level advisory group called the Executive Council that will assist in the organization's expanding industry role. The council will be made up of leaders of selected MSOs, cable hardware vendors, **CableLabs** and SCTE, plus other top industry executives.

> ### Mueller Becomes Construction Manager
Will Mueller was appointed construction manager to oversee the buildout of **American Broadband's** $170 million network in Rhode Island.

> ### McHugh Promoted
Chris McHugh has been promoted to director of materials at **Trompeter Electronics**, which produces RF interconnect end products, cross-connects and related tools for the telecommunications, broadcast, military and aerospace and instrumentation markets worldwide.

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Arris Gets New Name

By Natalia A. Feduschak, Senior Editor and Jonathan Tombes, Deployment Editor

It's a merger, it's an acquisition, it's a spin-off....It's **Arris International**!

But don't blink, you might miss the details of how **Arris Interactive**—a joint venture between **Nortel Networks** and **Antec**—changes its last name.

Nortel is trading its 81.25 percent stake in the joint venture for $325 million in cash and 33 million shares in the new company, to be named Arris International. Meanwhile, Antec retains its ownership share but undergoes its own name change.

"The merger of Antec with Arris Interactive so fundamentally changes the composition of Antec that we, in essence, will form a new company with a new name," Antec CEO and President Bob Stanzione said in a statement.

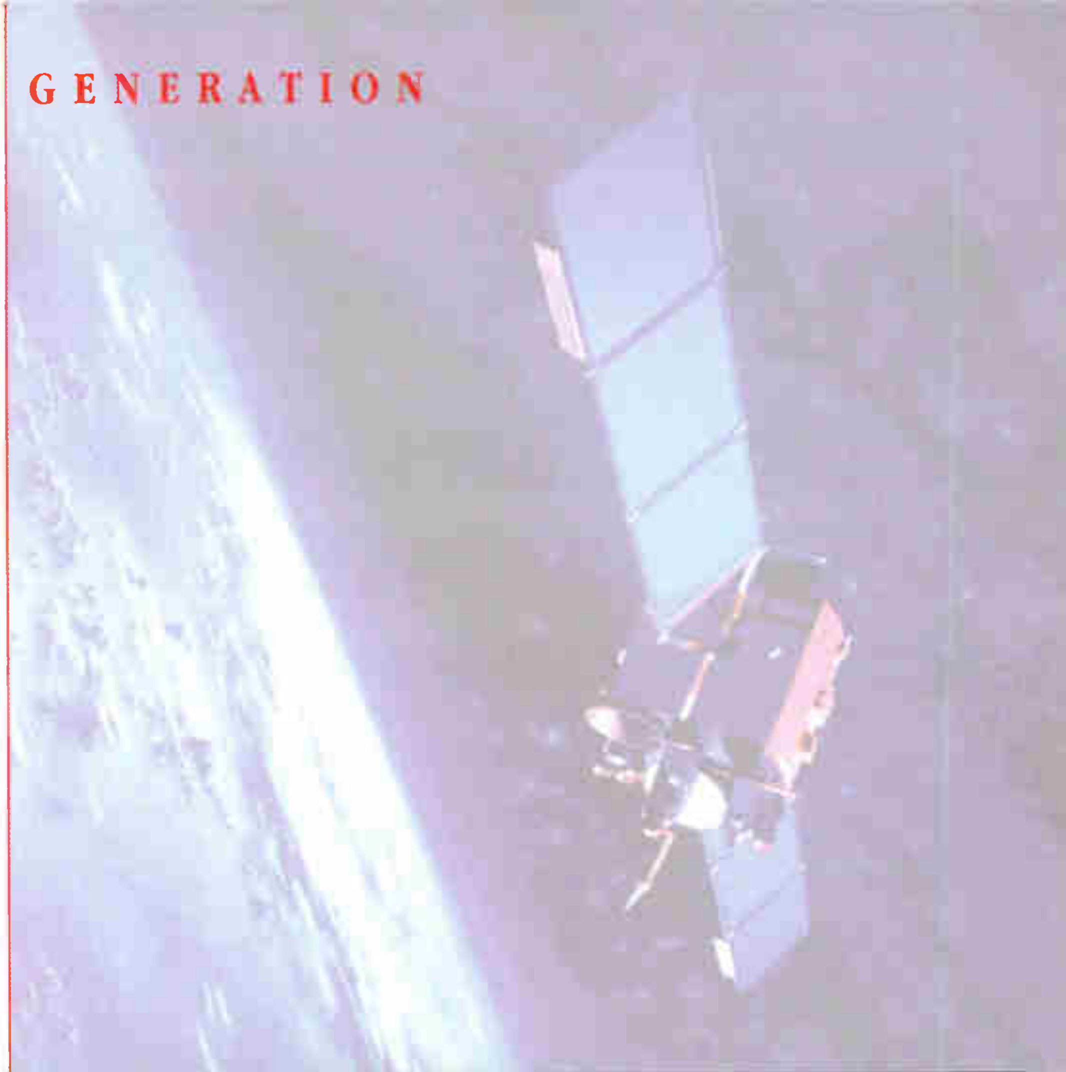
Last year Antec, with about 3,500 employees, generated $826 million in revenue. Antec and Nortel, in a joint release, said Arris Interactive had revenues in 1999 of $328 million, half of which were from sales to Antec. About 400 people work for Arris.

Dan Middleton, vice president of local Internet services for Nortel, says the deal arose because of interest in taking Arris Interactive public and Nortel's desire to concentrate on its core businesses. But Nortel isn't walking away.

Nortel's 33 million shares translate to an approximately 47 percent ownership interest in—and two seats on the board of—the new company. Middleton adds that Nortel and the new company will collaborate closely.

"We're now able to take the level of

THE NEXT GENERATION



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

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investment support pouring into Arris and see how we can make the network better for cable," Middleton says.

Next-generation focus

Arris recently announced the shipping of its one-millionth Cornerstone Voice Port. Combined with the company's Converged Host Terminal (an Internet protocol and constant bit rate headend), the port creates a voice application for hybrid fiber/coax (HFC) networks.

Deployment of Cornerstone cable telephony lines has increased fourfold over last year, the company says. (For more on Cornerstone, see "Roving Reporter," page 16.)

Another Arris product, Packet Port, delivers bundled Internet (over cable) and voice services to the residential market. Both offerings suggest a shift away from Antec's traditional radio frequency (RF) focus.

Nearly half of Antec's business will now be devoted to next-generation solutions, Antec spokesman Jim Bauer says.

"This alliance brings Nortel's tremendous capacity to deliver information and with Arris' ability to do it in a cost-effective manner," Bauer adds.

Michael Harris, president of the research firm **Kinetic Strategies**, says the new company will face a challenge in producing high-quality next-generation products, such as bringing to market a Data Over Cable Service Interface Specification (DOCSIS) 1.1 cable modem.

"They're going to have their work cut out for them," Harris says. CT

ITV Research: Big Growth Ahead

By Jonathan Tombes, Deployment Editor

A new report from **The Strategis Group** predicts that that by 2005 interactive TV (ITV) households will number over 40 million by 2005, 16.6 million of which will be video-on-demand (VOD) subscribers.

The report also offers a snapshot of consumer interest in ITV.

Co-author Ty Cottrill says that a survey of 504 geographically dispersed heads of households in August found relatively strong consumer interest in VOD and interactive programming, and less interest in Internet over TV and so called T-commerce.

Of those surveyed, 23.4 percent were "extremely/very interested" in VOD and 17.5 percent responded similarly to interactive programming. As for Internet over TV and T-Commerce, 15.5 percent and 11.5 percent, respectively, fell into that category.

While skeptics are beginning to wonder whether VOD will deliver as promised, the Strategis report's authors remain upbeat.

Co-author Keith Kennebeck admitted that, while unlikely, technical or licensing snafus could slightly dampen the growth rates. "But otherwise, we see great adoption rates," he adds.

Cottrill says the challenge for providers is to educate consumers. "If the industry does a good job of presenting the service in the right way, they'll get good results."

In addition to covering ITV's range of services, the report surveys categories of interactive platforms (thin set-top, thick set-top, headend-based) and types of service providers (broadcast TV, direct broadcast satellite and cable).

For more information contact The Strategis Group at (202) 530-7500 or on the Web at www.strategisgroup.com. CT

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Lucent's Lasers Run Hot and Cold

By Jonathan Tombes, Deployment Editor

Looking for a very hot—and cool—technology? Try the 1550 nm analog laser module for forward and return path dense wavelength division multiplexing (DWDM) cable TV applications from **Lucent Technologies**.

"With other lasers, the TE cooler would kind of run out of gas at the temperature extremes."
—John Frame, Lucent Technologies

Lucent's soon to be spun-off **Microelectronics Group** says the A1751A module operates over a 125 degree C temperature range, from –40 degrees C to +85 C. At the Western Cable show, look for a demo that involves either end of that range.

"What is unique about these lasers is that they are DWDM-capable over a wider temperature range than what was available previously," Lucent Senior Manager of Broadband Marketing John Frame says.

The basic issue is that temperature effects the behavior of wavelengths; hence the rise of thermo-electric (TE) coolers.

"With other lasers, the TE cooler would kind of run out of gas at the temperature extremes," Frame says. "You would lose the temperature control and, therefore, lose the wavelength accuracy as well."

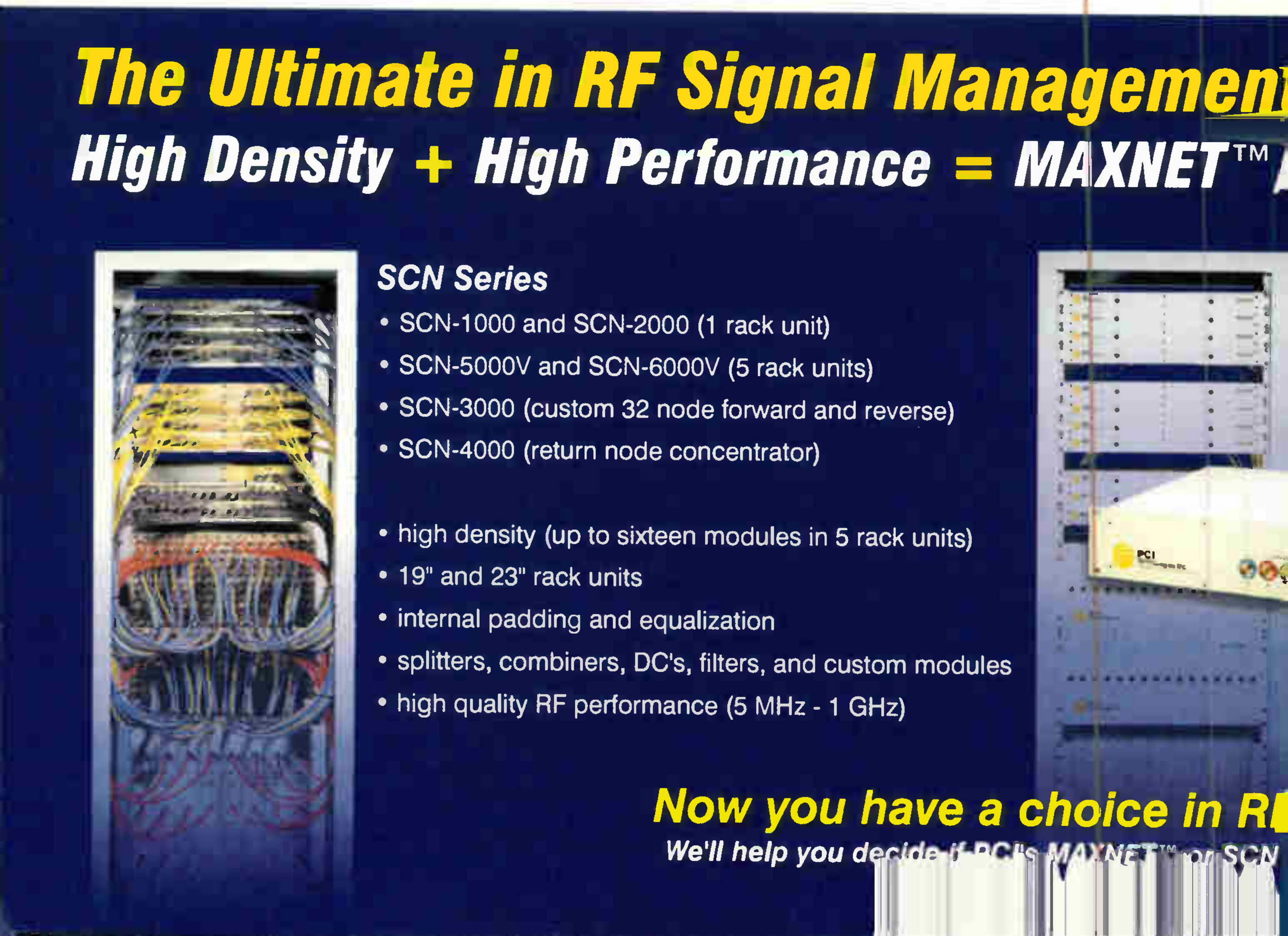
Temperature concerns are not limited to field applications of fiber rich architectures.

Ann Elizabeth Rogers, product line manager for laser modules, says that customers were asking for a wider temperature range for the node, but also raising the issue of more densely populated—hence hotter—transmitters at the headend.

Rogers also says the module increases coupling efficiency, or the amount of light that goes into a laser and the amount of power that comes out.

Technology tradeoffs

This component, aimed at original equipment manufacturers (OEMs), presents another factor in the ongoing price/performance tradeoff of compet-



ing technologies. Coarse WDM (CWDM), while "uncooled" and less expensive, has greater channel spacing requirements and carries fewer wavelengths than DWDM.

Stephen Montgomery, president of opto-electronics research firm **Electronicast**, predicts that the cheaper option will take off first. "We see a lot of activity in cable TV really starting in CWDM, and DWDM probably beginning in 2003 very early, and really not until 2005."

What Lucent is trying to do is get operators such as AT&T to notice DWDM and so move those estimates up, Montgomery suspects.

Is Lucent's attention-grabber newsworthy, after all? Mani Ramachandran, chief technology officer of **Synchronous**, says the temperature range on the lasers that his company uses is already sufficiently wide. Moreover, he questions the product's premise.

Lucent's A1751A DWDM laser module

"Why use analog in an uncontrolled environment?" Ramachandran asks.

The advantage is transmitting cable signals in "their native format," says Frame. But Ramachandran suggests that other techniques are more effective, especially in the return path.

"They're all going digital, anyway," Ramachandran says.

Obtaining information about who uses such components can be tricky. "Most of our customer alignments are under NDAs (nondisclosure agreements)," Lucent spokesman Brian Bardwell says.

Electronicast's Montgomery is surprised that Lucent's Microelectronics Group is even talking, given the imminent spin-off. "I thought this was their 'quiet period,'" he says.

The significance is that, quiet or not, Lucent and others are solving optical transmission problems that OEMs in the cable space have flagged. In a related development several months ago, **3M** announced an athermal package for optimized temperature stabilization designed for DWDM applications.

3M says its package expands the use of fiber Bragg gratings (a DWDM filter technology) to uncontrolled environments from –40 to 80 degrees C.

The A1751A module originates from Lucent's "Opto-West" unit in Alhambra, Calif. Formerly **Ortel Corp.**, it is now distinguished from the Lucent's facilities in Breinigsville, Pa. CT

A High-Speed Letter from Canada

By Natalia A. Feduschak, Senior Editor

High-speed data service is booming in Canada, by some measures outpacing the United States. Why?

One reason is an effort by the **Canadian Radio-Television and Telecommunications Commission** (CRTC), Canada's FCC, to make the Internet available everywhere.

"Cable hit Canada's major cities early."

"It was part of the social imperative," says Angela Draskovic, vice president of sales in Canada for **General Bandwidth**, a voice over broadband technology provider. "That is part of the Canadian psyche. We don't want haves and have-nots."

The CRTC also has mandated open access, a policy that remains hotly debated in Washington, D.C.

Canadians are wrapping up an open-access trial that will help implement that policy. Participants include **America Online**, **UUnet** and **Groupe Videotron**, Montreal's largest cable operator.

Canada is also highly penetrated by cable. Three of every four homes passed in Canada as of September 1999 subscribed to basic cable, **Canadian Cable Television Association** (CCTA) spokesman Bill Allen says.

By May of 2000, the comparable U.S. basic cable rate was just shy of 70 percent, according to **Paul Kagan Associates**.

Whereas cable in the United States initially provided TV signals to those outside the major markets and only later came to urban centers, cable hit Canada's major cities early.

A relatively high, largely urban cable usage gives Canadian operators a good base from which to launch advanced services. Draskovic says the implication is a shorter technology adoption curve.

Of course, investment also is necessary, and industry has responded.

Nick Hamilton-Piercy, chief technology officer for **Rogers Cable**, Canada's largest cable operator, says 95 percent of his company's plant is

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two-way data-ready. "We have close to 14 percent penetration of high-speed services," he says, noting that Rogers launched Internet access before most U.S. cable companies.

The overall picture also is impressive. "We are now in a situation where about 5.5 million homes are capable of high-speed Internet access," says Janet Yale, CCTA's president and CEO.

Bottom line

By mid-2000, Canadian cable operators had 670,000 high-speed Internet customers, while telephone companies had approximately 220,000, the CCTA reports.

The comparable number for U.S. cable operators was 2.3 million, according to **Kinetic Strategies**. (Recall, however, that the United States is about nine times as populous as Canada.)

Convergence Consulting Group of Toronto estimates that more than one million Canadian homes will have high-speed Internet access of some kind by the end of the year. That figure is expected to double by the end of 2001.

Canadian operators are exploring various ways to satisfy consumers' data needs. Rogers, for instance, has a 15-year service deal with **Futureway Communications**, a small telecom company, to provide fiber optic links in new housing developments.

Shaw Communications, the nation's second largest cable company, is also making advances in providing high-speed access.

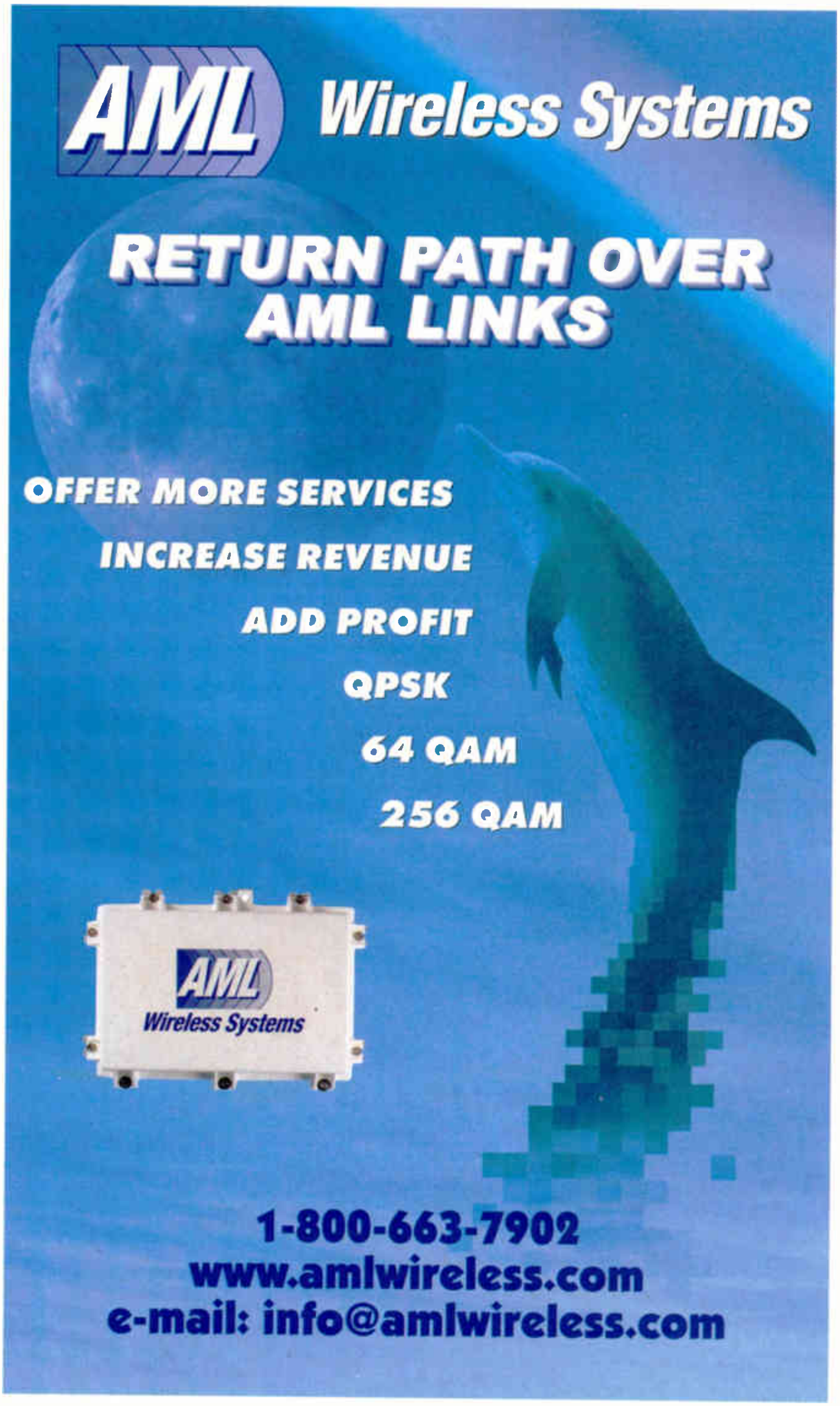
In a deal valued at $662 million, Shaw recently acquired a 94.5 percent stake in **Canadian Satellite Communications** (Cancom). With 400,000 customers, this deal makes Shaw the largest provider of video signals in Canada and boosts its efforts to expand high-speed Internet access.

The likelihood that a comparable U.S. deal (say, between **Time Warner** and **DirecTV**) would fail to pass regulatory scrutiny suggests additional differences between the U.S. and Canadian regimes.

Hamilton-Piercy says the approval process in Canada is both more bureaucratic and open than in the United States.

"The Washington approach is not as effective here," Hamilton-Piercy says. "If a new initiative comes up, whether buying a cable system or (granting) equal access for high-speed data, it goes through a public forum process."

Heavy lobbying by incumbents does not always pay off, he adds. CT



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Satellites Go Interactive

By Arthur Cole, Contributing Editor

Now is not the time to grow complacent when it comes to competition from the sky. Yes, the cable industry is making great strides toward interactive television and data services, but the direct broadcast satellite (DBS) industry is not exactly sitting on its hands.

In fact, the two main satellite providers in the United States—**DirecTV** and **EchoStar**—are turning to many of the same companies you are to provide interactive services to customers.

> **"It's one more way to get into the person's home."**
> **—Mark Lumpkin, EchoStar**

That fact was highlighted recently at a New York demonstration of the DirecTV Interactive service powered by the **Wink** Enhanced Television platform using new **RCA** decoders from **Thomson Multimedia**. Services include largely the same line-up available to digital cable subscribers, namely: interactive programs and advertisements, e-commerce, and news, sports and weather services.

DirecTV will download the Wink software to Wink-compatible RCA units free of charge. The company expected to have 1 million interactive viewers by the end of 2000, jumping to 5 million within a year.

DirecTV also has partnerships in place with **Liberate** and **Microsoft** to provide interactive services.

Meanwhile, EchoStar is working with Wink and **OpenTV** as it rolls out three new interactive platforms. One is DISHPlayer, which requires a souped-up decoder outfitted with a 17 GB hard drive to store video and program-

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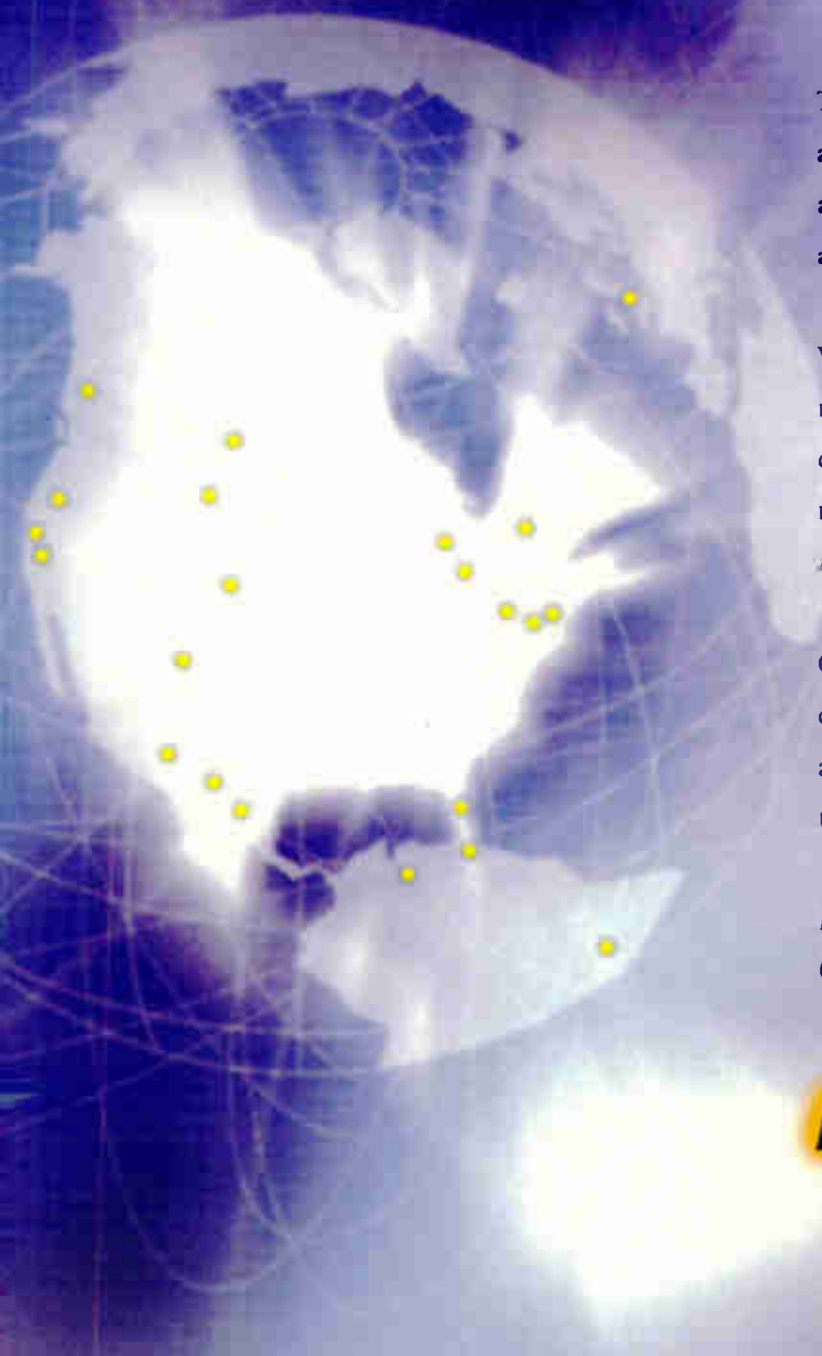

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ming. It features WebTV software for web-surfing over a 56 kbps dial-up modem. The company claims to have 100,000 DISHPlayers on the market.

EchoStar is gearing up to launch the GEOcast service, which features a 40 GB hard drive and is aimed at personal computer (PC) users.

But the most significant development for EchoStar is a recent joint agreement with a company called **StarBand** that will offer customers a mini home-uplink system operating at 150 kbps. The service will offer "always-on" broadband access via satellite. Hardware is expected to be pricey: $300 to $500 for a slightly larger dish than current EchoStar users employ. Service fees are expected to run $50 to $80 per month.

StarBand is a joint venture of **Gilat Satellite** networks, **Microsoft**, EchoStar Communications, and **ING Furman Selz Investments**. In November, the company launched its "Just Look Up" brand campaign.

"All (consumers) have to do is look up," StarBand's President and Chief Marketing Officer David Trachtenberg said in a statement. "If they can see the southern sky, they can enjoy StarBand service."

StarBand is scheduled to launch services in Alaska, Hawaii and Puerto Rico in 2001.

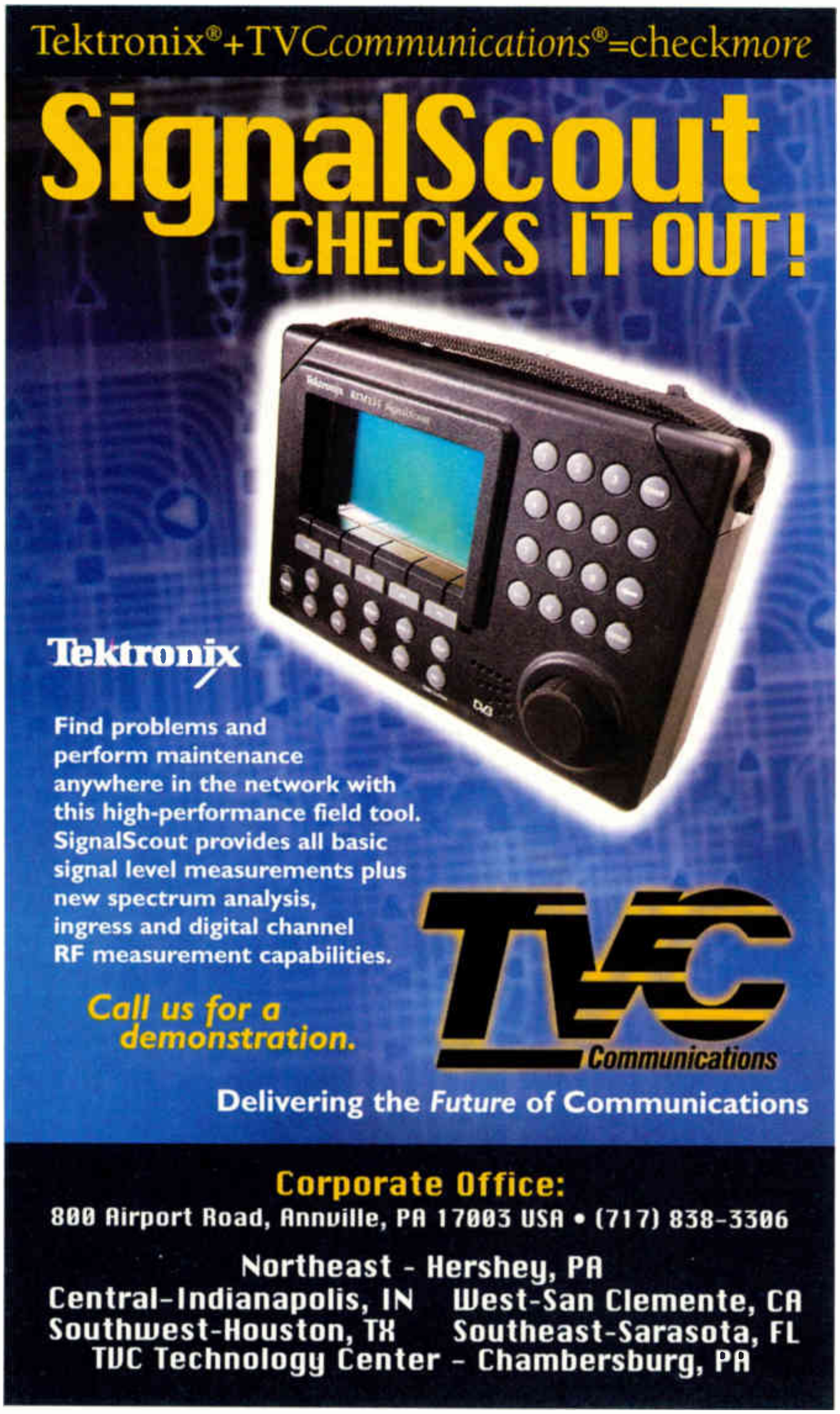
EchoStar spokesman Mark Lumpkin says interactive services are intended to provide more than just another revenue stream for the company. They are designed to keep the satellite industry out in front of the public.

"This is one of the arguments we have to counter customers who say 'I can get a cable modem or DSL [digital subscriber line], so why should I bother with satellite?'" he says. "It's one more way to get into the person's home."

According to Jim Stroud, a satellite industry analyst with **The Carmel Group**, expect to see more solutions focusing on the back-channel as a way to bring satellite-based interactivity into the living room.

"With the release of the StarBand communication dish, and the DirecPC service going to a two-way dish, you're going to see a migration from the PC-centric model to a two-way ITV service," he says. "These satellite companies also are making agreements with DSL providers for a back-end connection that is always on."

To get a glimpse of the future of satellite, Stroud says look at Europe, where **BSkyB's** OpenTV and **Canal Plus'** Media Highway are the two most popular services. CT



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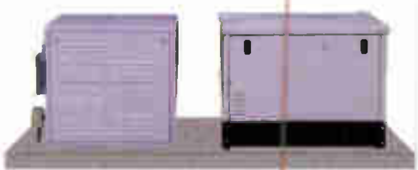

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CableLabs Gives Nod to Three CMTSs

By Natalia A. Feduschak, Senior Editor

RiverDelta Networks, **Riverstone**, and **Terayon Communications Systems** are the latest companies to receive **CableLabs'** stamp of approval for their cable modem termination system (CMTS) products. In addition, CableLabs requalified **Motorola** for a CMTS product and recertified one of its cable modems.

This brings to total eight companies that now have CableLabs-qualified CMTS products.

"This is a great milestone," says Elisa Camahort, director of product marketing for Terayon.

Although three companies were qualified, Terayon and Riverstone are putting the same product on the market because the two companies worked together to create the modem, Riverstone Director of Corporate Marketing Stephen Garrison says.

"It's branded as theirs and ours," Garrison says. Terayon's CableLabs-qualified product is the BroadbandEdge 2000 system, and Riverstone's is the RS 8000 switch router.

The two companies designed their CMTS from the ground-up to support the creation and delivery of a range of Internet protocol (IP) services.

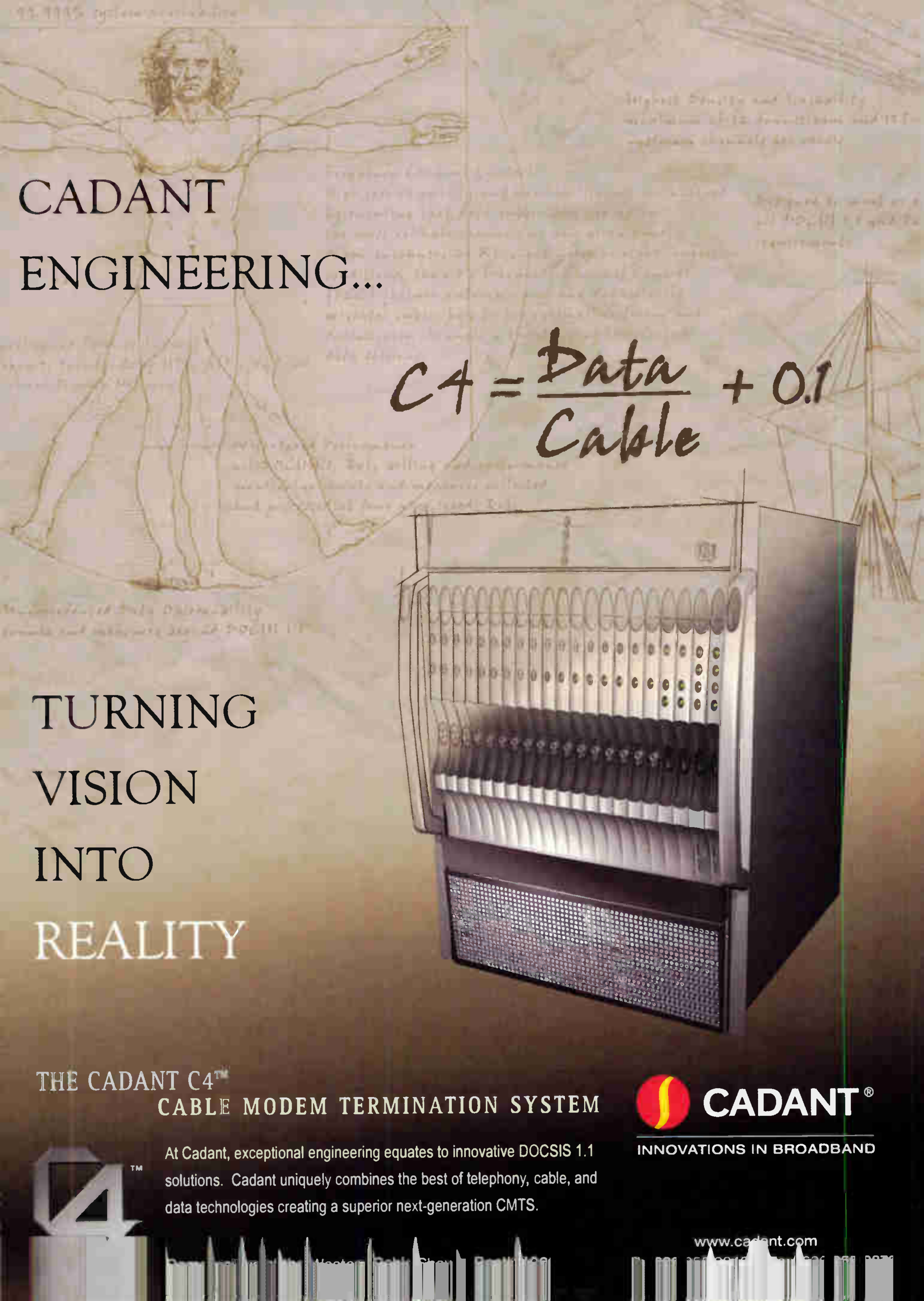
The doubly branded CMTS can go up to 38 megabits per second on the downstream for 256 quadrature amplitude modulation (QAM). It supports both quadrature phase shift keying (QPSK) and 16 QAM on the upstream, and may be upgraded to Data Over Cable Service Interface Specification (DOCSIS) 1.1.

RiverDelta Networks claims it is the first company to receive qualification after only two passes through the interoperability test suite. Its CMTS is part of the company's broadband services router (BSR).

Jeff Walker, RiverDelta vice president of marketing, describes the BSR as having a cache-based system that is dense in radio frequency (RF) capability.

Walker says the BSR is the most compact on the market, and is at supporting advanced servic[es].

"We really designed the pr[oduct] from day one to be DOCSIS 1.1 compliant," Walker says. CT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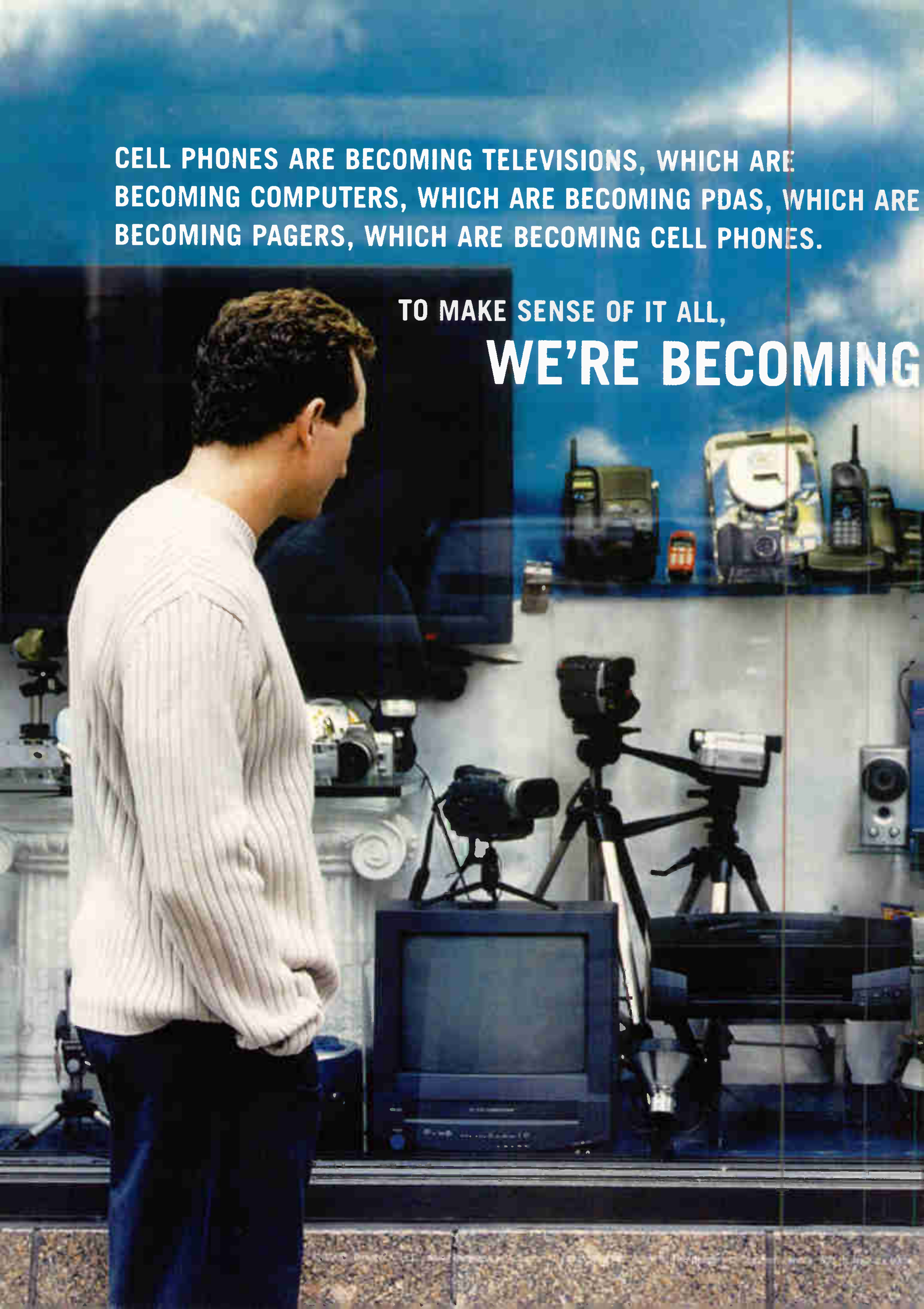
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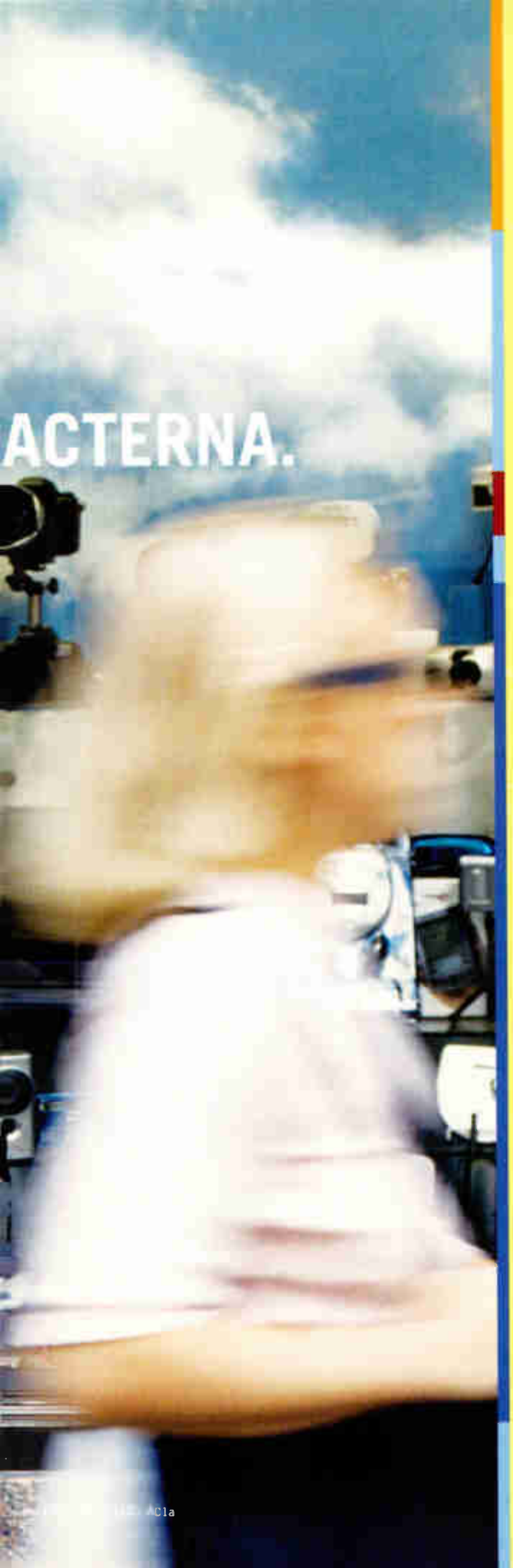

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The Cost of Service

For several years, I have used service-call percentage tracking as a means of gauging the cost of a cable system's corrective maintenance activities. Also called demand maintenance, corrective maintenance is a response to problems resulting in the dispatch of a service technician to a subscriber's home or to a portion of the network requiring attention.

"Customer goodwill has a definite dollar value."

An effective measure of corrective maintenance is the monthly service-call percentage. This is defined by the formula SC% = (T/N) x 100, where SC% is the monthly service call percentage, T is the number of service calls in a one month period and N is the average number of subscribers during the same month.

For example, if a 20,000 subscriber system has 800 service calls during one month, its service-call percentage for that month is 4 percent. Based on 22 working days per month, this averages to more than 36 service calls each day in this hypothetical system. Being conservative and using a figure of $50 per service call, this system's corrective maintenance is costing about $40,000 per month.

The $50 per service-call figure includes the technician's salary plus overhead, vehicle and tools, dispatch, customer service representative (CSR) time to talk to the subscriber and write up the call, computer processing/logging, etc. If you do the analysis, you'll probably find the real cost is more than the $50 figure I'm using here. Figures may go as high as $100 or more per service call.

When tracking these percentages, service calls include anything requiring a technician to go to the field. Among these are the usual service calls for network, drop and subscriber-caused problems, TV-set fine tuning adjustments, no fault found, no one home, and so on.

Typical cable systems have average service-call percentages around 3 percent per month, while well-maintained systems have monthly percentages in the 1 percent range. Monthly figures may be as low as 0.22 percent (very unusual) to as high as 26 percent (also very unusual). If the hypothetical 20,000 subscriber system had a monthly service-call percentage of 26 percent, its staff would be taking care of 5,200 service calls each month, or more than 200 per day. At 0.22 percent, the figures would be 44 per month, or two each day.

Using the 4 percent figure for the hypothetical system, if service calls could be reduced by half—and a good preventive maintenance program has been shown to sometimes have that much impact—corrective maintenance costs would likewise be cut in half. With a 2 percent monthly service-call percentage, our hypothetical system's staff would have to deal with 400 calls per month, or about 18 a day. At $50 each, that's an estimated $20,000 per month for corrective maintenance compared to the previous $40,000 per month.

How does that savings actually make it to the bottom line? One way is staff reduction. If each service technician can complete eight calls per day, the first scenario at a 4 percent service-call percentage will require five technicians (technically 4.55, but I'll round up since I've never seen half of a technician). At a 2 percent rate, three technicians could do the work (technically 2.27, but quarter technicians are even harder to find than half technicians), and with a little extra individual productivity, maybe two could do it.

In this particular example, however, an alternative to outright staff reductions should be considered. Instead of laying off competent technicians, they could be given new job assignments, such as full-time preventive maintenance or other technical positions that were to be filled with new hires.

Some might question where the savings are—service calls went down, but staff size stayed the same.

Plans to fill other technical positions with new hires, may be avoided by utilizing existing trained and experienced staff. Staff size remains the same, those new positions are filled with individuals who already know the system and will require little, if any, additional training. Furthermore, because they are experienced, you bypass the usual productivity ramp-up problems. From one perspective, the previously mentioned staff reductions will save actual dollars, but from another perspective,

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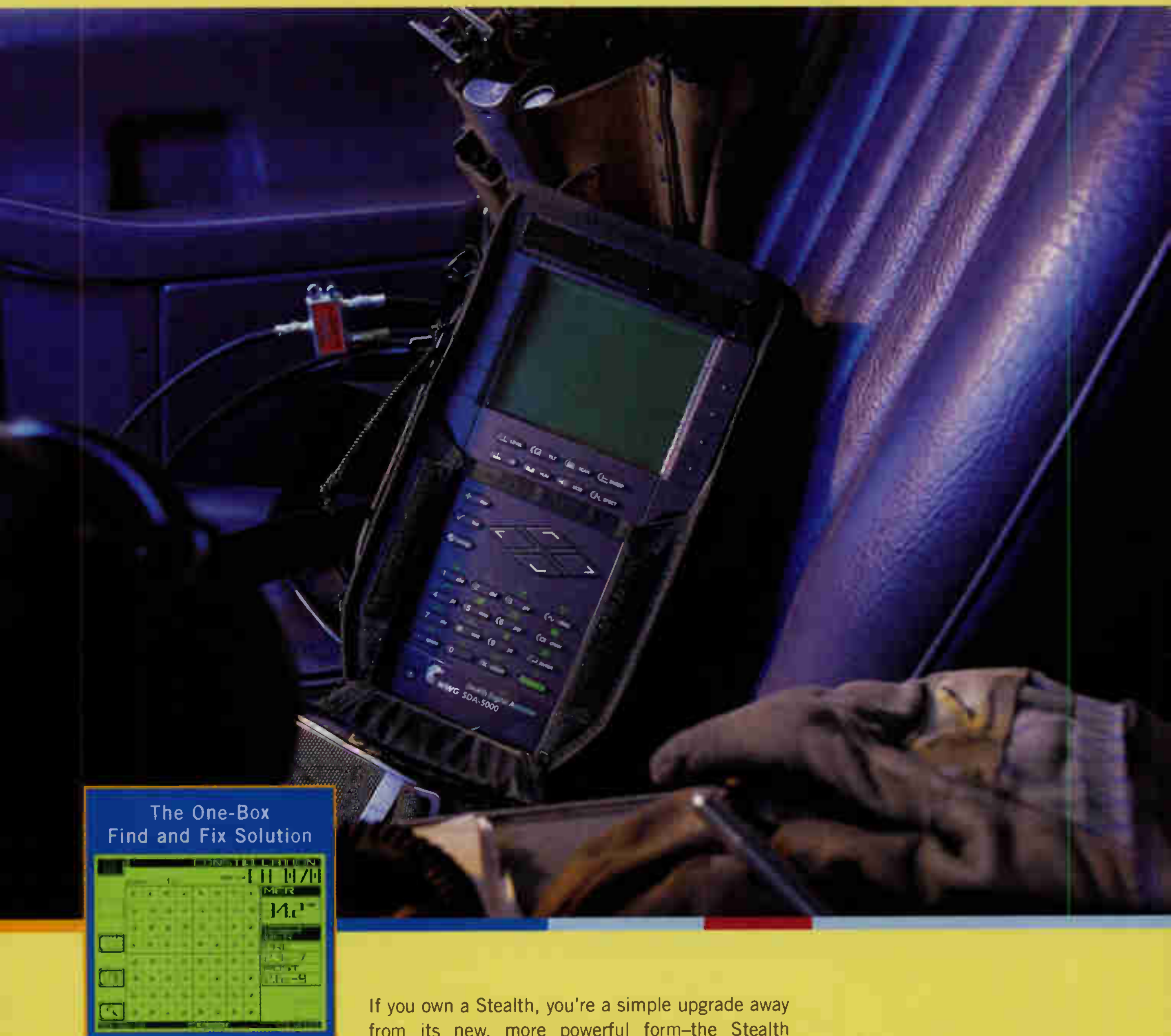

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transferring existing staff to other functions will save budgeted dollars.

Moving service technicians into full-time preventive maintenance has a more tangible impact on the bottom line, but one that may not be so obvious at first glance. It is the value of customer goodwill.

Having a dedicated full-time staff performing an effective preventive maintenance program means that the number of service calls will continue to decrease, while system reliability and service quality will improve. A better system results in happier subscribers. Happier subscribers mean less churn.

Churning costs

Consider the value of a subscriber, both from a capital perspective—what the subscriber is worth when the system is sold—and a gross revenue perspective. For the former, let's use $4,000. For the latter, $35 per month over a subscriber life of five to seven years (this may vary depending on how a company calculates subscriber life) works out to between $2,100 and $2,940 in gross revenue. As you can see, each subscriber is valuable.

Churn is categorized as controllable and noncontrollable. Noncontrollable churn averages about 15 percent per year and is mostly attributable to subscribers who move. The actual figure varies from market to market, but in the hypothetical system, 15 percent is 3,000 subscribers per year. Controllable churn—nonpay disconnects, dissatisfied subscribers and so on—may comprise an additional 15 to 25 percent, or, in the case of the hypothetical system, between 3,000 and 5,000 subscribers per year. Here, too, the actual figure will vary from market to market. A conservative rate for the hypothetical system would be an annual controllable churn of 10 percent, or 2,000 subscribers per year. What happens if that figure is reduced to 9.7 percent? In other words, controllable churn needs to be reduced from 2,000 subscribers per year to 1,940 per year, by "saving" 60 subscribers.

If service-call reduction efforts prevent just five subscribers from disconnecting each month, the company saves $20,000 in capital value, $2,100 in annual revenue, and between $10,500 and $14,700 in subscriber life revenue for those same five subscribers. Over the course of a year, 60 subscribers saved are worth $240,000 in capital value, $25,200 in annual revenue, and $126,000 to $176,400 in subscriber life revenue.

While some may or may not agree with the specific figures used in the hypothetical example, the philosophy is what counts. Plug in your own numbers. It's obvious that customer goodwill has a definite dollar value. If some of that customer goodwill is the result of improved service because of effective preventive maintenance and a corresponding reduction in service calls, then those maintenance efforts become pretty much self-funding.

In the past, many disgruntled subscribers who disconnected eventually came back. In today's environment, with multichannel multipoint distribution service (MMDS), direct broadcast satellite (DBS) and other competition, disgruntled subscribers have the opportunity to take their business elsewhere and never come back, making it all the more important to ensure the best service possible is provided. CT

This article has been updated from a column that ran in CT in June 1996.

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

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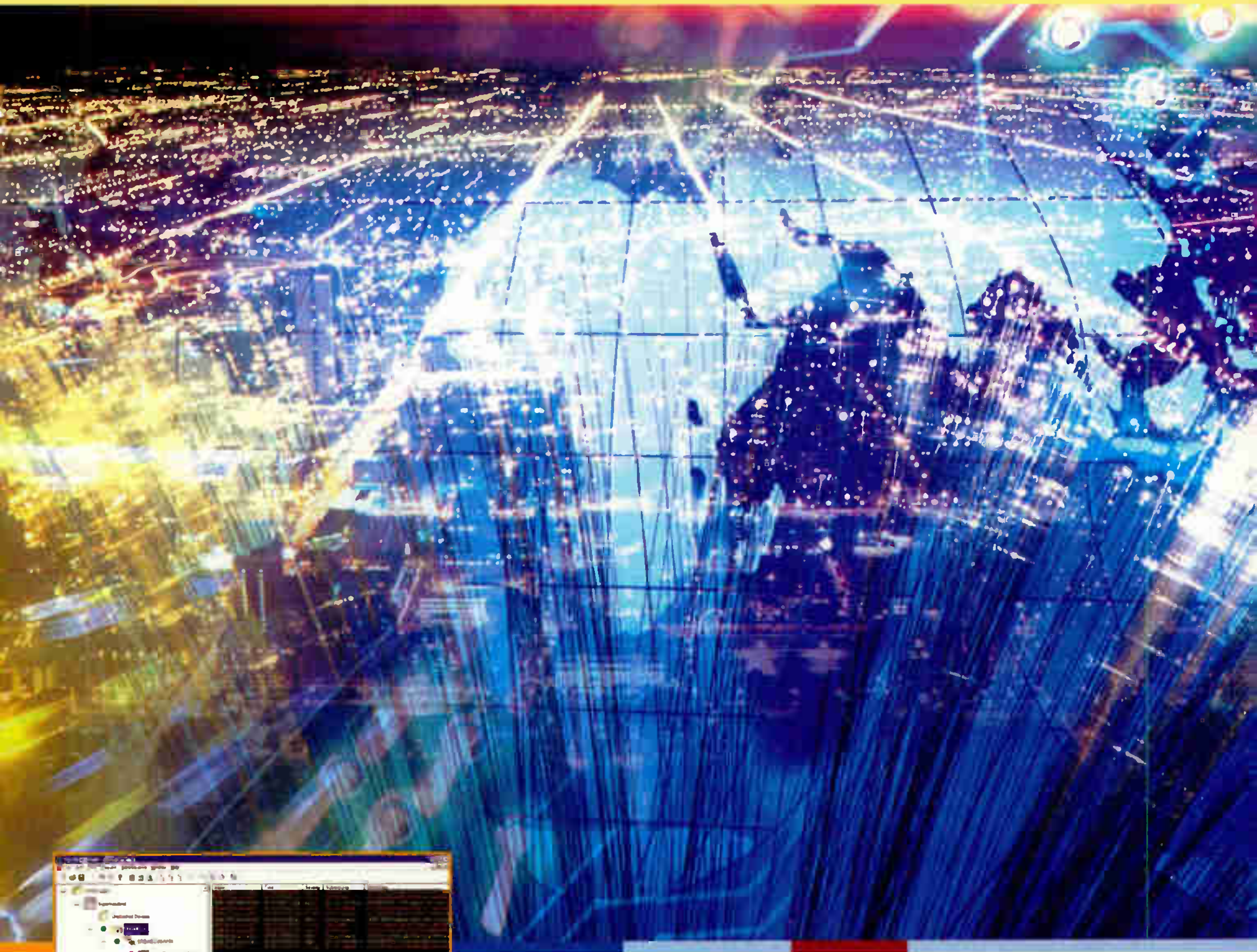

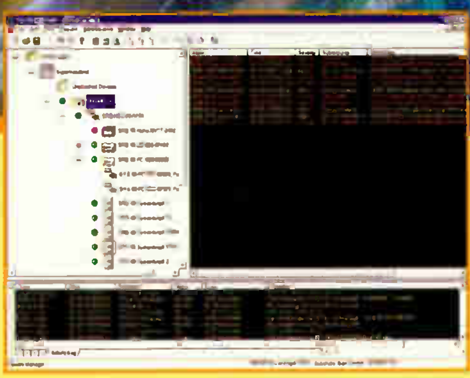

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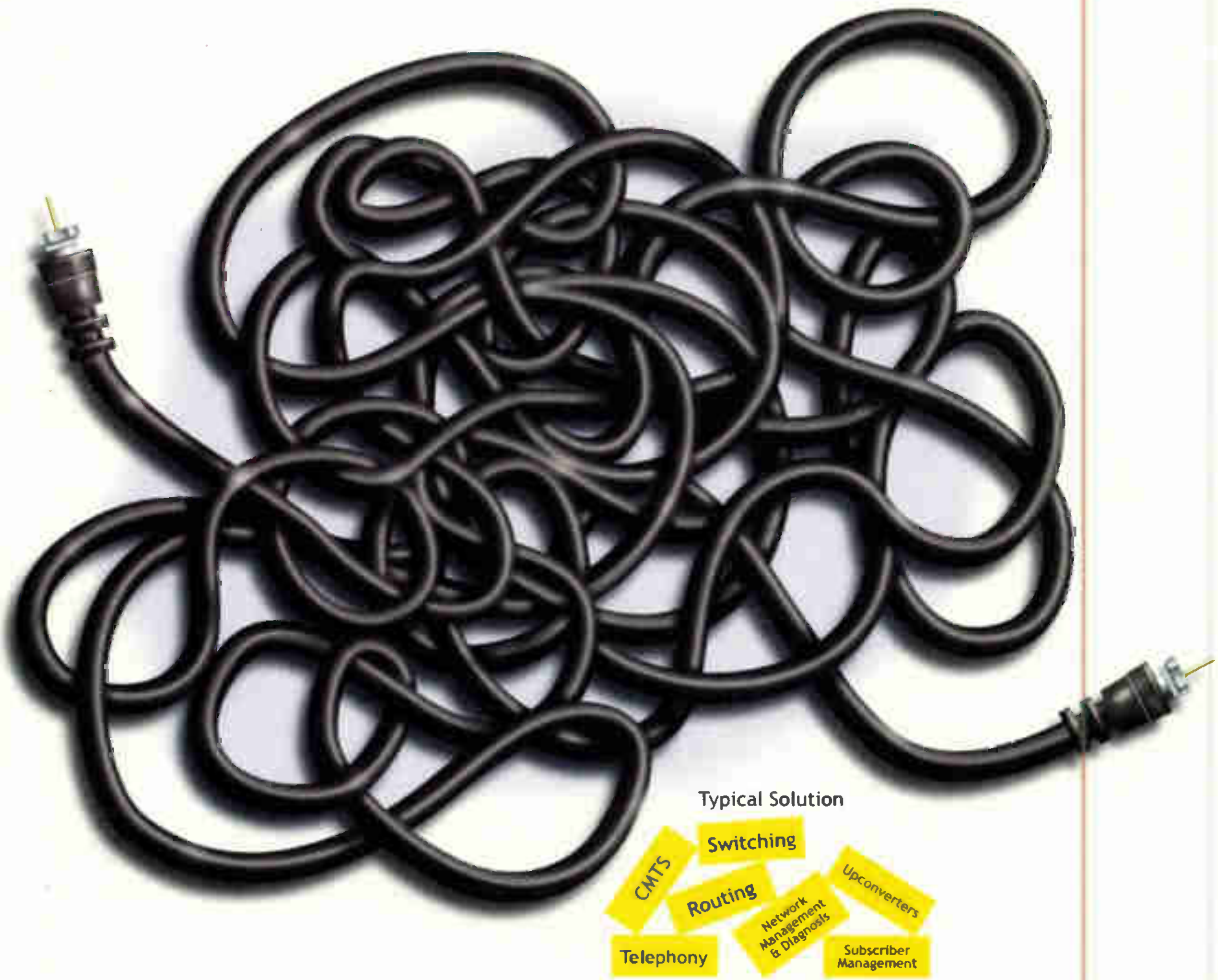

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Cable Telephony Comes of Age

In this column nearly five years ago, I conducted a verbal "tour" of a telephone company's central office, to give our industry's technical people some insight into how telephony could change a typical headend. With all the activity in cable telephony in year 2000, I thought it would be interesting to revisit that tour side-by-side with a tour of a headend that is actually equipped for cable telephony. It's kind of fun to see how far we've come, and in many ways, how much better we look than our telco counterparts.

"It's kind of fun to see how far we've come, and in many ways, how much better we look than our telco counterparts."

Realize, however, that this tour is a visit to a circuit-switched telephony headend. Sometime in the future, we can do this all over again for Internet protocol (IP) telephony. That doesn't mean this tour is irrelevant—it just reflects the dynamic nature of telecommunications in our industry. In the meantime, however, there's a whole bunch of cable headends that are becoming their own version of a telco central office.

So, here's the side-by-side tour. The old central office tour from my May 1996 column is in italics. Today's cable telephony tour is in regular type.

Telco: *The telco central office is readily recognizable as a telephone building by the brown brick exterior, the receptionless entry door, and relative lack of windows. There's typically a parking area for telco service trucks. So far, not too different from the headend.*

Cable: Some things never change.

Telco: *Now, let's walk into the building. We start our tour in the basement. This is where cables containing the twisted pair copper wires enter the building. In a metropolitan location, almost everything enters from underground cable ducts. Typically, the cable diameter is 2 or more inches. The room we enter is pressurized and the door is alarmed to ensure it remains closed. That's because toxic "sewer gases" could also enter via the cable entry points.*

Cable: Hybrid/fiber coax is a lot more efficient media for the "last mile." There's no need for a pressurized room to house thousands of cables entering the building. Even considering splitters and combiners, our link to the subscriber is a lot more compact.

Telco: *Outside the cable room we find the power for the central office equipment. Of course, commercial AC enters the building and is converted to -48 volts by a bank of rectifiers. What we don't expect is the nearly 50-foot long shelf holding 3-foot high glass cylindrical lead acid storage batteries. This power reserve is connected to a bus to the commercial power line and central office equipment. This is the last course of electrical reserve, which must power the office for at least eight hours. They are the last choice for powering the office, and hopefully, they will never be used. They are continually being charged, however, to maintain readiness.*

Close by, in another room there is a diesel generator, which is an alternative source of AC power and the first alternative in the event of commercial power failure. Diesels generate toxic fumes, so this subbasement room must be rigidly ventilated to the outside with a system of fans, ducts, and filters.

Cable: The headends I have visited typically have the diesel generator outside the building, or rely on natural gas to power it. Like the telco, we are equipped with battery reserve, which is usually inside the headend building. We engineer to the same standards as the telcos for hours of outage.

Telco: *Our next stop is on the ground floor, where we find the distributing frames. This is the cross-connect point for the lines from the outside world to the central office equipment. Common to all systems of cross-connects is that one side of the cross-connect goes to the wire pair to the subscriber, and the other side goes to the central office equipment, typically a switch line card. The frame has two sides: a vertical side, where the lines from the cable entry room are terminated, and a horizontal side, where the equipment is terminated. As part of the line installation, the craftsperson makes the crossconnection between the two.*

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Cable: We bring coax cables to the host digital terminal (HDT) frame, where demodulation occurs. Connection to the path to the switch is done by internal electronics, within the Next Generation Digital Loop Carrier (NGDLC) part of the HDT. The link to the switch is over DS1 lines, each transporting 24 separate subscriber calls.

Cable management has markedly improved. The headends I have visited have color-coded coax for telephony, which is neatly bundled along the rear side of each frame, up to the point of termination for each cable. It's a visual pleasure to see an HDT frame that has been properly cabled.

Telco: *Now that we've seen the interfaces to the outside world, we're excited about getting to the business end of the offices—the switch and the transmission plant. The switchroom is somewhat of a disappointment. In the far corner of the room are four rows of what looks like computer equipment, but is actually the digital switch. It's quiet in here. All you hear is the hum of the equipment cooling fans.*

On closer inspection, we see that the rows of equipment are arranged by functions. The row closest to the wall is the processor portion of the switch, where the system software resides, and where the printer and display terminal are connected. This row also houses the hard drives with billing records.

The other rows contain frames of switching modules. Some of them hold circuit cards for line circuits (the equipment connected to the lines on the distributing frame). Others have trunk circuits (similar equipment connected to the rest of the public switched network, possibly to interexchange carriers), and service circuits for announcements, testing and signaling, such as ringing the line.

In some central offices, other equipment for special service offerings is put in the switch lineup. One example might be a voice messaging system, to provide the subscribers with an alternative to an answering machine.

Cable: Our telephony switches are often remotely located from the headend. In this case, the only headend interface is the DS1 lines from the HDT to the switch, which are often multiplexed to OC-x rates and carried over fiber to the switch location. The headend tech will therefore also be responsible for maintaining the multiplexing equipment and connections.

The switch itself is not much different than its telco counterpart—which is one reason we can offer telephone service which is the same or better quality than our competition. We follow all the same rules for electrical distribution, especially grounding, and physical environment.

Our tour of these two worlds has been completed. Like I said at the beginning, it's fun to see how far we've come. Obviously, as an industry, we still have a lot of work to be done if we are to be accepted by subscribers as a viable alternative to the telephone company. Much of that work is training our personnel to maintain the headend telephony equipment and the associated services, especially the HDTs and their interfaces. We're moving in that direction too, but that subject needs to be saved for another column. CT

Justin J. Junkus is president of KnowledgeLink, Inc., applications engineering director for ANTEC, and Communications Technology's telephony editor. Upi may reach him by e-mail at jjunkus@knowledgelinkinc.com.

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Congratulations, Margaret GAILLARD:

One of Cable's Rising Stars

By Sally Kinsman

It's always exciting to recognize the achievements of a star in the cable industry, especially when that star is someone I've known for 17 years. This year, ***Communications Technology***, **Women in Cable and Telecommunications** (WICT) and the **Society of Cable Telecommunications Engineers** (SCTE) have chosen **Margaret Gaillard** as the winner of the 2000 Women in Technology Award.

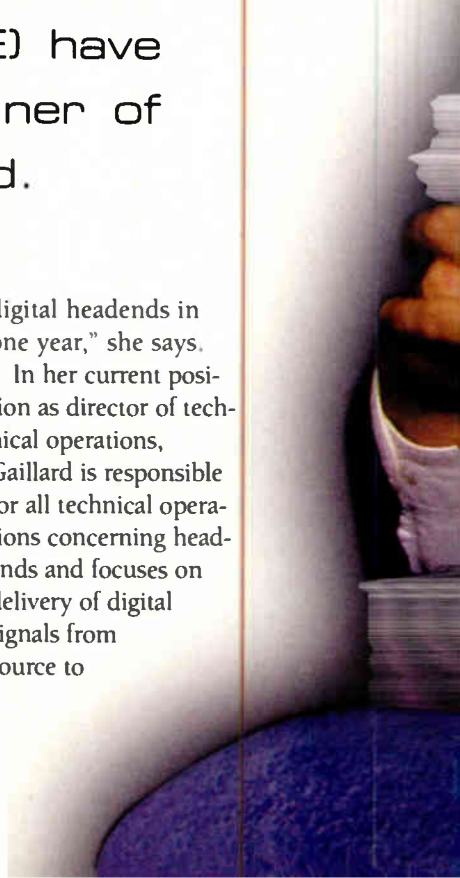
Margaret Gaillard has demonstrated outstanding personal and professional growth and has made significant contributions to the industry. Currently the director of technical operations for **AT&T Broadband**, she describes herself as "determined and a source for others to come to when they can't get things done." Others describe her as extremely intelligent, hard working, direct and to the point—someone who fights for what she believes in. She has the skills to get people to work together and solve problems.

Digital champion

Gaillard joined **TCI** (now AT&T Broadband) in 1996 as project engineer to launch digital television. The digital headend was her primary responsibility, although she also developed budgets, training programs, requirements for pre-packed headends and operational procedures for warehouse, installation and product launches. Gaillard also coordinated all transponder programming.

"This allowed for consistency across the company to roll out 500 digital headends in one year," she says.

In her current position as director of technical operations, Gaillard is responsible for all technical operations concerning headends and focuses on delivery of digital signals from source to



home. She currently is working on enhanced digital services that include video-on-demand (VOD), e-mail and Internet access over television.

Her responsibilities also include remote and keyboard design and development for these new services, as well as legacy digital.

"It seems odd to refer to digital TV as legacy, because so many other MSOs are launching the services for the first time," Gaillard says. "But to me, it's old technology." Gaillard continues to do some training, such as bringing in regional engineers during the launch of new products.

"Margaret is a key player when launching new products at our company," says Gaillard's boss, Tom Lambrecht, vice president of ITV for AT&T Broadband. "She is the liaison between engineering and the local systems, taking deployments from a white board to the customer, watching out for the customer's best interests. She is in an engineering role and has broken through any issues with her being a woman, gaining respect from all levels of the AT&T Broadband engineering staff because of her strengths. I can't say enough about her work ethic and her ability to be a team player."

Her early years

So how did this digital guru get her start?

Gaillard grew up in southeast Iowa, where her father taught high school history and government, and her mother was the deputy auditor for the county. She has two brothers and one sister.

Her love of things technical began early in life. In school, for instance, her favorite subjects were chemistry and industrial arts, unusual for a young girl.

"However, I could not enroll in the industrial arts program in junior high school because it was only open to boys," Gaillard remembers. "I had to settle for home economics."

She was finally allowed to enter the industrial arts program in high school and had to fight educators to get into the industrial arts program at North East Missouri State University. There, she became one of the first women to receive an associate of arts of degree in industrial arts.

"The teachers resented me for being in the typically male program, and it wasn't always a pleasant experience for me," Gaillard recalls. Getting into the program, however, taught her that if she were determined, she could achieve whatever she wanted. That insight has helped shape and mold her since then, she says. In 1996, Gaillard received a bachelor of science in business management from the University of Maryland. >

> **Vital Statistics**

Margaret Gaillard is known for her sense of humor. The following are some "insights" spanning her life and career.

What has been your most challenging job professionally?
"They have all been challenging at some point, and when one job starts to become boring, I move on to the next challenge."

What has been your most challenging personal event?
"Balancing college, work and a husband."

What is your greatest professional accomplishment?
"I haven't reached it yet."

What is your greatest personal accomplishment?
"Getting a man to marry me—I'm not easy to live with."

What is your greatest regret?
"I never negotiated a better salary which included a good exit package."

What's the most memorable advice you did not take?
That came from her father, who told her that "cable TV is not a career because no one would pay for television."

What would you suggest to younger women interested in entering a technical position in the cable industry?
"Cut your hair! Wearing my hair shorter seems to earn me more respect in a technical position. Seriously, jump in and try to understand each piece of the operation. Take advantage of every position you hold, learn everything you can and remember that the skills we use in our industry are not taught in a classroom. Learn not to be too thin skinned. And above all, don't be afraid to apply, try and maybe even fail."

Gaillard also credits some of her success in the male-dominated world of cable to the fact that she grew up with two older brothers. "I learned to be one of the guys and to have a thick skin," she says. "I've been in the male work environment for so long that I can hold my own, and frankly don't think about it very much."

Starting out in cable

After completing college in 1981, Gaillard moved to New Mexico to look for work. When she received no job offers, she headed north to Colorado. There, she submitted a resume to **ATC** (now **Time Warner Cable**), but again came up empty-handed.

"I started back to New Mexico when the timing chain broke on my car, cracking the engine," Gaillard remembers. But like with many life-changing events, fate had its way. "As I waited for the car to be fixed, ATC called and offered me a job as drafter in their corporate design department."

Gaillard says her biggest blunder in cable happened at ATC when she sent plat maps out for enlargement. These maps were used as the base for adding strand and design information.
"I put one too many zeros on the enlargement instructions and the returned order took two people to carry," she recalls.

Gaillard left ATC in 1983, where she reached the level of drafting supervisor, to start her own business called **Butler Drafting Services**. She provided contract drafting services to various multiple system operators (MSOs), including **Jones Intercable**, **United Cable**, and my design consulting firm in Denver, **Kinsman Design Associates.**

I was very impressed with Gaillard's work ethic and competence, and used her company's services until Gaillard joined **United Cable** in 1985 as a designer and drafter, where she stayed until 1989. Gaillard says she enjoyed having her own business. But the cable world, particularly the MSOs in Denver, were offering great learning and advancement opportunities, especially for women in technical positions.

New growth opportunities

Jones Intercable hired Gaillard as manager of design and drafting in 1989. Before bringing her on board, Jones used the department primarily for extensions, and it contracted out most large design projects. Gaillard's job was to build a design and drafting staff and bring all functions inhouse. Coincidentally, the job at Jones became available when the department manager, Pam Nobles, the

Gaillard and her colleagues from Jones' design and drafting department gather for a managers' conference.

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1996 Women in Technology award recipient, moved on to other opportunities within Jones.

Gaillard operated the department as a separate business to ensure cost effectiveness when developing budgets and tracking all operating expenses. She hired and trained five associates, determined network architectures and vendor selection, and monitored plant construction.

Fiber was just making its entrance in the cable industry. "I helped formulate fiber and RF deployment at Jones Intercable, and proposed cable phone specifications and digital video distribution," Gaillard explains.

She also developed technical training skills and taught classes to employees, including basic cable

Gaillard and her husband Michael enjoy the outdoors near their cabin in the Rocky Mountains.

Early career: Jones provided Gaillard with opportunities to advance from manager of design and drafting to formulating fiber and RF deployments.

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-Simone Weil

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design, advanced design and a vendor-of-the-month program. "All departments had the opportunity to gain detailed technical knowledge of various new and existing vendor products," she says.

"Remember the skills we use in our industry are not taught in a classroom."

—Margaret Gaillard, AT&T Broadband

Gaillard also conducted technical and professional training programs for other companies, including **New Brunswick Telecom** and **Northern Telecom**.

Roger Seefeldt, president of **Telecommunications Architects**, a headend system integration firm in Denver, was Gaillard's boss at the time.

"She was a fun, energetic type of person, with a strong work ethic and good leadership skills," Seefeldt recalls. "Margaret was willing to take on the responsibilities to find alternative solutions, and then present them to the group. One of her attributes was being able to translate technically related issues to other business associates so they made sense to the group."

Industry involvement

Gaillard has been a member of SCTE since 1989 and an active member of the SCTE standards subcommittees, notably design, construction and fiber. She also has been a presenter at various SCTE seminars.

A member of WICT, Gaillard is a frequent presenter at the Rocky Mountain WICT Chapter technology workshop, and conducts analog and digital training.

"My portion of the workshop takes about one day, during which I also include field trips to local headends or the DMC (Digital Media Center at AT&T Broadband)," she explains.

Courtney Cowgill, president of WICT's Rocky Mountain chapter, is a big fan of Gaillard's. "Margaret is a wonderful person and supporter of women and WICT," Cowgill says. "Margaret firmly believes that all women must become familiar with all forms of technology. Every time Margaret teaches at the Rocky Mountain WICT technology workshop, she is rated the best presenter. She takes technology that appears too intimidating and complicated for the nontechnical attendee and makes it easy to understand."

Gaillard has also found time to be involved in **P.E.O.**, a philanthropic and educational organization, where she has been treasurer and active in several committees. >

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Tribute

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Still, Gaillard says she regrets not being more involved with the SCTE and WICT.

"During the rollout of 500 digital headends at AT&T, I had to delay any outside involvement to get the job done. Maybe now is the time to become more involved," she says.

Personal life

Gaillard has been married to husband Michael for 15 years. She describes him as "a house-husband who does all the things I hate to do." She says she's been fortunate to achieve professional success, work in a dream job, and to be able to support both of them. They have a three-year-old Basset hound named George.

"With a husband and a dog, who needs kids?" she asks.

Gaillard's outside interests while growing up included hanging out at motorcross tracks and riding motorcycles, although she never raced.

"I was too much of a kamikaze and would take things to the edge," she says. She eventually gave up skiing for this very reason.

Gaillard does, however, own an ATV, with her husband's blessing. "It has four wheels and should be safe," she jokes.

The couple owns 85 acres in Colorado's Rocky Mountains, located between Cripple Creek and Canyon City, where she usually drives her ATV. The property came with a log cabin although Michael recently completed an addition, doing much of the construction while Gaillard was working in Denver. She describes the cabin as her retreat from work, although she admits to taking her cell phone with her.

"I would like to thank my husband for all the support he has given me over the years," she says. "I promise to spend more time with him when I retire. My personal goal is to retire before the age of 50 and be a Wal-Mart greeter. The job requires no decisions, is low stress, and has a benefits package."

A tribute

Margaret Gaillard has been a rising star within the technical cable TV community for nearly 20 years.

"Although my job is fast-paced and high stress, I enjoy every minute of it," she exclaims. "I get paid to play with new technologies and solve problems. It's a dream job."

Gaillard is a woman who provides a clear message that anyone in cable can enjoy their job and that there are always opportunities for women to succeed. I have known Margaret personally for 17 years and she truly is an inspiration, a technical leader, and a nice, funny lady.

Please join me in congratulating Margaret Gaillard, a great role model and very deserving candidate, as this year's Women in Technology award winner. CT

Sally Kinsman is TNS program manager for Motorola Broadband Communications Sector and was the recipient of the 1999 Women in Technology Award.

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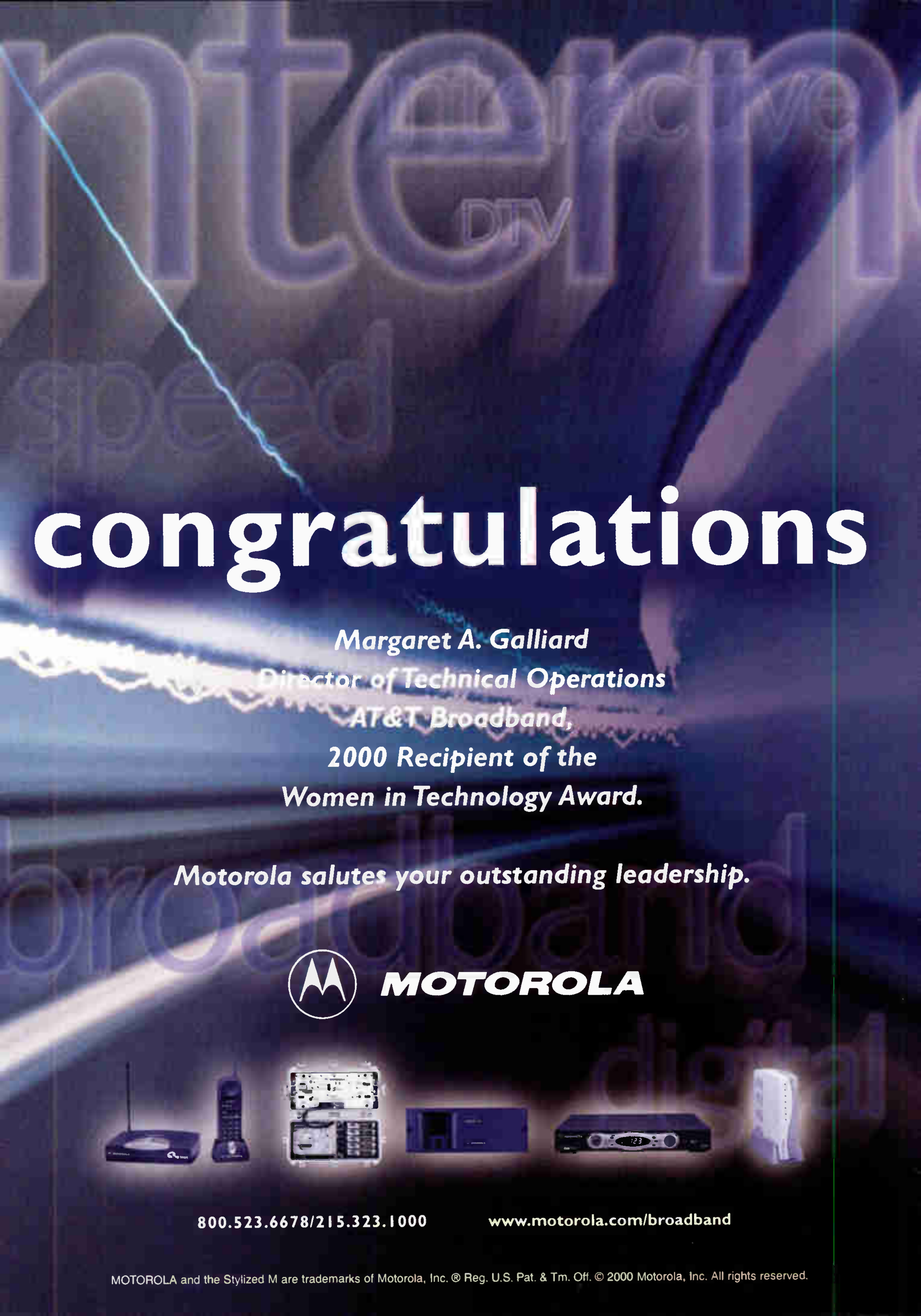
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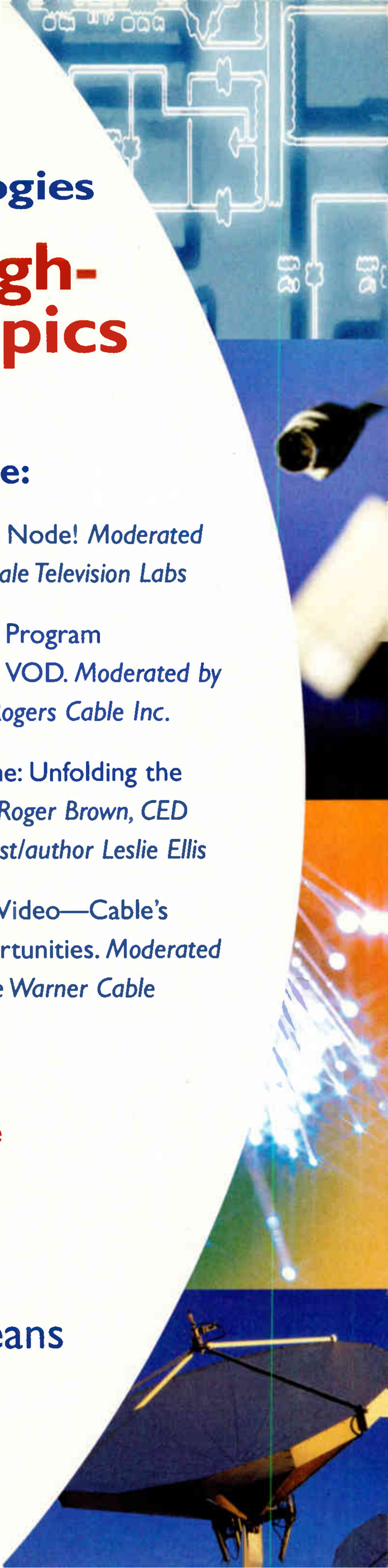


Upstream Power Measurements:

Watts up, Doc?

By Ron Hranac and Mark Millet

In this sequel-of-sorts to their September article on downstream power measurements, the authors take a look at upstream digitally modulated carrier power measurements using a procedure known as the zero-span method.

In the September 2000 issue of *Communications Technology* (page 114), we discussed the proper way to use a spectrum analyzer to measure downstream digitally modulated carriers. As we pointed out in that article, the noise-like characteristic of those carriers means care must be taken when performing amplitude measurements. Fortunately, much of today's available test equipment includes automatic digital channel power measurement capability in the equipment's operating software, firmware or hardware. Further simplifying downstream digitally modulated carrier amplitude measurement is the fact that the majority of those carriers are on continuously, just like downstream TV channels.

Upstream digitally modulated carriers are another story altogether. Most are bursty in nature, which means they're on only when a given in-home device actually is transmitting. This lack of continuous carriers makes measuring upstream levels challenging, to say the least.

One method that many use is to take a spectrum analyzer, tune it to the carrier frequency of interest, put the analyzer in max hold, and wait for the bursty upstream carrier to "paint" a display of its apparent amplitude. This is not a good way to measure upstream digitally modulated carriers. More on this later.

Given the so-called long-loop automatic gain control (AGC) operation with regard to most upstream digitally modulated carriers—especially cable modem signals—you might be inclined to wonder why it's even necessary to be concerned with their amplitude. In the case of cable modems, the headend's cable modem termination system (CMTS) manages cable modem upstream levels for every modem in the system. A CMTS that's compliant with Data Over Cable Service Interface Specification (DOCSIS) will keep all modems to within about 1 dB of each other, unless configured to do otherwise.

Accurately measuring upstream carriers

If you want to do some routine measurements to verify proper operation, you really need to make certain you're measuring the levels accurately. For instance, it would be nice to know that you're not overdriving your system's upstream lasers. Overdriving lasers often causes clipping. The inevitable result of laser clipping is reduced data throughput because when a laser clips, nothing gets through. Why? During the time clipping occurs, a laser has no optical output. Cable modems may tolerate this to a certain extent because missing data may be retransmitted, but services such as voice-over-Internet protocol (VoIP) telephony don't live well in this environment. One —sult is dropped syl—-les — words, and —haps even dropped calls! This would not be good if someone were trying to place a 911 call.

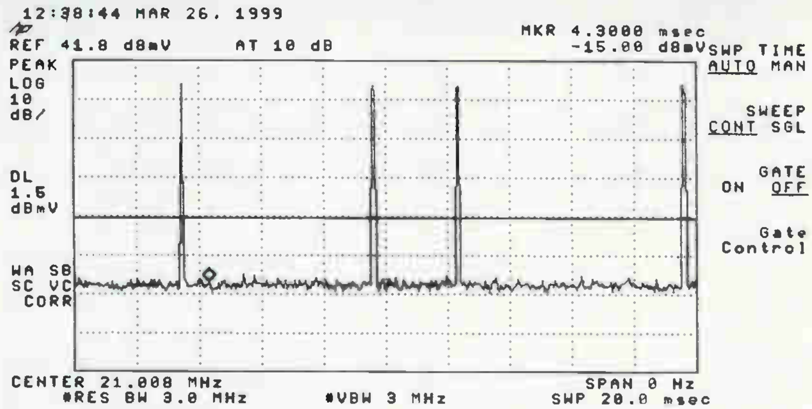
So, how do you go about accurately measuring a cable modem's bursty upstream digitally modulated carrier?

Step one

First, you'll need a spectrum analyzer that supports sweep settings in the 80 microsecond (μsec) range. Most cable TV spectrum analyzers are capable of this sweep speed. After it has

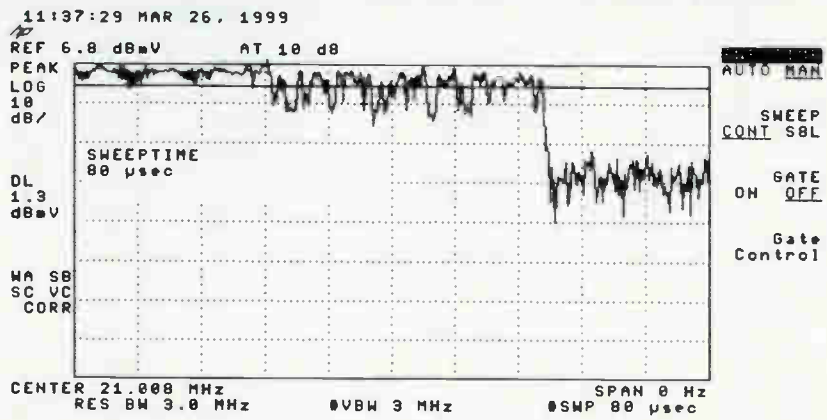
Photo Courtesy Agilent Technologies

FIGURE 1



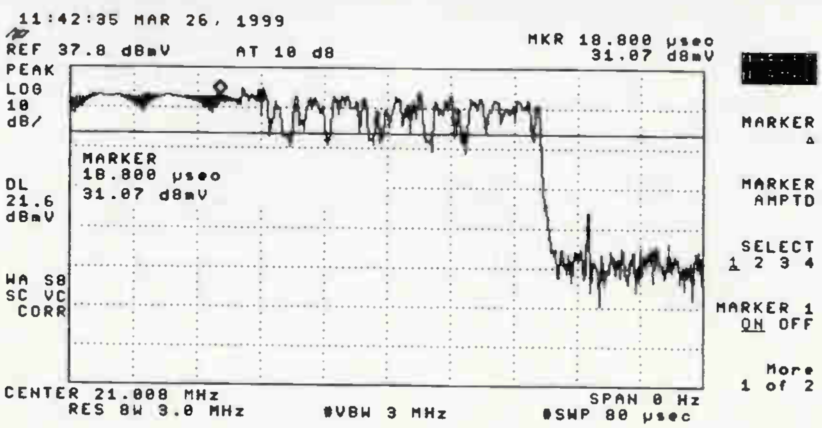
After tuning to the upstream digitally modulated carrier's known center frequency and setting your analyzer to zero-span, you should see a display similar to this.

FIGURE 2



Change the analyzer's sweep to 80 µsec.

FIGURE 3



Adjust the reference level control to place the upper part of the signal in the top graticule, and position the trigger line accordingly.

warmed up for a few minutes, tune your spectrum analyzer to the upstream carrier's known center frequency. Make sure the analyzer's reference level and attenuation controls are adjusted to keep the expected carrier peaks approximately on-screen. For now, set the sweep to 20 milliseconds (msec). Adjust the span control to 0 Hz, sometimes called zero-span. This essentially converts the analyzer from a frequency domain instrument to a time domain instrument, much like an oscilloscope. Set both the resolution bandwidth (RBW) and video bandwidth (VBW) controls to 3 MHz. Activate and position the trigger line (refer to your analyzer's instructions if necessary) to about the middle vertical graticule. One or more active cable modems should produce an analyzer display similar to Figure 1. >

BOTTOMLINE

> Accurately Measuring Digitally Modulated Carriers

The noise-like characteristic of downstream digitally modulated carriers means care must be taken when performing amplitude measurements. Fortunately, much of today's available test equipment includes automatic digital channel power measurement capability in the equipment's operating software, firmware, or hardware. Further simplifying downstream digitally modulated carrier amplitude measurement is the fact that the majority of those carriers are on continuously, just like downstream TV channels.

Upstream digitally modulated carriers are another story altogether. Most are bursty in nature, which means they're on only when a given in-home device actually is transmitting. This lack of continuous carriers makes measuring upstream levels challenging, to say the least. The most accurate way to measure upstream digitally modulated carriers is a procedure known as the zero-span method.

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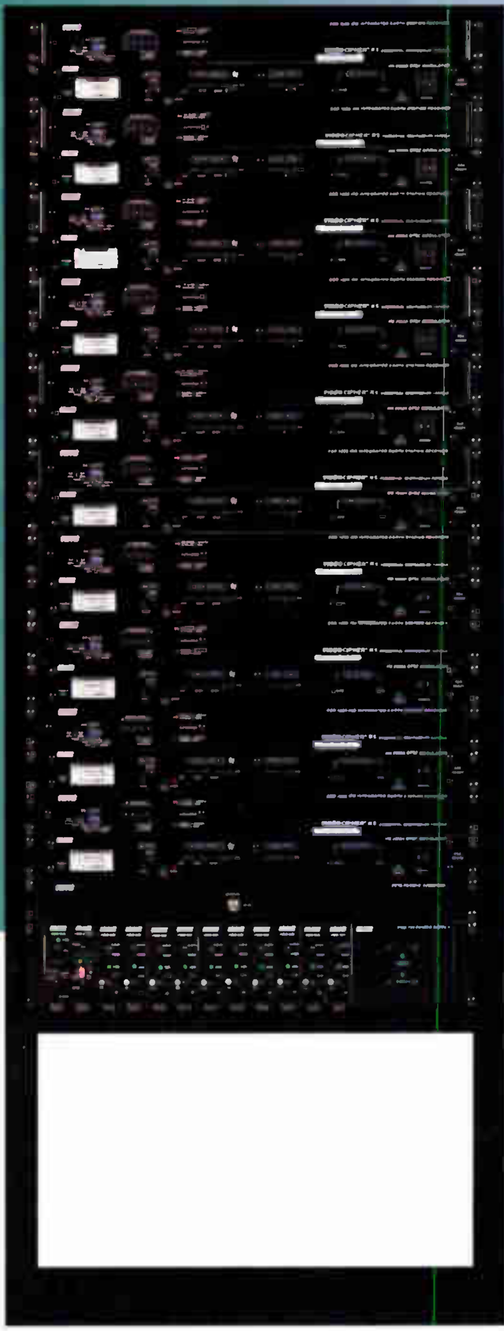

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Step two

Adjust the sweep to 80 µsec. You should see a display similar to Figure 2 (page 66). Position the trigger line so that it's about halfway between the highest and lowest parts of the displayed signal.

Now adjust the reference level control so that the top part of digitally modulated carrier is in the top graticule, and move the trigger line up or down as necessary until you get a display like that in Figure 3 (page 66).

Notice the part of the signal that occupies the first two or three horizontal divisions in the upper left of the figure. Here it appears to have a sine wave component. This is the preamble. Turn on and position a marker about 7/8 of the way into the preamble.

A quick side note here: The preamble you see on your signal may have a different width than what's shown in Figure 3, depending on the upstream channel's bandwidth and data rate, modulation format and DOCSIS burst-profile configurations.

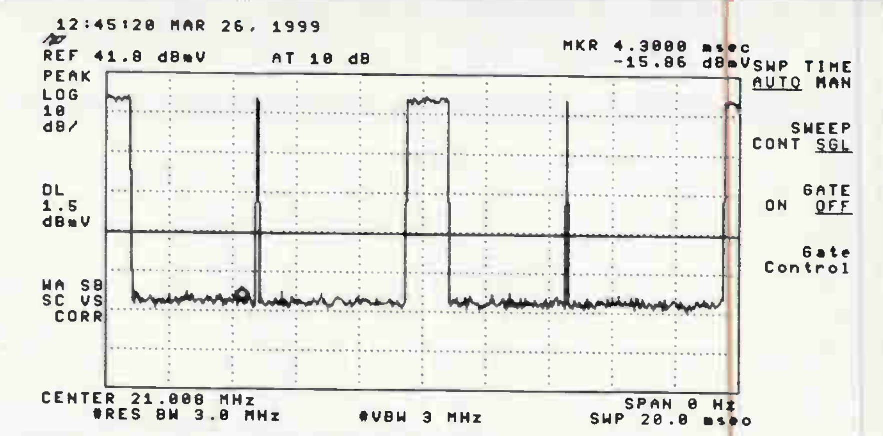
In this particular example, the marker amplitude indicates +31.07 dBmV. To validate the accuracy of this procedure, we compared it to an Agilent HP89441A vector signal analyzer and a Boonton burst power meter, and found the zero-span measurement of the preamble's amplitude to be within 1 dB of the entire packet's true burst amplitude.

Another side note: If you find the preamble to have a significantly lower amplitude than the rest of the signal, you're using an RBW setting that's too narrow for the DOCSIS channel width in use. Incorrect RBW may cause problems if adjacent carriers are present, as well as affect the accuracy of the measurement. The following Web site describes a procedure for measuring upstream carriers under adjacent channel conditions or if the chosen RBW is too wide and is letting too much noise into the channel under measurement: www.cisco.com/univercd/cc/td/doc/product/cable/cab_rout/cr72hig/cr72cnrf.htm

Other measurements

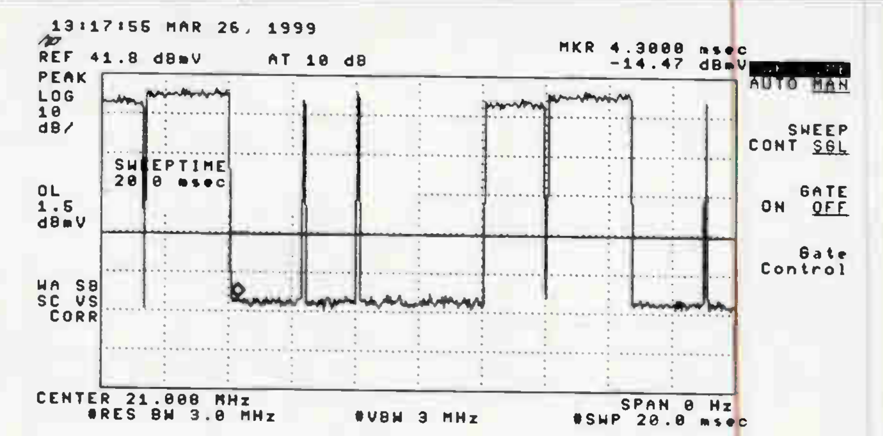
Besides the amplitude of the upstream digitally modulated carrier,

FIGURE 4



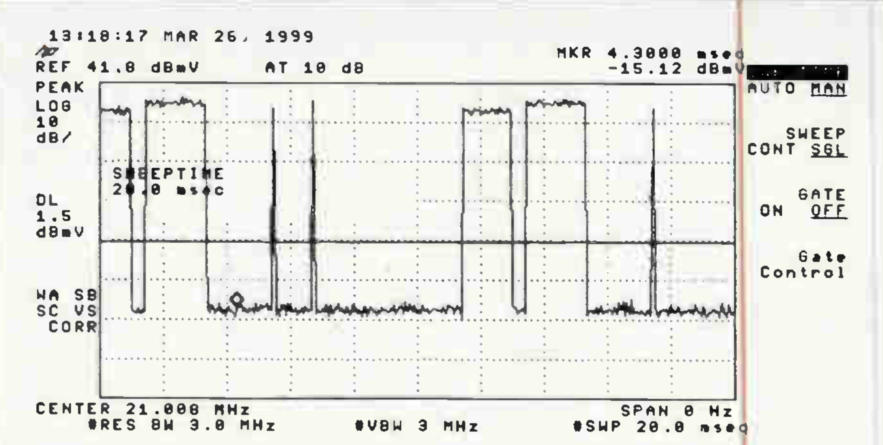
1500-byte data packets and bandwidth request packets.

FIGURE 5



Packets from two modems. Note the difference in amplitude between the packets.

FIGURE 6



Another example of packets from two modems.

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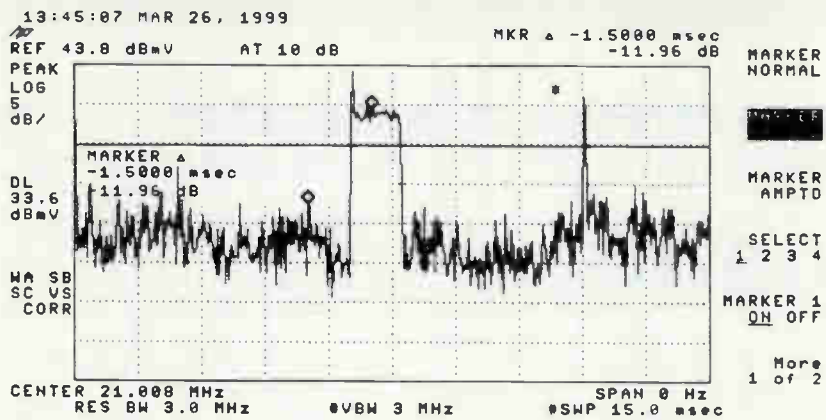
FIGURE 7



Upstream packets in a very noisy return path.

what else can you determine from the zero-span measurement method? Go back to Figure 1 (page 66). That particular measurement was done in a lab environment, which is why the noise floor is so clean. The first and third spikes in that figure are bandwidth request packets, and the second and fourth spikes are 64-byte ping packet returns. Figure 4 (page 68) shows 1500-byte ping packet returns, along with bandwidth request packets. Both of these examples are from a 3.2 MHz bandwidth, 16-QAM (quadrature amplitude modulation) digitally modulated carrier.

We stated earlier that a max hold method is not a good way to measure the amplitude of upstream digitally modulated carriers. To see why, look at Figures 5 and 6 (page 68). They show signals from two cable modems. You can see the modems' bandwidth request packets (the narrow spikes) and their ping packet returns. However, note that the amplitude of one of the modems is about 3 dB lower than the other.

In this case, the lower modem was transmitting at maximum power, and unable to achieve sufficient input level at the CMTS. A modem operating this way will go offline constantly and have excessive power-adjust messages. This level difference may not seem like much, but in properly operating systems, the difference between any two modems should be no more than about 1 dB at the input to the CMTS.

Thus, if you measure any one packet, the amplitude of all packets should be within 1 dB of that value. If you were to attempt to measure the upstream digitally modulated carrier using the max hold method, the analyzer would show only the highest modem's amplitude. If the modem with the highest output level were a malfunctioning one (that is, the modem wasn't supposed to be transmitting at that high of a level),

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you might be inclined to think all of your modems were operating too high. Conversely, if you were looking for one particular low level modem, the normal modems' signals would mask the lower signal level.

Look more closely at Figures 5 and 6 (page 68). The difference in the spacing between the bandwidth request packets in the two figures is caused by the contention-based nature of multiple remote cable modems operating in the same network. Differences in the spacing between the ping packet returns are a function of packet size and the system's upstream channel usage. These conditions are normal. In fact, two ping packet returns may be so close together that they might appear on some spectrum analyzers to be one big packet with a slight amplitude change about halfway through the packet. This, too, is normal, and merely indicates the upstream channel is 100 percent occupied during the time period you're observing.

Real-world conditions

Figure 7 (page 70) shows conditions in a real two-way plant. Here you can see one bandwidth request packet and one ping packet return. You also can see a lot of noise, including impulsive noise. The difference between the packet and a nearby noise spike is only about 12 dB, clearly below the 25 dB DOCSIS spec. You may count on this particular packet being dropped in real-world operation. In general, if in-channel impulse noise comes within 25 dB of the packet's peak amplitude, the hybrid fiber/coax (HFC) network technically is not DOCSIS-compliant. This condition may cause lost packets.

If the noise is during the preamble, it generally will force the CMTS to not receive it, while if it is during the data section, it will either cause a correctable or uncorrectable forward error correction (FEC) error. If the error is uncorrectable, the packet is lost entirely.

One critical step to ensure reliable two-way operation is to make sure you're accurately measuring both downstream and upstream digitally modulated carriers. For the former, use test equipment that has automatic digital channel power measurement capability. The latter is best accomplished with the zero-span method, which also allows you to more readily see the true magnitude of impulse and similar noise that appears in-channel. CT

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Everyone's Jumpin' On The BroadBandwagon:

Applications Galore To Appear At This Year's Western Show

By Monta Monaco Hernon

Original photo ©2000 PhotoDisc, Inc.

Now that broadband technology has a foot in the door of homes and businesses, vendors and cable operators are focusing on the applications that could drive up penetration. With that in mind, this year's Western Show will be filled with ideas for value-added services and the latest in management tools.

Broadband is not just for providing high-speed access to the Internet anymore.

That's the message that will permeate the **California Cable Television Association's** (CCTA) Western Show (November 28 to December 1), this year. Exhibitors and presenters will showcase advancements in technology, but also will highlight razzle-dazzle applications that could become value-adds and attract subscribers.

"For cable modems, the first 5 percent penetration is easy to get," Fred Stefany, COO of **Zatso.com**, says. "These people want speed and always-on capability. Beyond that it is a tougher sell."

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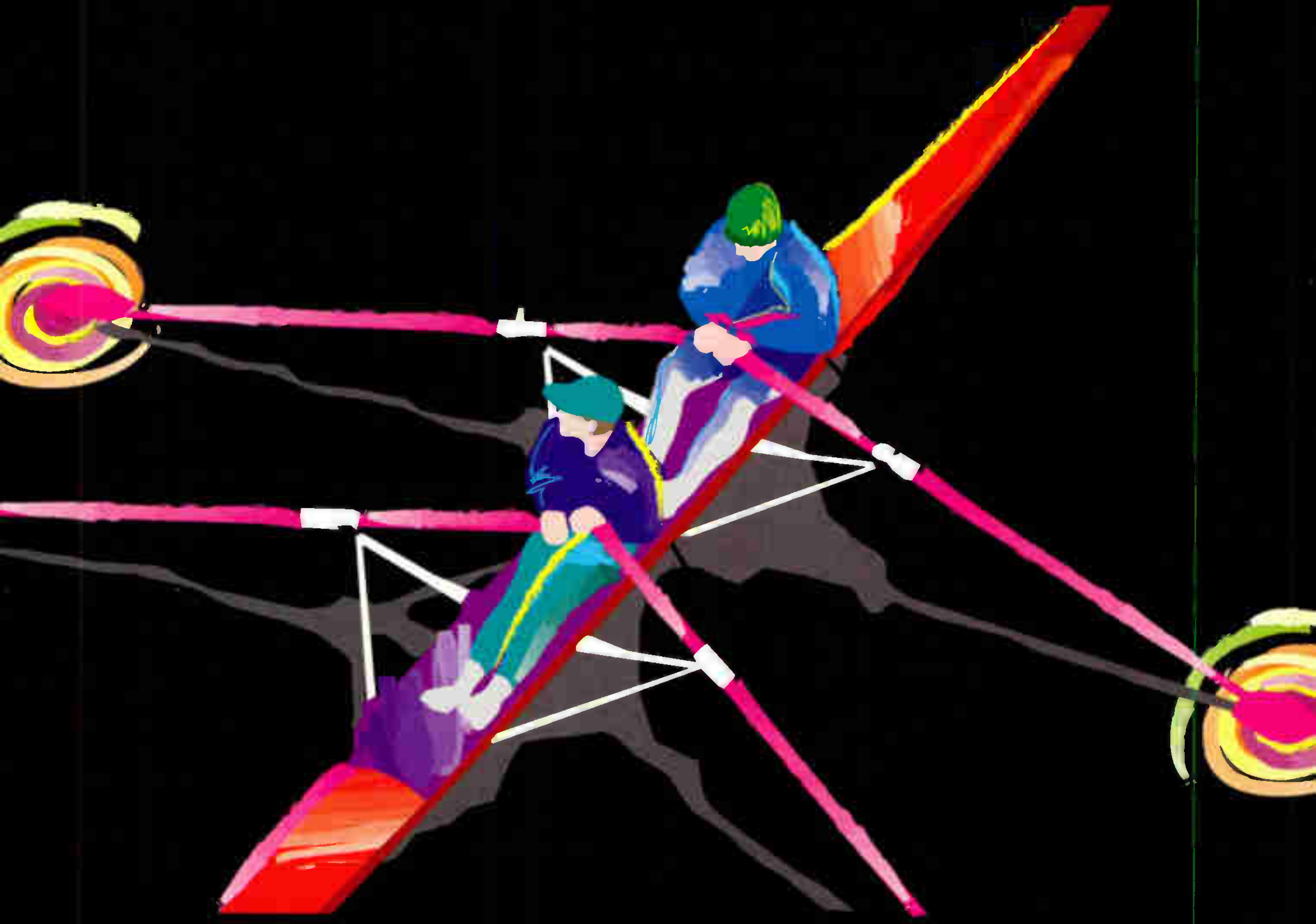

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Stefany's company currently offers personalized newscasts over the Internet at no cost to the end-user.

"We have 200 new local video stories per day that people can get," he says. "This is a great way to use cable modems. Cable companies don't have to use film trailers to show off the benefits of high-speed access. Personalized newscasts are a great application to help drive broadband deployment."

He adds that while Zatso.com will not have a display at "Broadbandwagon: The Western Show" this year, Roger Keating, Zatso.com's president and CEO, will speak during the Plenary General Session, "Streaming to a Home Near You," on November 28 (3:30 p.m. to 5 p.m.).

The company is working on making its personalized newscasts the "killer app" for set-top boxes and interactive television as well. Beta tests are in the works and talks with "most of the major MSOs" are underway.

"We are trying to be provocative and show what can be done. Swapping out boxes is not going to drive the rate of adoption of interactive television. Thinking about cool new applications can," Stefany says.

Emphasis on applications

For the eighth year, CCTA and **CableLabs** together are running a section on the show floor called CableNet that typically highlights technology coming down the pike. This time, however, the exhibit—with the theme, "What's Next?"—has a new look. According to Mike Schwartz, senior vice president of communications at CableLabs, more of the 10,000 square feet looks like an actual home, office or retail store, replacing many of the stand-alone pedestals that dominated in years past.

"This stuff is reality now so people should see it in a [real] environment," Schwartz says.

Like Zatso.com, some of the CableNet 2000 participants believe applications are the key to driving up subscribership for broadband services. For example, **IBM** will show how its Hot Media Interactive TV Solution will allow viewers to purchase items they have just seen advertised.

Redback Networks, on the other hand, is using its space at CableNet to demonstrate the fruits of its partnership with **Portal Software, Inc.** and **Inktomi Corp.** A system using technology from all three companies allows for the instantaneous provisioning and billing of value-added broadband services. This means a subscriber would be able to click on an icon advertising a video clip for a certain price. If he or she agrees to pay, the program will be delivered in the correct bandwidth and the amount due added automatically to the next monthly bill.

"This eliminates the Internet side of the equation where the provider can't guarantee the quality of anything. They can guarantee what is available on their own network," says Chris Johnson, Redback's director of cable marketing.

Like many CableNet participants, Redback also has its own separate booth, where it will feature its managed access solution. This solution configures the correct bandwidth, security features and services, depending on who is using a modem. Separate people with different accounts may use the same computer, and a virtual private network (VPN) may be opened concurrently with the regular Internet.

"Our system allows you to set up another connection route and choose a different connection speed . . . It gives the service provider the ability to figure out who is behind the modem and to dynamically set up bandwidth and security for that particular person," Johnson explains.

Scientific-Atlanta also says it will make an effort this year to show how its Explorer series set-top boxes can enable cable operators to deliver multiple interactive TV applications. They should think about subscribers being able to order pizzas through their television and being able to offer up a machine that remembers program preferences and tapes a show without any prompting.

"In the past, our solution has been more hardware-focused," says Dave Davies, director of strategic planning and business development, Subscriber Networks, Scientific-Atlanta. "Given that by the end of the year we should have four million digital set-top boxes

BOTTOMLINE

> **Technology in Action**

Vendors and presenters at this year's Western Show are looking to razzle dazzle, showing a multitude of applications made possible by the latest broadband technology. The goal is to give multiple system operators (MSOs) a look at what they might entice customers with to get them hooked on cable modems or interested in interactive television. Attendees will see and hear about personalized newscasts, ordering pizza through the television, and Internet protocol (IP) telephony, for example.

More of CableNet 2000 will be devoted to showing how the technology actually will work in the home. More space than ever will be made to look like actual rooms in a house or a retail store. The idea is to see broadband technology in action.

Another focus will be on management tools. MSOs will need help provisioning and billing for the many services they will be able to offer consumers via the world of broadband. They also will need finely tuned network management capabilities. Examples of both will be highlighted on the show floor.

Finally, in light of the convergence that is taking place, attendees this year will be able to hear from CEOs of networking firms outside the cable industry.

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deployed, we are in a position to help our customers drive applications into our networks . . . We are showcasing the ability to deliver these multiple applications and to help MSOs [multiple system operators] drive revenue and lower subscriber churn."

Scientific-Atlanta does have a new product, the Explorer 6000, that serves as a home "gateway," delivering voice, video and Internet access. S-A will feature it at CableNet.

According to Ken Klaer, vice president and general manager, marketing and business development, Subscriber Networks, Scientific-Atlanta, the company particularly is excited about the potential connection between the Explorer 6000 and wireless voice or data delivery to the home. Once certain types of next-generation wireless phones are available, standards may be incorporated into the set-top box, allowing a subscriber to make Internet protocol (IP) calls at home using these handsets. They become like a cordless phone; the minutes will not be billed as cellular.

"We will show applications that are being deployed and making real money for cable operators, and we will show where applications begin for the future," Klaer says.

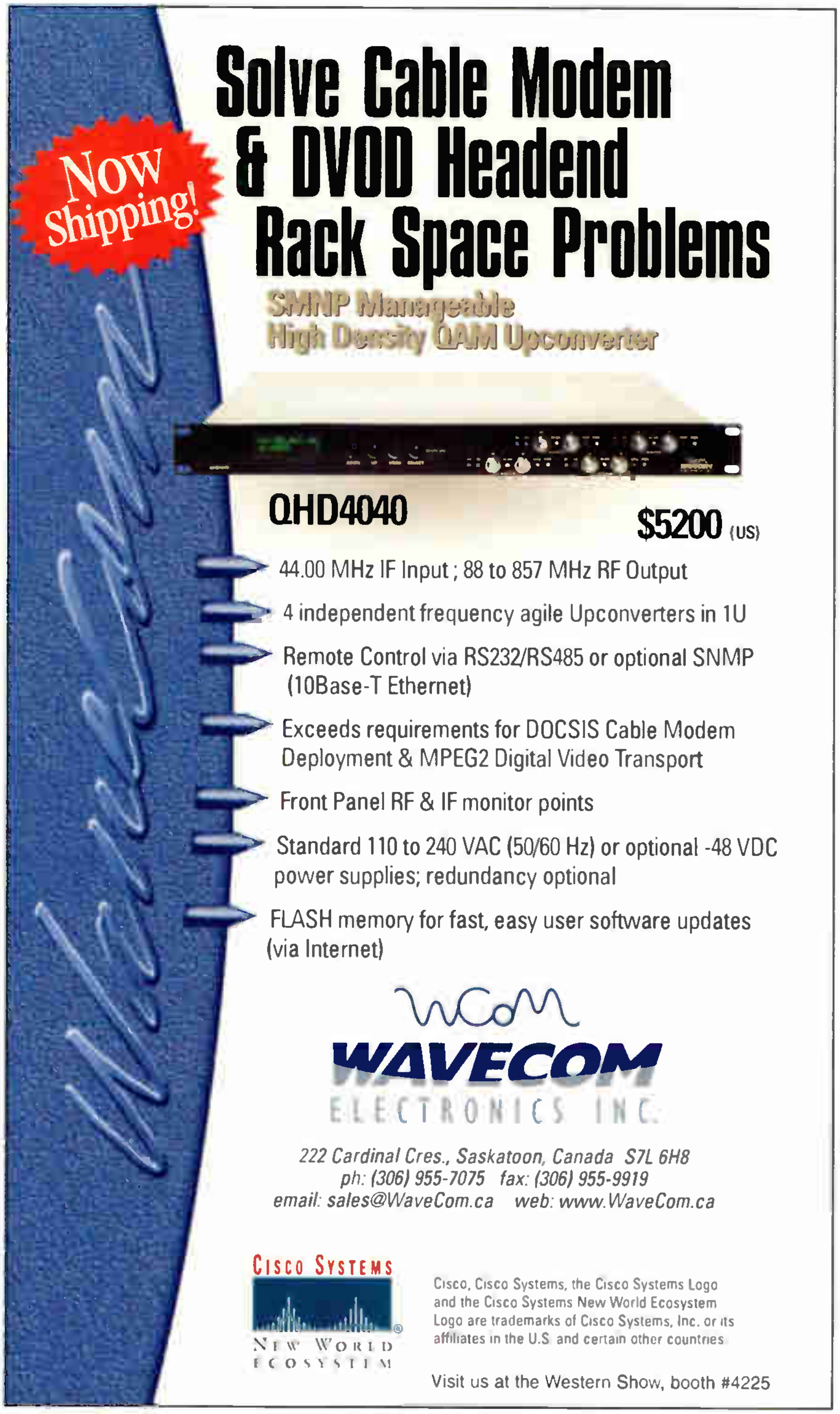
More telephony

Video and streaming capabilities are not the only applications making appearances at the Western Show as potential value adds. Telephony also will be on the exhibit floor and debated among panelists. Moderator Steve Craddock, vice president of new media development for **Comcast**, says industry insiders will hash out the various models for the delivery of telephony by MSOs during the "Will Cable's Telephone Ring Off The Hook?" seminar on November 30.

Comcast, for example, is leaning toward an entirely IP solution that uses only a so-called softswitch, Craddock adds that at the same time, the big push for his company still is on the penetration of high-speed access.

"If the cable division has been wildly successful in high-speed data, it is a lot easier to offer high-speed telephony because the infrastructure to the house will already be there," Craddock says.

Bart Bartolozzi, director of strategic development for **Net2Phone, Inc.**, scheduled to speak on Craddock's

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panel, says he will remind participants that if a company plans for telephony "right out of the box," it can bundle high-speed data with free calling minutes as a marketing tool.

His company will target the cable service provider market by integrating its telephony solution with set-top boxes. Net2Phone already has announced a deal with Scientific-Atlanta and expects the resulting boxes to be available in the second or third quarter of 2001.

To make calls, the end-user needs only a standard phone. He or she will be issued an account number and pin number both as a way to keep track of the free minutes used and as a way to recharge the amount available through Net2Phone's Web site. The monthly payment would go to Net2Phone, which would share the revenue with the cable provider.

"This will allow them to recoup profits from broadband," Bartolozzi says. Look for the Scientific -Atlanta box at Net2Phone's booth on the exhibit floor.

Other companies also are billing their products, in part, as a way to facilitate telephony. **Com21**, for example, will have its new DOCSIS-certified single-chip cable modem on display at Western. According to Ehsan Rashid, Com21's vice president of access products division, the single-chip modem not only will bring down costs, but it also will require the use of less power for the system because it is integrated. To be a telephone provider, a cable company has to be sure it can provide lifeline services even if the traditional power supply goes out.

"Cable companies have been playing around with the idea of providing the necessary power for the modem through coax," Rashid says, explaining that the lower the power requirement, the better. The single-chip product also allows for firewalls to be placed directly on the modem.

Network management

MSOs certainly want to know they will be able to troubleshoot adequately so they can ensure they are delivering quality broadband services. Network management systems, therefore, will get big play on the show floor this year.

Micromuse has a new version of Netcool Visionary. What is different about version 1.5 is that it is fully in-

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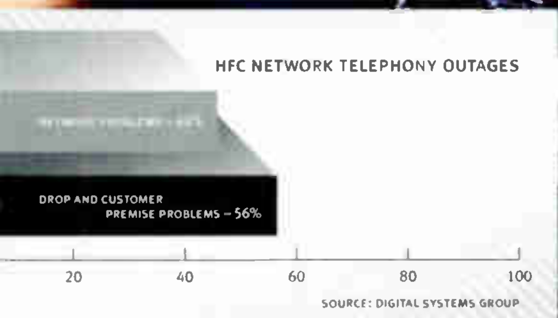

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tegrated with the Netcool object server and the company's flagship product Netcool Omnibus. The latter is a real-time fault monitoring system, which gathers information from 200 devices. The results may be viewed in full or part on a graphical interface screen at the network operation center or the cable headend.

"Cable operators in the era of deregulation also are offering voice and Internet service," Evan Birkhead, vice president of marketing for Micromuse, says.

"The beauty is we monitor devices in the infrastructure underlying all of those systems."

NetCool Visionary adds the capability of monitoring simple network management protocol (SNMP) devices and allows the results to be read on the same event screen.

"We expect this product to become an enabler of sales of the entire Netcool suite into the cable industry because they require this information," Birkhead explains.

Other network management systems include **C-COR.net's** COR-Convergence platform that integrates network management technology with customer care and billing systems. It pinpoints the source of an outage and who is effected.

C-COR.net has a multimedia demonstration at Western that will illustrate how COR-Convergence is playing out as part of the Time Warner Integrated Services Management System pilot in Tampa, Fla. This project has involved 900,000 subscribers receiving high-speed data and entertainment services.

"The solution is intended to grow with **Time Warner's** business and be able to accommodate new service applications that are not part of the business fabric today," Carrie Packer, C-COR.net vice president of broadband management engineering, says.

Aside from its network management system, C-COR.net is introducing a new addition to its transmitter product line. The 1550 nm Externally Modulated DWDM Forward Path Transmitter will help networks support digital video, high-speed data


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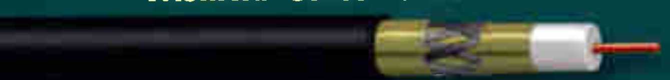
TriShield Construction 	F6TSV-BW F6TSVV-BW F6TSVM-BW	F11TSV-BW F11TSVM-BW
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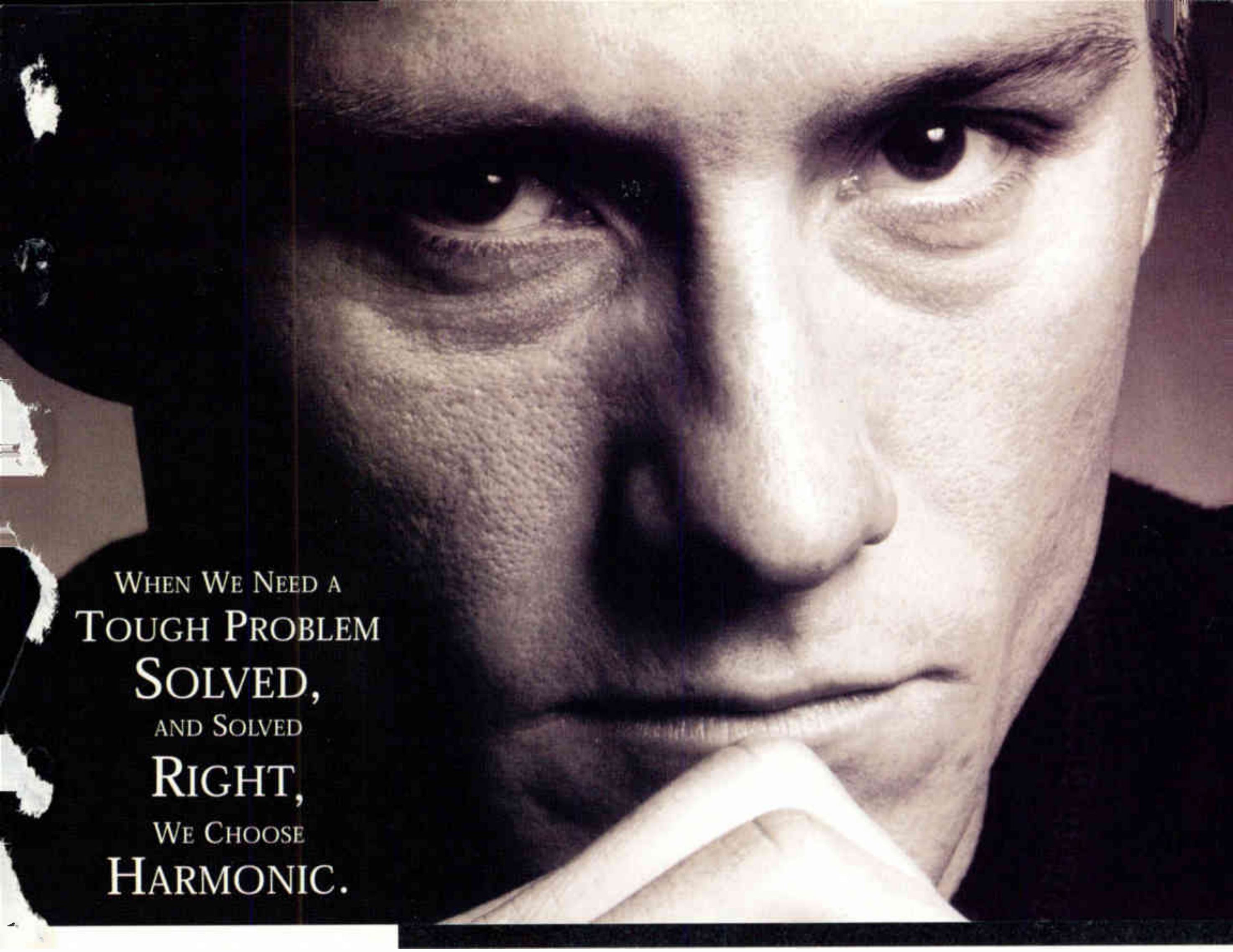

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Other new show features

Given the new applications and the new fields that cable operators have open to them, CCTA this year is sponsoring two one-on-one sessions with people outside of the industry.

"We just want to have excellent examples of corporate business as cable—increasingly through broadband and other means—goes into a variety of business applications through the Internet. We want to hear from high-level CEOs who can talk about the business environment for Internet software and cable and their views of those worlds," Paul Fadelli CCTA's public affairs director, says.

According to Fadelli, on Wednesday November 29, Larry Ellison, chairman and CEO of **Oracle Corp.**, will be CCTA's guest while on Thursday, November 30, John Chambers, president and CEO of **Cisco Systems**, will be asked about what he sees as cable's ties to broadband.

Because the Western Show is in Los Angeles again this year, CCTA also wants to explore how high-tech and Hollywood content are converging. "In general, the synergies demonstrate themselves throughout the show," Fadelli says.

Specifically, Wednesday's "Hooray for Hollywood" is the venue. At our deadline, the speakers for this session had not yet been announced.

In the end, whether it be streaming, specialized programming, the ability to provision and bill, the Western Show this year is all about showing MSOs how the technology will work for them. Look to be surprised by how much already is available today and wowed by what vendors have in store for the future. CT

Monta Monaco Hernon is contributing editor to Communications Technolo... She may be reached at mmhernon@earthlink.net.

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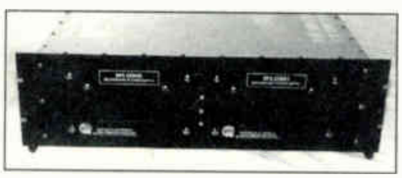

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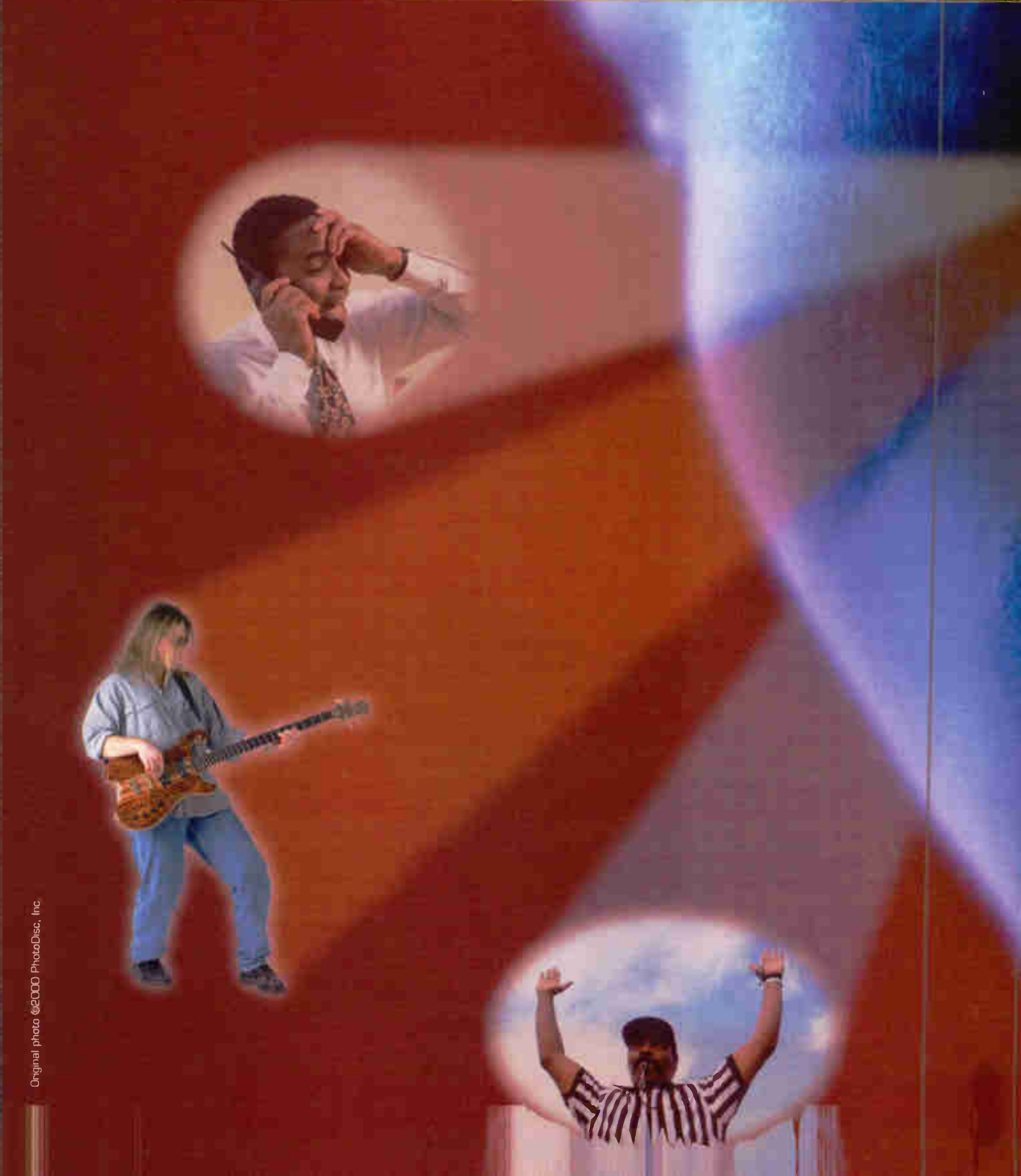
Video Compression 5: AUDIO



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Can You Hear the Difference?

By Jim Farmer

So far in this series on intuitive approaches to digital television, we have talked about "lossy" video compression. But there's another component of your program that needs to be compressed—your audio.

"Lossy" video compression refers to the portion of the video that gets lost during the process of doing the compression. The trick, of course, is to find a way to lose only information that the eye could not detect anyway. Moving Picture Experts Group (MPEG) video compression offers a toolkit full of standards for decompressing material, but it does not explain how to do the compression. The thinking is that compression algorithms will improve with time, and yet be compatible with all decompression circuits. We hope. There are also loss-less compression tricks, which we'll cover later in this series.

But now we need to talk about the other part of the program, without which the video would be pretty useless. We have to have audio to go with the video, and that audio must also be compressed.

We can get a lot of compression out of video—you end up with about 2 percent to 3 percent of the bits you start with. Audio is not quite so nice. You can get down to maybe 7 percent to 8 percent of the bits you started with. The ear is just too sensitive to allow much more compression than this, at least at the present state of the art.

Remember that we are not going to make you a compression guru with this series, but we will give you an appreciation of the basics. And we provide several references to other sources to take you further.

What's in it?

The audio compression used in the United States is AC-3, developed by **Dolby Labs**, the same company that gave you the noise reduction technology used for years in tape recording. The compression used with the digital video broadcast (DVB) transmission system in Europe is usually called MPEG audio compression. It works on similar principles, but the two are not compatible. AC-3 is the same compression that you find in the famous, or maybe infamous, MP3 audio files, where MP3 is said to be a contraction of MPEG and AC-3 coding.

AC-3 encodes the so-called 5.1 channel surround sound, where the five channels are center (used for dialogue), front left and right, and rear left and right. The ".1" comes from a sub-low channel used to reproduce the lowest frequencies that are perhaps felt as much as they are heard.

There are a number of different service types defined for AC-3 audio by the **Advanced Television Systems Committee** (ATSC):

- **Complete main (CM):** dialogue, music and effects are included in the 5.1 channels. The CM signal is constrained to using a maximum data rate of 384 kbps or less.
- **Music and effects (ME):** dialogue is separate from the music and effects. Several channels of dialogue may be sent, and one selected to be combined with the music and effects. This would be done where it is desired to transmit several languages, for example. One set of music and effects are transmitted, and several dialogue channels are sent.
- **Dialogue (D):** The dialogue to accompany ME. A single channel must use a bit rate of 128 kbps or less, and two dialogue channels must use no more than 192 kbps combined. Typically, the two dialogue channels would be used for two languages, for example, but would not include music and effects, which are sent on separate channels.
- **Visually impaired (VI):** A narrative description of the video is sent.
- **Hearing impaired (HI):** The dialogue may be processed for improved intelligibility.
- **Commentary (C), voice over (VO), emergency (E), karaoke.**

A main channel, plus associated services intended for simultaneous decoding, must use no more than a data rate of 512 kbps.

The audio sampling rate used in ATSC implementations of AC-3 is 48 ksps (thousand samples per second), locked to the 27 MHz system clock. The basic AC-3 channel sampling is done at a minimum of 16 bits and a maximum of 24 bits. AC-3 as defined by Dolby supports 32 ksps and 44.1 ksps sampling as well as 48 ksps, but these are not supported in the ATSC system.

The basic principle

The audio in each channel is sampled and converted to digital representation. This is done many times each second by breaking the signal into blocks of 512 samples. At a 48 ksps, each block lasts 10.67 ms, though later in the processing, more than one block may be combined when possible. When a transient sound is encountered, the block size is halved to improve the reproduction of the transient. (An example of a transient sound is a drum beat or a cymbal crash.)

The block is taken every 256 samples, so each block overlaps the preceding and succeeding blocks by 50 percent. This reduces the amount of compression possible, but is necessary because of the extreme sensitivity of the human ear to errors—an example of why audio compression is more complex than video compression.

The basic principle behind both AC-3 and MPEG audio compression—and this is really basic— is sub-band encoding. For each audio channel, the audio stream from 20 Hz to 20 kHz is digitized then filtered through a filter bank to determine the spectral content of the audio stream.

You may have used audio spectrum analyzers in consumer electronics equipment that display the signal level in each of a number of frequency bands across the audio spectrum. An audio spectrum analyzer contains crude filters doing the same thing as the filter bank used in compression.

Initially, the spectrum is divided into 93 Hz-wide bands, but later some bands may be combined again in the processing when they may be treated as one. The exact number of bands ultimately used depends on the characteristics of the audio.

Analyzing spectral bands

After the audio spectrum is divided into a large number of narrow bands, the contents of each are analyzed. If during a particular block, no significant sound power exists in a band, then it is not necessary to transmit any information regarding that band, and we save bits. It is a well-known principle about human hearing that a loud sound in one frequency band will mask softer sounds in adjacent bands. So where we have a band with high power, we don't need to transmit softer sounds in bands that are close to the loud one. Considerable effort has gone into determining just how much masking we get, and you can find graphs published on the subject.

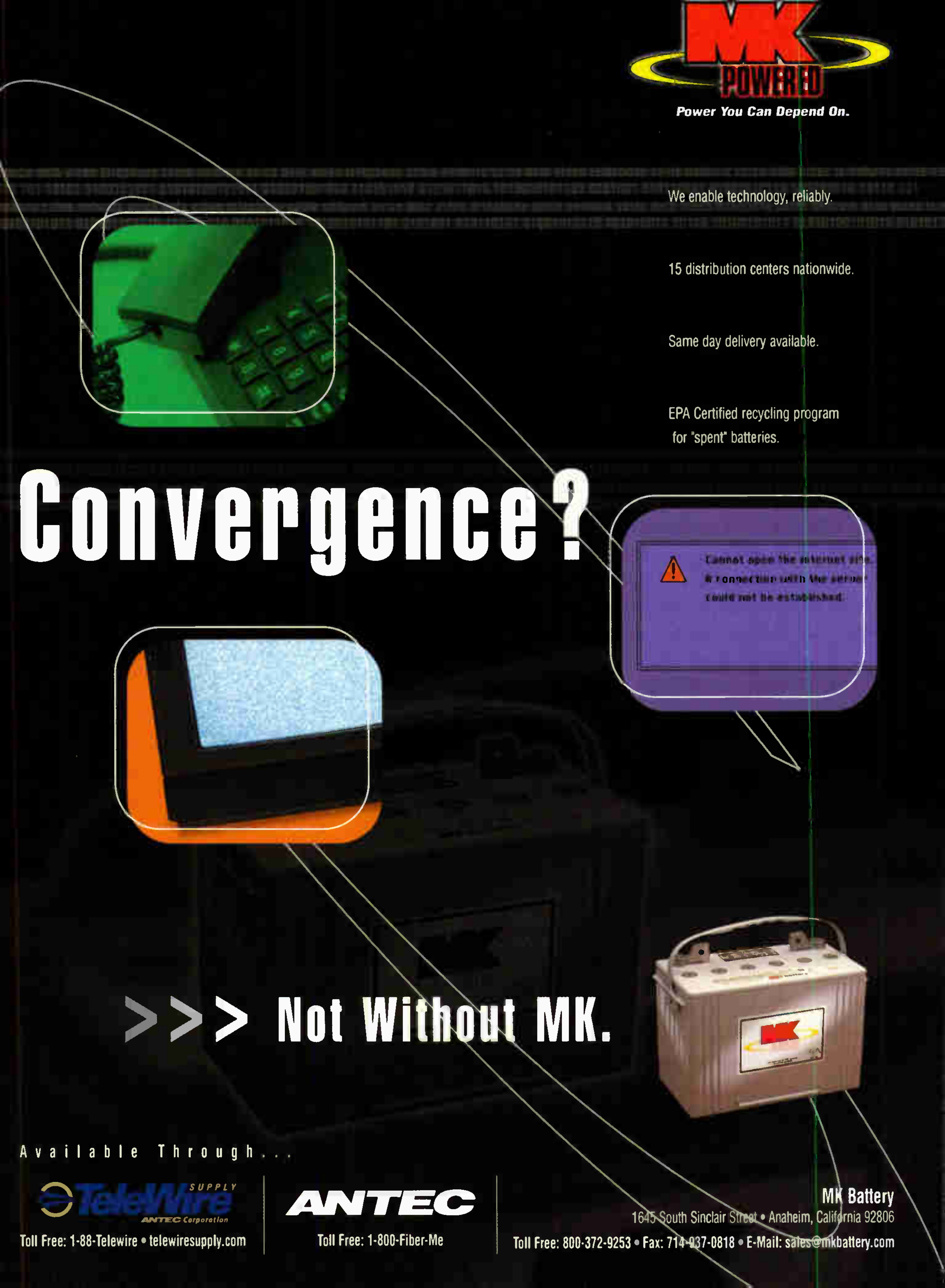
It is often the case that the ear can hear softer sounds in some bands near, but not necessarily adjacent to, loud bands. But the ear does not need a great signal-to-noise ratio in those bands. In this case, we can save some bits by encoding the signal in those bands to lower resolution. That is, rather than transmit maybe 18 bits per sample, we can get away with transmitting perhaps 8 bits or some other smaller number of bits.

Thus, we have several possibilities for handling each of the spectral bands. The encoder may not to transmit information from a band, or it may transmit it with lower resolution. It may decide to combine bands or to combine blocks. In each case, we save bits. The process of deciding what bits to send is known as adaptive bit allocation. >

BOTTOMLINE

> The Art of Audio

Audio compression as practiced in North America uses a technique developed by Dolby Labs called AC-3. It works on the principle of sub-band encoding, where the signal is broken into narrow bands, and each band is analyzed for content. Those bands that don't contribute the most to the content are either not transmitted or are transmitted at lower resolution.



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Obviously, we must communicate the bit allocation to the decoder. There are two ways to communicate this allocation. With forward adaptive bit allocation, the encoder explicitly tells the decoder what the bit allocation is. This is preferable from the standpoint that the encoder has knowledge of just what the original signal was, so it can optimize bit allocation. Also, as improved psychoacoustic models become available, they may be incorporated in encoders. This, again, is the principle that we allow improvements in encoding while preserving the functionality of the decoders in consumers' hands.

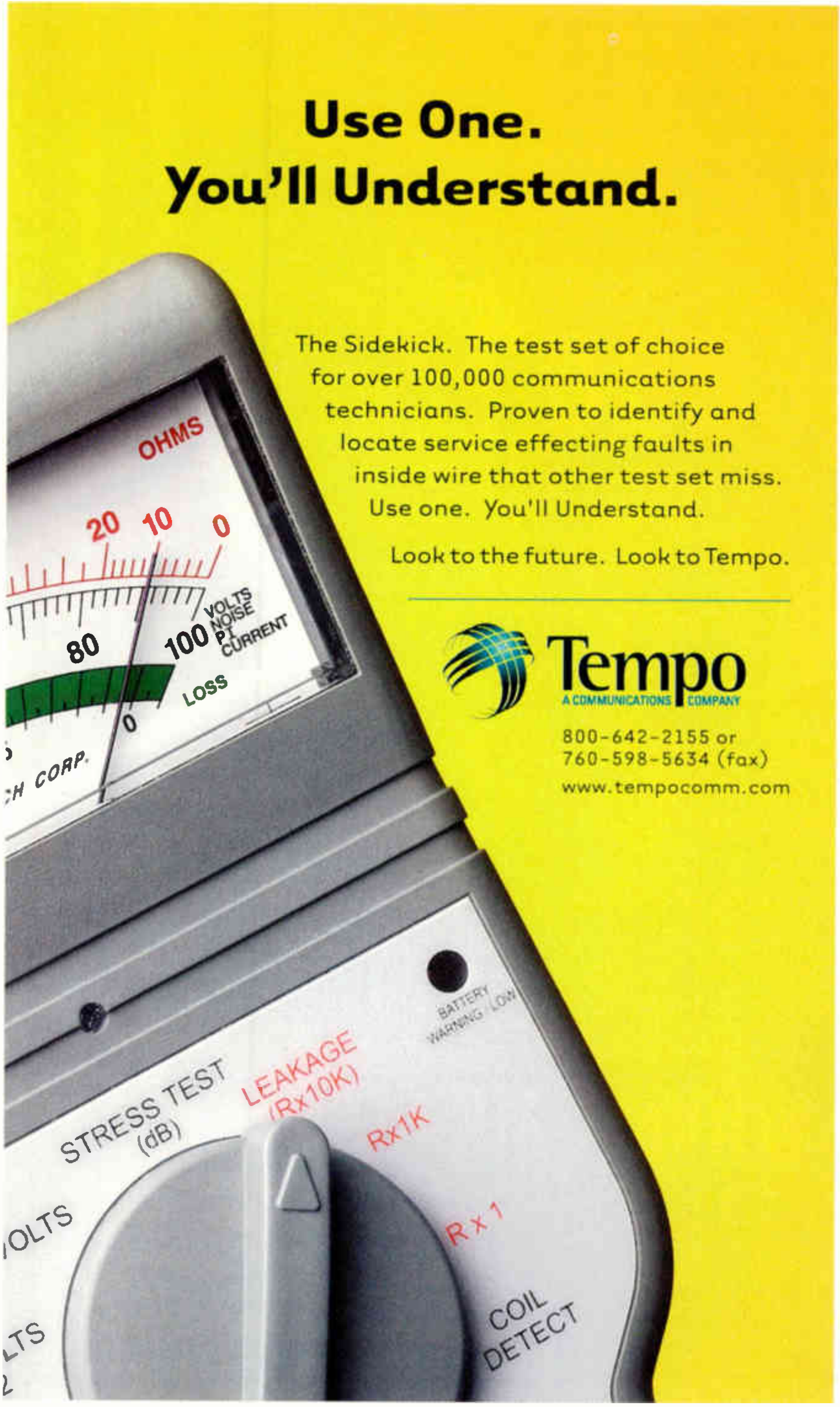
The problem with forward allocation is that it requires extra bits to be transmitted, which works against optimum compression. The alternative is backward adaptive bit allocation, where the decoder infers the bit allocation from the data it receives. This saves bits, but is limited in that the decoder does not have perfect knowledge of the original signal. Also, it does not lend itself to incorporation of improved psychoacoustic models. The encoder performs the same decoding process as is done in the decoder, so it knows how well the encoder will infer the proper bit allocation. If backward allocation does not yield good enough performance on a particular block, then forward allocation is used.

Other tricks

While adaptive sub-band encoding is the main way audio bit-rate reduction is achieved, you have other tricks at your disposal. It is not necessary to transmit all frequencies on two channels to achieve good location. Very high and very low frequencies do not help locate a sound, so they may be combined between the various channels and transmitted only once. Where two channels have nearly the same information except for the phase, you can force the phase to be common between the channels as long as the location is not affected. These tricks are called coupling strategies.

Location refers to preserving the characteristics of sound that allow you to locate the sound relative to where you are. Close your eyes and have someone stand in front of or behind you, or to one side. When that person speaks or makes any sound, you can point to them even though you can't see them. You know where they are because your psychoacoustic system can differentiate sounds arriving from different directions.

The object of a surround sound system is to bring this experience to you in audio reproduction, which is why we have five full sound channels. (The center, or dialogue, channel actually is used more to allow proper location over a wide range of places in the listening room.) Stereo is a huge improvement over mono, but only can locate sounds in front of you. Surround sound gives more



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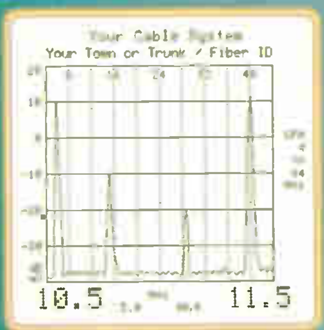

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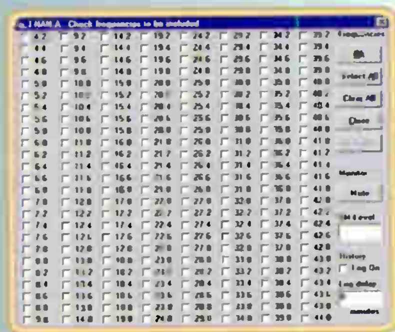

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of a sense of being there, by allowing sounds to come to you from all sides. (I wonder when they will add the third dimension...)

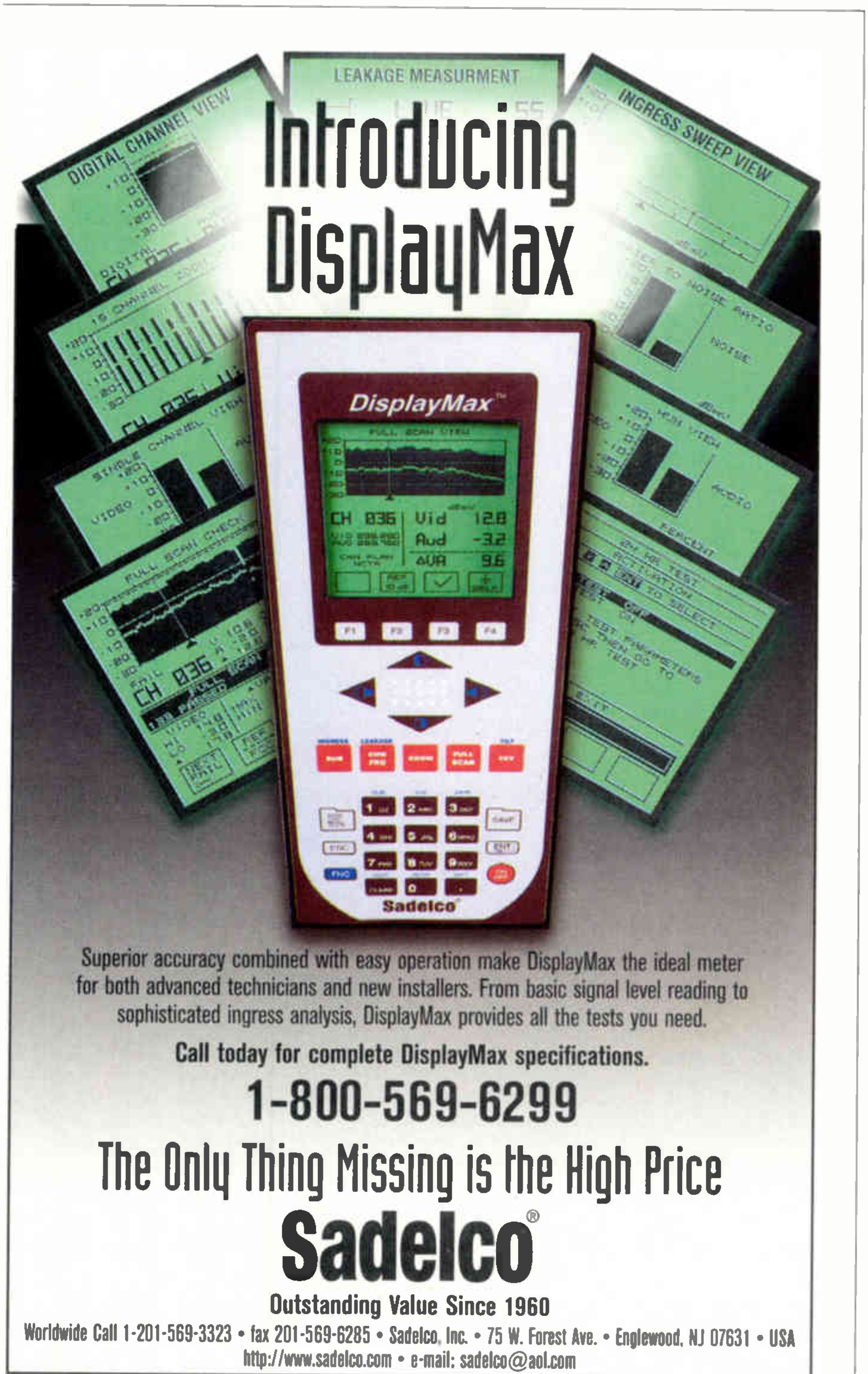
It is interesting, though off the subject, to think about what properties of the sound are used to allow you to locate sound at all angles around you. Intuitively, you might expect the brain to use relative amplitude and phase of sounds arriving at each ear to distinguish where the sound originates. But this does not explain how you can differentiate sounds directly in front from sounds directly behind. This ability is thought to have something to do with the shape of the outer ear—it filters the signal in a way that allows the brain to locate sound. A lot of work has been conducted in recent years toward understanding this filtering.

A humorous conclusion

Last January, I addressed a different type of audio compression used in IP telephony and elsewhere in our sister publication, *CT International* (then known as *International Cable*). This compression algorithm is called linear predictive coding (LPC), and essentially works by modeling sounds as being produced by a carrier with certain modulation. It works fairly well for speech but does not work well for music and other sounds. While researching this column, I ran across an interesting book that I was reminded of while preparing this material.

Michael D. Alder, a professor at the University of Western Australia, has posted a book covering pattern recognition—*An Introduction to Pattern Recognition: Statistical, Neural Net and Syntactic Methods of Getting Robots to See and Hear*—on the Web.[1] He covers LPC in this book, and in the introduction to that chapter makes an observation that is most apropos, and with which this author heartily agrees:

> "Once the reader understands that this is desperation city, and that things are done this way because they can be, rather than because there is a solid rationale, he or she may feel much more cheerful about things. For speech, there is a theory that regards the vocal tract as a sequence of resonators made up out of something deformable, and which can, in consequence, present some sort of justification for linear predictive coding. In general, the innocent beginner finds an extraordinary emphasis on linear models throughout physics, engineering and statistics, and may innocently believe that this is because life is generally linear. It is actually because we know how to do the sums in these cases. Sometimes, it more or less works."[1] >



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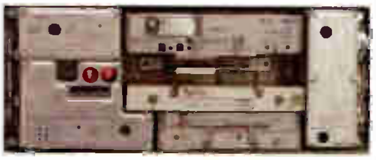

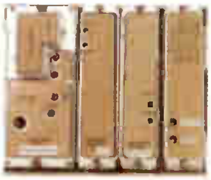

- Phillips (5-42MHz) LER,GNA,TNA,5RT
- Motorola (5-40MHz) SJ,X,SX,MB,JLC,JLE,JLX
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Additional references

There are a number of references available on the subject of audio compression. The basic specification is ATSC A/52. The entire suite of ATSC specifications is one of the best bargains in the whole world of standards: you can download them for free from www.atsc.org. The problem with reading the specifications themselves is that they are not intended to provide understanding of the principles, but rather assume you understand what is going on, and that you need the gory details.

Dr. Michael Isnardi of **Sarnoff Labs** is an outstanding teacher and writer on the subject of compression. He has presented several superb tutorials on the subject at the **IEEE Consumer Electronics Society's** annual conference—the International Conference on Consumer Electronics (www.icce.org). Unfortunately, I don't believe he is going to be presenting at the 2001 conference—in a rare moment of weakness, he agreed to chair the program committee. I have used several of his past presentations in preparing this material. If you have access to any of his writings, grab them and study them because he offers invaluable information.

The *Digital Consumer Electronics Handbook*, by Ronald K. Jurgen (McGraw-Hill, ISBN #0-07-034143-5), covers audio compression in a fairly understandable and readable manner. The coverage is a bit brief, but is useful. CT

Jim Farmer is chief technical officer of Wave7 Optics, Inc. He may be reached at jofarmer@mindspring.com.

Did this article help you? Let us know our thoughts. Send an e-mail to jwhalen@phillips.com.

[1] Adler, Michael D., *An Introduction to Pattern Recognition: Statistical, Neural Net and Syntactic Methods of Getting Robots to See and Hear*, September 19, 1997, http://ciips.ee.uwa.edu.au/~mike/PatRec/

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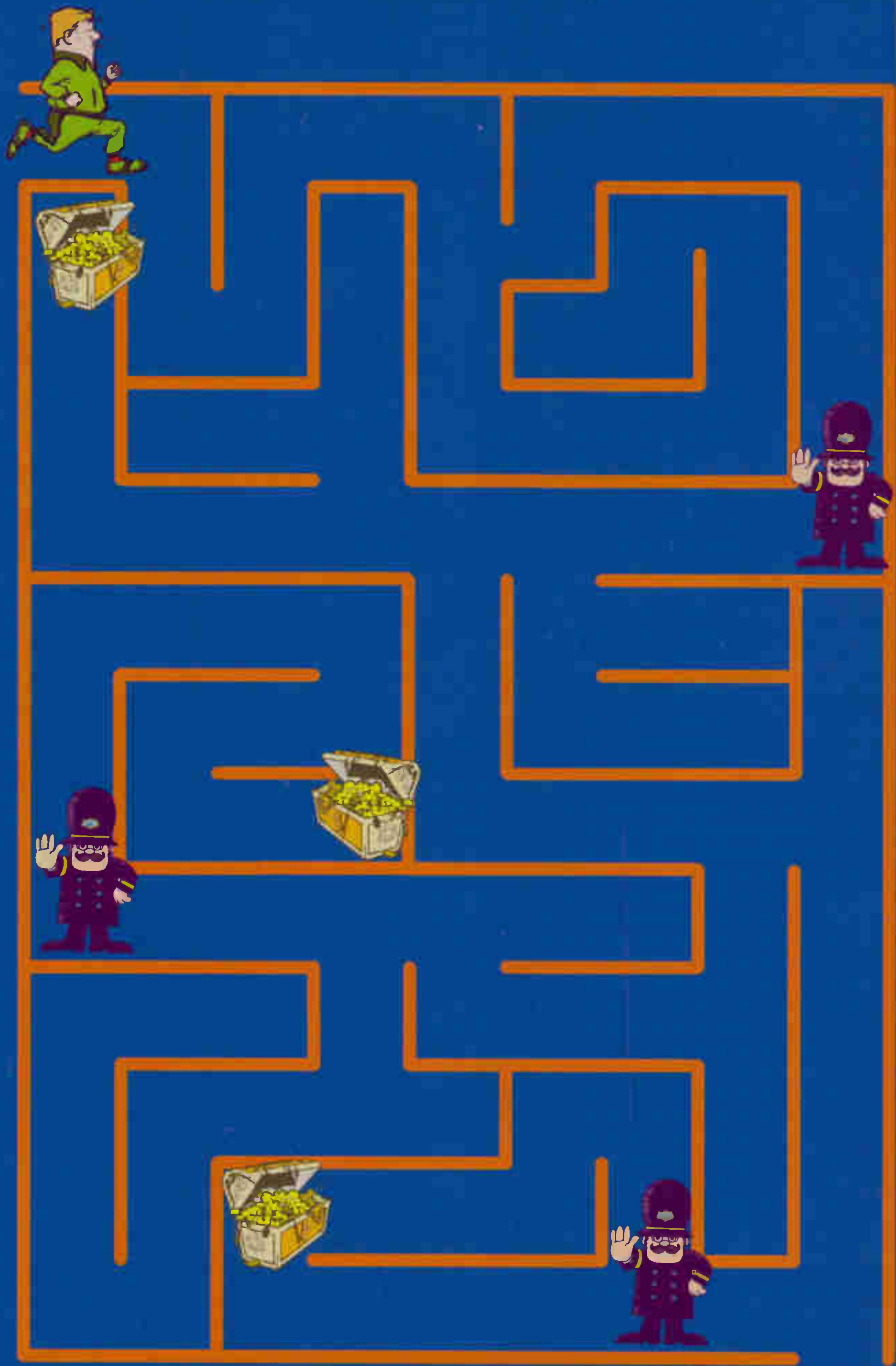


Has Open Access Got You Lost?

A Roadmap for Providing Choice—Part 1

By Bruce Bahlmann

Open access weighs heavily on the minds of today's cable engineers. You know it's coming, but what exactly does open access mean? Does it only pertain to high-speed data (HSD) services? How will you implement it, and what are the challenges?

While the advent of open access promises to bring nothing but good things to customers, the challenges faced by vendors and broadband operators are extremely steep. In fact, many of the components required to completely implement an open broadband system do not exist yet. We'll spend the next three issues dissecting this thorny problem.

What is open access?

The basic concept of open access is to provide individual broadband customers with a choice of service providers. The term "service provider" represents a supplier of content like information and entertainment or connectivity service. From here on out a service provider represents any company that can utilize the broadband media to deliver some service directly to customers. The breadth and scope of content and connectivity services available are limited only by the imagination. This is especially true as the amount of bandwidth available between the service provider and the customer increases.

The basic components

Open access will afford each broadband customer the opportunity to choose those service providers that best meet their needs. Figure 1 (see page 98) represents the major areas of challenge with regard to open access. They are basic hybrid fiber/coax (HFC) connectivity, connectivity management and service management.

Basic HFC connectivity in a completely open access environment goes beyond today's single frequency pair. Basic HFC connectivity in this case represents a spectrum of bandwidth dedicated to open access and managed by the broadband operator. This bandwidth permits the guaranteed delivery of one or more subscribed services to every broadband customer. Connectivity management represents the low level switching and routing necessary to permit various service providers to deliver diverse connectivity options that do not interfere with one another. Lastly, service management administers the resulting array of service options that will be available, the presentation of these options to broadband customers, and the subscription changes to their respective service provider. Of the three components, service management represents a green field business area with few (if any) shipping products.

It's more than data

Remember that open access means more than simply allowing customers to access the Internet as today's high-speed data (HSD) over cable service provides. Open access means freedom of choice for all types of information and entertainment services via the broadband media (see Figure 2, page 98). Choice implies competition, and it's competition that drives innovation, diversity, and value—all good things for broadband customers. Management components are essential to provide customers with an organized and fair selection of service and connectivity options.

While choice is to be commended, obstacles loom large for cable operators. Many of the components needed for an open broadband system aren't available. Some of these challenges are described in this article.

Bandwidth is scarce

As the model of open access gains more popularity, traditional broadband operators will grow ever more limited as they continue supporting analog video along side new digital services. This is because it is too expensive for them to reclaim the bandwidth used by these analog systems because it would require their analog customers to return their set-top boxes in favor of a digital set-top (or equivalent).

In the meantime, new broadband operators (perhaps those who have overbuilt HFC to compete with traditional broadband operators) can maximize their use of the available bandwidth without giving up some of their best frequency spectrum to analog services. Until traditional cable operators can rid themselves of analog video, new broadband operators will enjoy a significant advantage. They will have more than twice the available bandwidth (of traditional cable providers) to deploy new services.

In contrast, traditional broadband operators must squeeze out everything they can from the new bandwidth made available as a result of upgrades. Those that have not yet upgraded cannot offer any new services without taking something away from their existing analog customers. Thus the problem of getting rid of analog video may slow or reduce the number of services that can be offered in an open access market.

Analog is inefficient

A customer watching a video program on a 6 MHz analog channel throws away the rest of the available spectrum on a 870 MHz system. Meaning, on an analog system if you are watching a program on one channel all the other programs running on other channels are still being received—they are just not being watched (tuned). This does not take into account the inefficiency inherent in using a full 6 MHz for viewing a single video program. Bandwidth needlessly is wasted in analog systems, and this wasted spectrum often is some of the best quality bandwidth that broadband operators have because it is usually the least prone to interference.

In contrast, a higher quality digital video channel requires only a fraction of this bandwidth—as many as 16 digital channels could occupy the same bandwidth as a single analog video channel. Additionally, broadband operators also broadcast channels that are rarely watched. In fact, a high percentage (as much as 30 percent to 40 percent) of a broadband operator's content is viewed by less than 1 percent of its customers. This is the result of concessions made to obtain various franchise agreements as well as how certain video channels are packaged.

If progress is to be made in making broadband more bandwidth efficient, some mechanism is needed to distribute content only where it is subscribed. Video-on-demand (VOD) is the ultimate application of this, but it is only designed for single, well defined programs and not continually running events (for example, a 24-hour news channel). Products are needed to allow broadband operators

FIGURE 1 Major components of Open Access

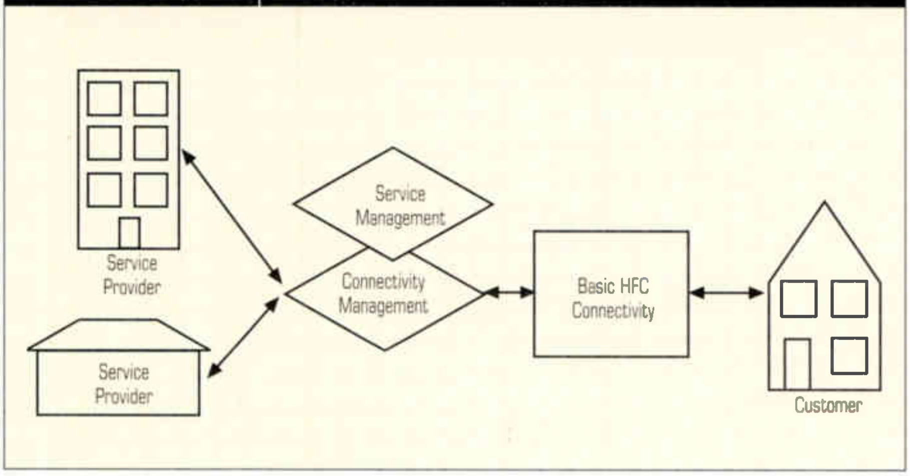
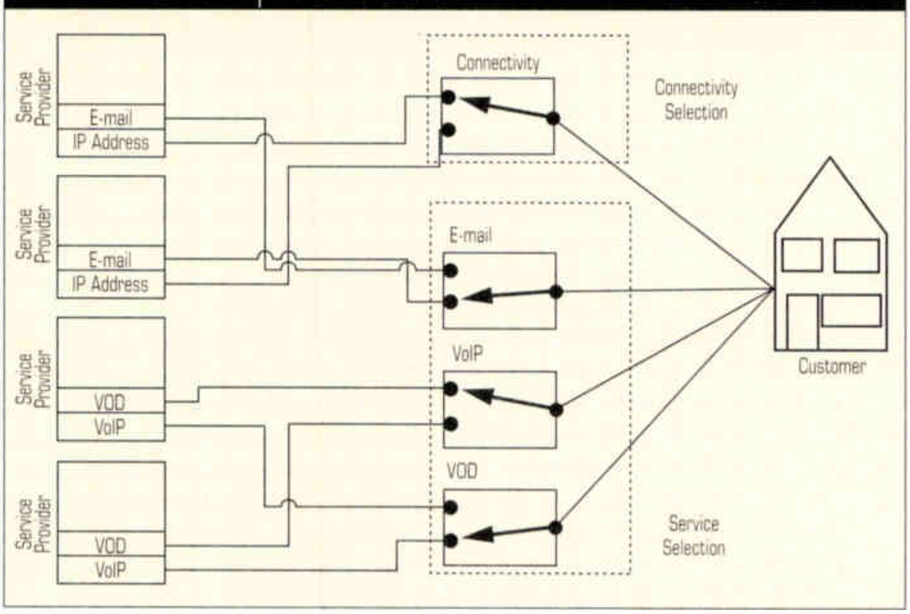


FIGURE 2 Management Components of Open Access



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to route more content to each customer or distribution hub rather than broadcast everything to everyone.

Fresh content, Revolutionized distribution

Much of today's broadband content is replicated. Essentially, it's the same movies playing over and over again. Very few cable channels actually maintain "fresh" (continually changing) content—some examples of these include 24 hour news channels, sports channels, etc. Oddly enough, most all public broadcasting stations maintain "relatively fresh" content—as one is unlikely to see the same program twice in one day or during the same week.

Service providers that just repeat the same content over and over will face stiff challenges from more diverse service providers that offer fresh or personalized content on demand. The advent and perfection of VOD along with assembling extensive libraries of popular movies will decrease demand for long-standing movie channel providers.

Customers want to watch what they want when they want rather than what is playing at specific times that may or may not be convenient—that is the beauty of VOD. Although some movie channel providers produce some original content, it will be difficult for them to spin off as a separate service provider organization or sell their services directly to broadband customers, because they do not officially own a majority of their content.

It is the movie-making companies who are in the driver's seat to make their extensive archive of movies available for VOD viewing. Such a service provider would be attractive to broadband operators and would permit movie-making companies to directly sell their movies to broadband customers. In the end, the number of service providers that offers movies would decrease or perhaps specialize into genre specific focuses (sci-fi, action/adventure, humor and so on). Regardless, the content distribution mechanism must be revolutionized.

Maximizing return on Capital investments

Open access will challenge traditional broadband operators' ability to compete with businesses that specialize in providing information and entertainment. Some new broadband operators have already taken a more toll-road type of common carrier approach as the time required to turn profit on capital investments to launch new content services is growing out of control.

To address this, broadband operators may need to create a separate operating group that could sell its information and entertainment services to several broadband operators. These new service providers would compete with other service providers to ensure that broadband customers receive increasingly better services and quality content. By doing this, smaller broadband operators could offer nearly the same content as larger operators (depending on their available bandwidth) without investing in costly capital equipment.

"Until traditional operators can rid themselves of analog video, new broadband operators will enjoy a significant advantage."

In this case, becoming a service provider also is more attractive because a single capital investment can claim several income streams. However, traditional broadband operators only have considered providing open access to the Internet. In the grand scheme of things, open access is not simply Internet access. Rather, open access means freedom for broadband customers to choose from a much broader array of information and entertainment services provided by a multitude of different entities. Open access for Internet service is but a small step in this direction, and more steps are needed to realize its full potential.

Rock-solid reliability

Before service providers can be successful using broadband, the HFC network must be tight and ultra reliable. By not having to seek new content services, broadband operators could invest more energy in scrutinizing minute changes in the HFC network in an effort to make broadband a very reliable transmission media. However, today's operators are spread thin attempting to move new services onto broadband, while building up completely new HFC maintenance and network operations organizations. As

BOTTOMLINE

> The Freedom of Choice

Although most of the attention on open access has focused on high-speed data services, we ought not to limit our thinking to data. Open access means freedom of choice for all types of information and entertainment services.

While open access promises to bring nothing but good things to customers, the challenges faced by vendors and broadband operators to implement it are steep. Many of the components required to completely implement an open broadband system do not yet exist. In part one of this three-part series, we explore at some of the issues to be tackled before open access is a success. They include:

- Scarcity of bandwidth
- Inefficiency of analog video
- Freshness of content
- Distribution mechanisms
- Reliability of the hybrid fiber/coax network

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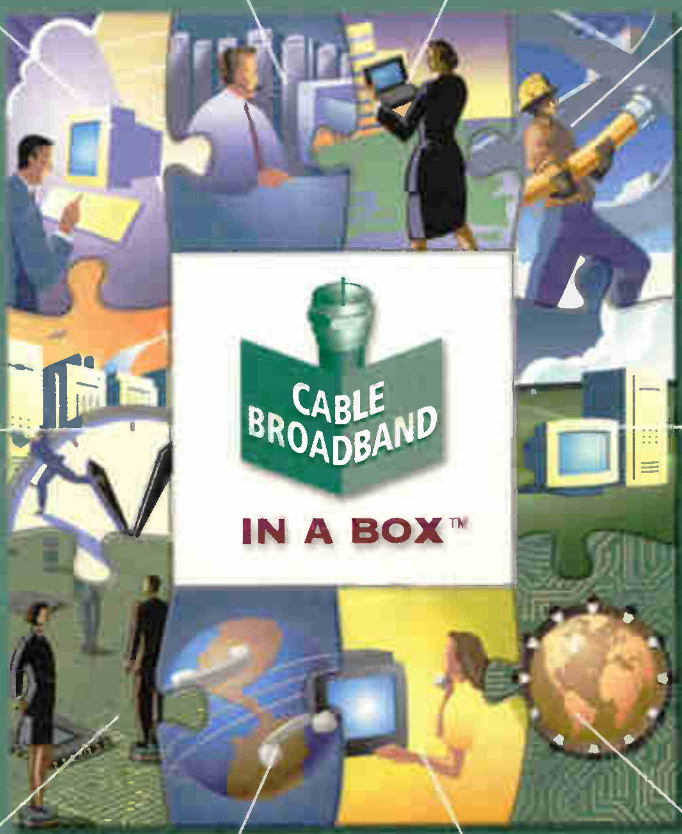

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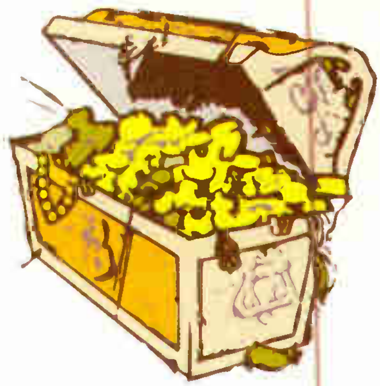
a result, HFC maintenance, automation, and staffing takes a back seat to launching new services which are increasingly dependent on a rock-solid broadband transmission media.

While the broadband industry claims good network availability numbers, they are not "five nines" or 99.999 percent, let alone the old Bellcore spec of 99.99 percent. There also is some doubt about the accuracy of these numbers as explained in last month's article about customer premise versus end of line monitoring (see *Communications Technology*, November 2000, page 92). Essentially, a large portion of the HFC network is invisible to broadband operators. If it is invisible, the availability numbers do not reflect the health of the whole broadband network but only a portion of it. Products are needed that permit operators to delve further into the inner workings of their HFC networks and help them detect, diagnose, troubleshoot, and correct problems before they become service impacting.

Pushing content to the edge

Another challenge with moving to open access is the problem of providing readily available content. As the network pipe that connects individual users to broadband increases, the availability of content at the networks' edge becomes paramount. This problem has plagued many popular Internet sites as they quickly discovered that providing a single web site for the world to access is unachievable. Instead, the best method of providing content is to push it down to the far reaches (or edges) of the network so it can be cached as close the customer as possible.

For broadband providers, this means placing content in the headends and distribution hubs. Traditional broadband HSD actually was designed with this in mind, placing numerous Internet services extremely close to customers. However, open access may pull this content back away from customers and place it at more distant service provider facilities.



For example, in order for multiple service providers to offer e-mail to customers, each would need to place an e-mail server in every broadband operators' headend—an unlikely solution because broadband providers would not be willing to give up the floor or rack space to facilitate this (some don't even have the available space).

Pushing content further up from the networks' edge forces the rest of the network to handle more capacity while juggling critical service quality, scalability, and redundancy issues. As a result, solutions are needed to enable completely open access to different service providers without extending the content beyond its optimal reach.

All broadband providers can benefit from open access because it allows them to specialize in taking care of their customers while managing their service providers, bandwidth, and network reliability. Best of all, open access completes the vision of broadband by placing new service activation on the open market and making bandwidth available for any new startup that wants to become part of broadband.

Stay tuned...

Next month, we'll be back to address the problem of managing the connectivity associated with open access. We'll introduce some of the hurdles that you'll need to negotiate and how you can begin preparing for a more complex infrastructure. CT

Bruce Bahlmann is senior architect for Alopa Networks. He may be reached via e-mail at bahlmann@bigfootcom.

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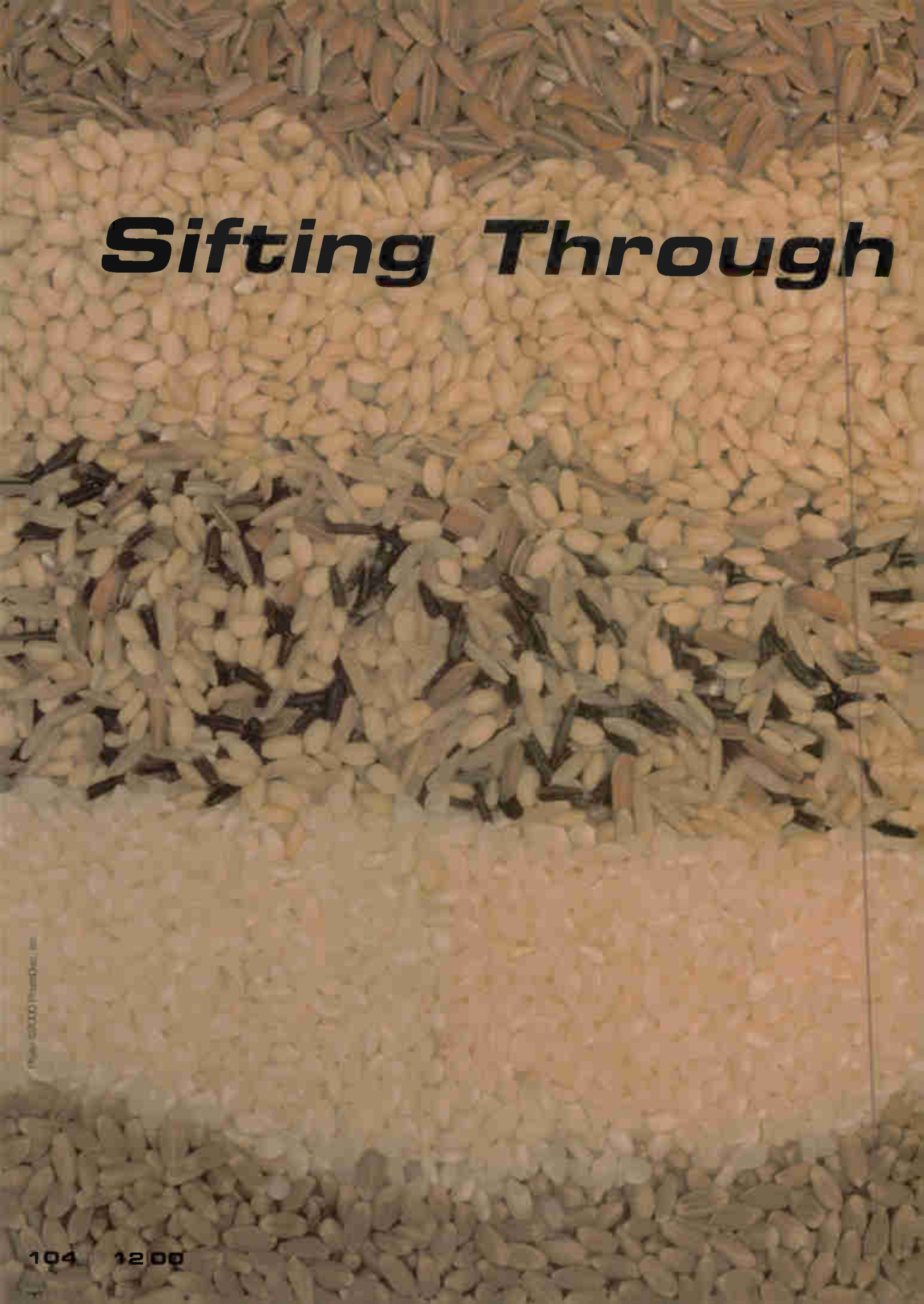


the MAC Sublayer

Resolving Channel Contention in Broadcast Networks

By Louis Litwin

This two-part tutorial focuses on the media access control (MAC) sublayer and the algorithms used at that level, which are found in Ethernet and wireless home networks. In this first part, we illustrate what the MAC sublayer is and where it fits in the protocol stack.

An interesting problem arises on a broadcast network where all of the devices share the same transmission medium. In such a system, only one device can transmit at a time. If multiple devices transmit simultaneously, all of the transmissions are garbled and lost. Clearly a mechanism is needed to control the access to the transmission medium. This task is the responsibility of the MAC sublayer.

A communications network is broken down into a series of layers that perform specific functions. These functions are accomplished by implementing a given set of rules called protocols at each layer. For any given layer, all devices on the network use the same protocol. This standardization of the protocols allows a given layer on one device to "talk" to the corresponding layer on another device. On a particular device, a given layer can communicate with the layers immediately above and below itself. An example of this hierarchy is shown in Figure 1 on page 106.

This hierarchy is designed so each layer isolates the layer above it from the rest of the protocol stack. For example, when layer 3 passes data to layer 2, it is not aware of or involved with the protocols and techniques used by layers 2 and 1. As far as layer 3 is concerned, it is communicating directly with layer 3 on another device. The details of how this communication actually takes place are left to the lower layers.

The advantage of such a structure is that lower layers can be replaced as technology advances without affecting the communication of the upper layers as long as the interface between layers remains constant. As an example, layer 2 could be replaced with a more efficient protocol without affecting the protocols in layers 1 and 3.

The collection of protocols used by the different layers is organized into a protocol stack. An example of a protocol stack that is typical of that found in a modern communications system is shown in Figure 2 on page 106.

The physical layer

The physical layer is the lowest layer on the protocol stack and interfaces directly with the transmission medium, or channel. The channel is the physical medium over which information is transmitted by the manipulation of some physical property, such as voltage. Examples of channels in a wired communications system include phone lines, coaxial cable and fiber-optic cable. Wireless channel examples include the earth's atmosphere, the ocean and outer space.

The physical layer must deal with the various non-ideal effects of the channel including thermal noise, signal reflections due to a multipath channel and interference from other communications systems. Other effects are caused by imperfections in the transmitter and receiver components, such

as an offset in the local oscillator frequency. Techniques to mitigate these effects include channel equalization, filtering, timing and frequency synchronization and error control coding. The goal of the physical layer is to take bits from the data link layer and move them across the channel error-free.

The data link layer

The data link layer's task is to provide the network layer with an error-free communications link. The data in this layer is broken down into units called frames. It is the responsibility of the data link layer to determine if the frame arrived intact at the receiver.

FIGURE 1 EXAMPLE OF LAYER-BASED PROTOCOL HIERARCHY

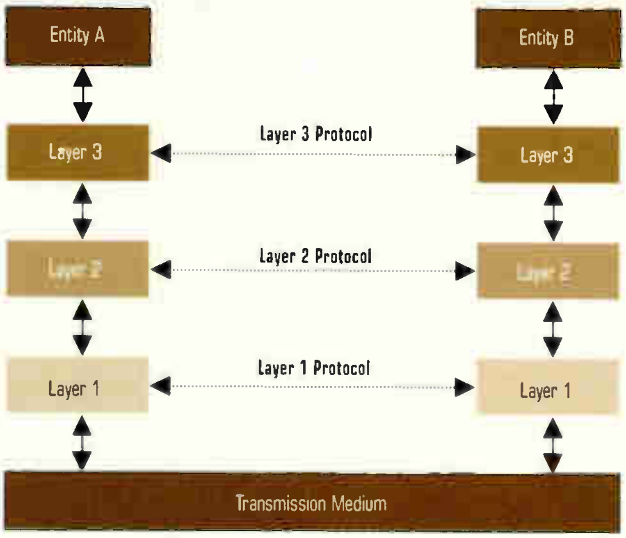
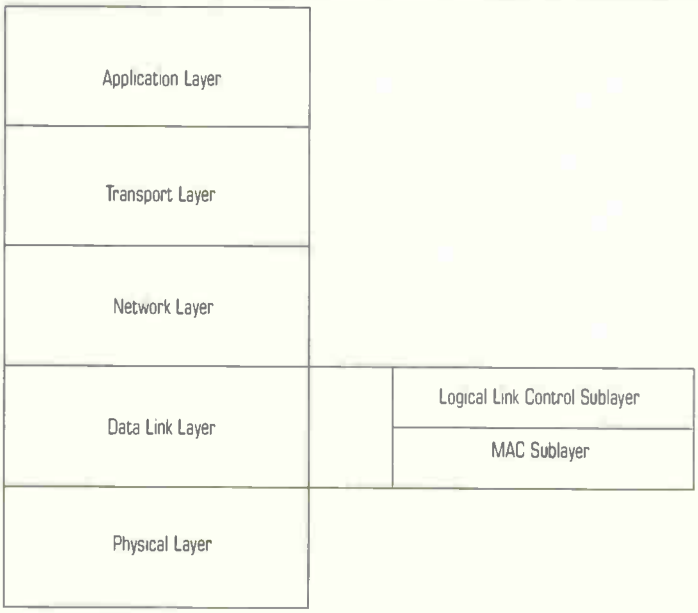


FIGURE 2 EXAMPLE OF A TYPICAL PROTOCOL STACK



A mechanism known as frame acknowledgement is employed where the receiver sends a frame back to the transmitter to inform it of the status of the received data frame. If there were a problem in the transmission, such as if a frame were garbled or lost completely, the transmitter could retransmit the frame.

This layer also handles data rate regulation. Transmitters and receivers often process data at different rates, and this imbalance can lead to overflow (the transmitter sends data faster than the receiver can process it) and underflow (the receiver processes data faster than the transmitter can send it) conditions at the receiver. >

BOTTOMLINE

> **Time share**

Broadcast networks need an efficient way to let users share the common transmission medium. In part one of this tutorial, static allocation protocols are introduced. Two common static protocols are frequency division multiplexing (FDM) and time division multiplexing (TDM).

Although simple to implement, these protocols are only efficient in systems where all users have constant transmissions at the same data rate. In systems where the users' bandwidth requirements are heterogeneous, FDM and TDM are inefficient.

The second installment in next month's issue will introduce the more efficient family of protocols known as dynamic allocation protocols.

The protocols mentioned demonstrate that, in general, the more polite the users of a network are, the more efficiently the bandwidth is utilized.

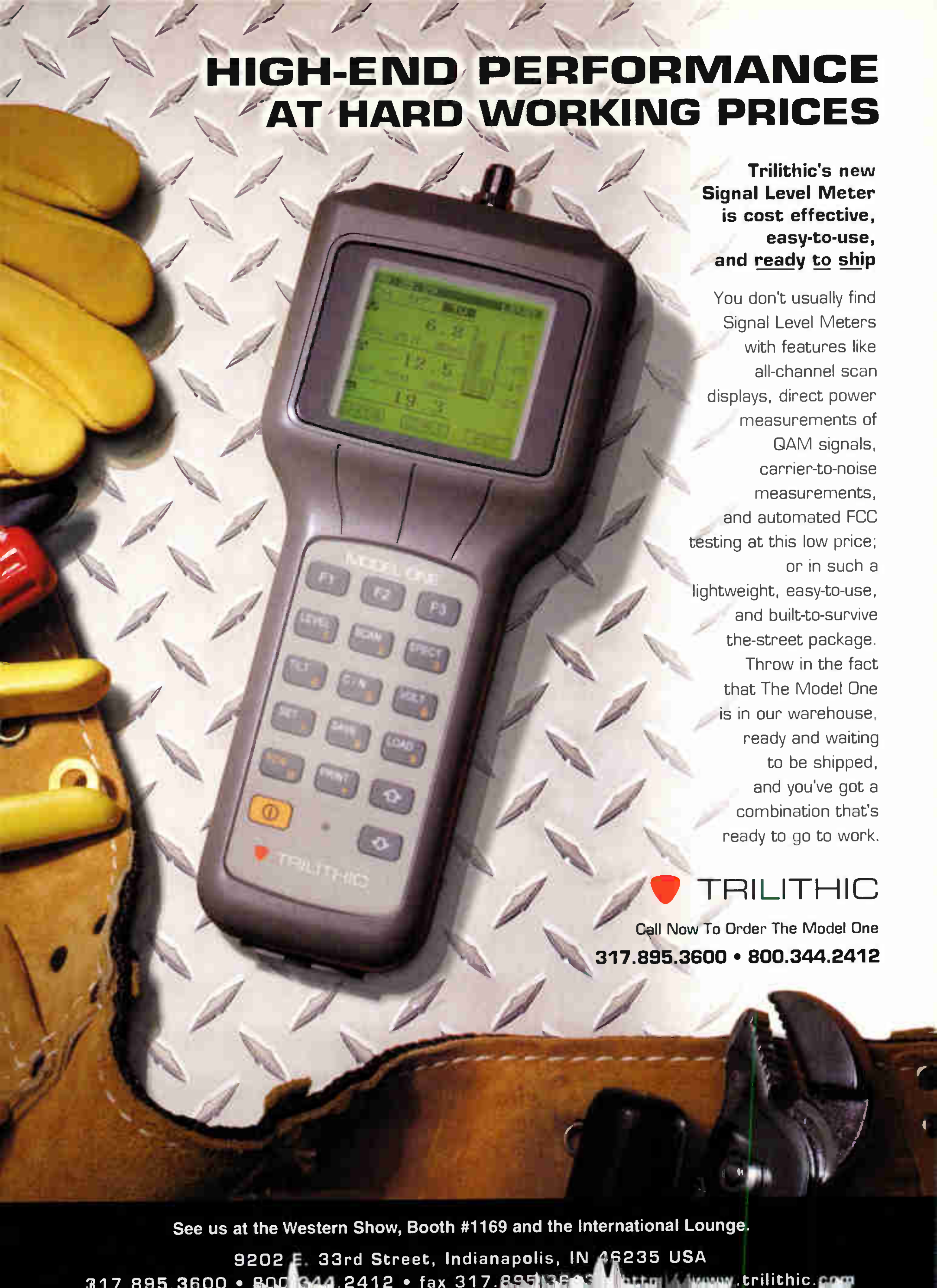

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FIGURE 3 Spectrum Allocation in an FDM System Where N = 3

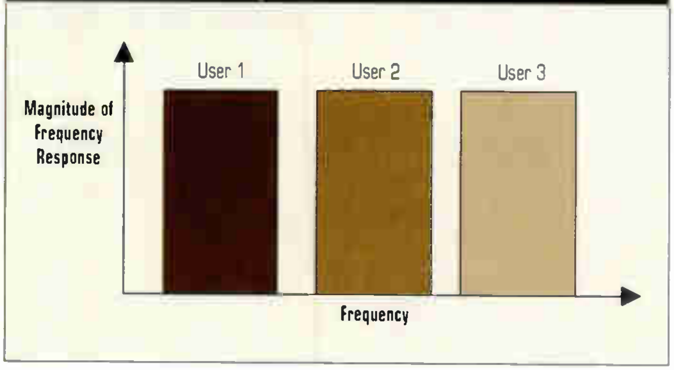


FIGURE 4 Time Slots in a TDM System Where N = 3

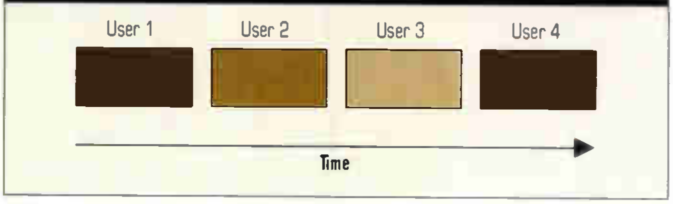


TABLE 1 Examples of Protocols Used in the Application Layer.

Protocol	Acronym	Application
File Transfer Protocol	FTP	File Transfer
HyperText Transfer Protocol	HTTP	Web Browsing
Simple Mail Transfer Protocol	SMTP	E-mail
Telnet	—	Virtual Terminal

The network layer

The network layer is responsible for ensuring packets are properly routed from the transmitter to the receiver. Routing is trivial in a broadcast network because all nodes can see all packets. However, the routing problem becomes much more complex on a point-to-point network. A large-scale example of such a network is the Internet. Sending an e-mail from Los Angeles to New York is accomplished via a series of hops between nodes. The packets carrying the e-mail message will need to travel through several nodes before arriving at their destination and the routing issues are no longer trivial.

Further complicating the problem is the presence of congestion. When a node has sent too many packets at one time, the node forms a bottleneck on the network. The network layer protocol must handle the routing of packets while taking network congestion into account. Although a given route between two nodes might be optimum in the sense of the least distance traveled, it might be inefficient to use the route if it contains one or more congested nodes. The protocol might choose an alternative route that physically covers more distance, but that actually is faster because of less congestion.

The transport layer

The transport layer is in charge of setting up and tearing down connections between two machines on the network. The type of connection used depends on the required quality of service (QoS).

An application that involves transferring a file between two machines will require an error-free service, and would use a connection-oriented service. This type of service ensures that packets arrive error-free and in the order they were sent. The trade-off is that the service experiences a delay because of the overhead required to provide an error-free link, such as some of the throughput that is used for acknowledgements and retransmissions.

An application that is sending two-way audio is more concerned with having a low latency, and it can tolerate the presence of some errors. In audio and video systems, a long delay is more noticeable to the customer compared to a few errors. For these applications, a connectionless service would be used, which is unreliable because no guarantees are made to prevent errors. However, the latency also is lower than a connection-oriented service because of the reduction in overhead.

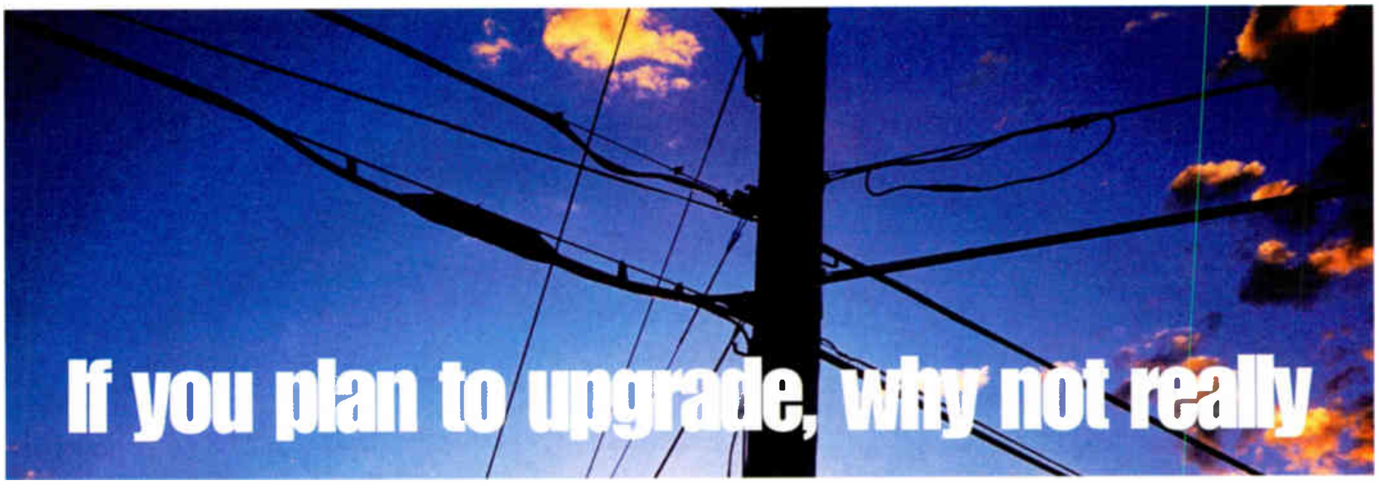
The application layer

The application layer sits at the top of the protocol stack, and it is concerned with the protocols used by various application software. Examples of some protocols used at this layer are shown in Table 1.

The MAC sublayer

The MAC sublayer is a subset of the data link layer and contains protocols addressing the problem of controlling access to the transmission medium in a broadcast network. Not all networks require a MAC sublayer. For example, most point-to-point networks are set up in a host-client configuration. The host machine waits idle until the client contacts it, then communications alternate between the two machines. An example of such a network is two personal computers (PCs) connected via their parallel ports.

Communications become more difficult in a broadcast network where several devices must communicate by sharing the same transmission medium. Because of the common transmission medium, all other machines on the network can hear a transmitted frame. Each device receives a unique address, called a MAC ID, when it is produced at the facto-



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ry. A device determines which frames are intended for itself by examining the MAC ID in the frame header.

Without a protocol to regulate access to the shared medium, devices often would transmit simultaneously causing a collision and garbled frames. All frames involved in a collision will be in error and must be retransmitted. Because the physical layer handles any errors that occur as a result of impairments on the transmission medium, such as thermal noise, the only errors occuring at the MAC sublayer are caused by collisions.

Static allocation protocols

Static allocation protocols are the most basic method for controlling access to a shared transmission medium. These protocols divide the system bandwidth into N slices of equal size where N is the number of users in the system. The static nature of the allocation simplifies the implementation; each user is given the same amount of bandwidth, which does not change.

"TDM works by assigning all N users their own reserved time slot."

Although ease of implementation is a definite benefit of static allocation protocols, these protocols can result in an inefficient use of bandwidth in some systems. Static allocation protocols work best in systems where all N users are constantly transmitting equal amounts of data, thus consuming all of the available bandwidth. This equal bandwidth usage pattern is not valid for a large number of applications, and it is in these cases that static allocation protocols become inefficient.

Imagine a system with N users where only M users need to transmit data at any given time and M < N. The bandwidth allocation in this system is not efficient because N - M "slices" of the bandwidth are not being used at any point in time. The problem is exacerbated when the M transmitting users do not have equal bandwidth usage requirements. As an extreme example, one of the M users might need to transmit a few keystrokes to a remote terminal, while another might need to transmit high bit-rate streaming Moving Pictures Experts Group (MPEG) video. Static allocation protocols fail in situations such as these. However, despite their limited flexibility, they do work extremely well for systems with uniform bandwidth requirements for each user.

Frequency division multiplexing

The technique of frequency division multiplexing (FDM) is a good example of a static allocation protocol. The available frequency range of the system is divided into N equal parts called subbands and each user can only transmit on a single assigned subband. An example of an FDM spectrum is shown in Figure 3 on page 108.

The subband assignment is constant, so if a user is not transmitting, their portion of the spectrum is wasted. Similarly, there is no mechanism to allow a user to have a bandwidth greater than a single subband. The inflexible nature of FDM can result in an inefficient use of the system bandwidth when users are not transmitting at all times, however, this arrangement also simplifies implementation. Each transmitter simply sends out a signal at a predetermined center frequency.

A good example of an FDM system is AM or FM radio where each radio station is assigned a constant subband of the available spectrum. FDM works well for radio because the stations are always transmitting and the bandwidth is efficiently used. Unfortunately, this constant bandwidth usage does not hold for typical computer networks.

Time division multiplexing

Time division multiplexing (TDM) is a static allocation protocol that works in the time domain instead of the frequency domain like FDM. Instead of dividing up the frequency range, TDM works by assigning all N users their own reserved time slot. Users in the system can transmit only during their corresponding time slot, and then must be silent at all other times. Once all N users' time slots have passed, the slot assignment wraps around to the first user's time slot and repeats.

Like FDM, TDM does not make efficient use of the available bandwidth when users are not constantly transmitting. If a user has nothing to transmit during his slot, no other user can transmit during that time either, and the system bandwidth remains unused for that time period (See figure 4, page 108).

TDM is slightly harder to implement than FDM because it requires global time synchronization. If a user is not synchronized to the TDM slot framework, when he thinks it is his time to transmit he actually will be transmitting during another user's time slot. This situation will result in a collision, and both users' data will be lost.

Although static protocols such as FDM and TDM are easy to implement, they are inefficient for controlling channel contention. Next month, we'll review some of the dynamic allocation protocols that are available via the MAC layer. CT

Louis Litwin is with the technical staff of Thomson Multimedia Corporate Research. He may be reached at litwinl@tce.com.

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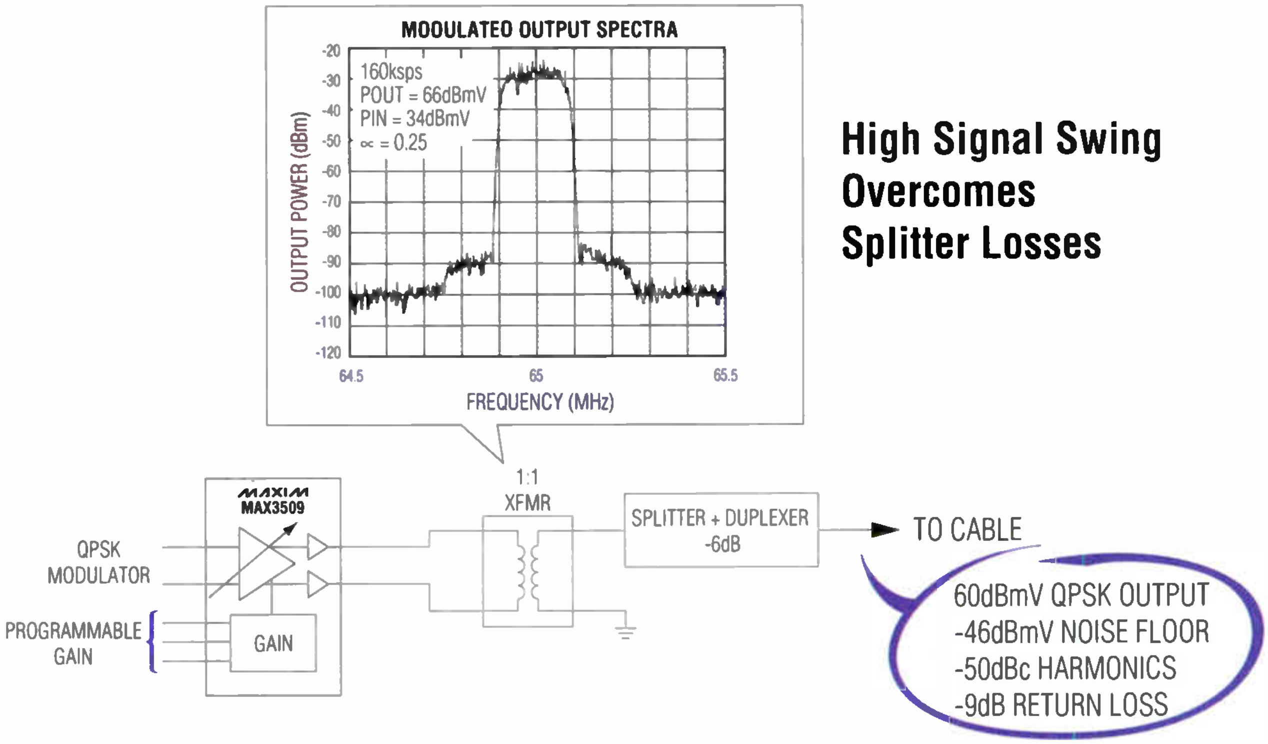

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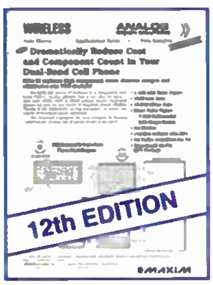

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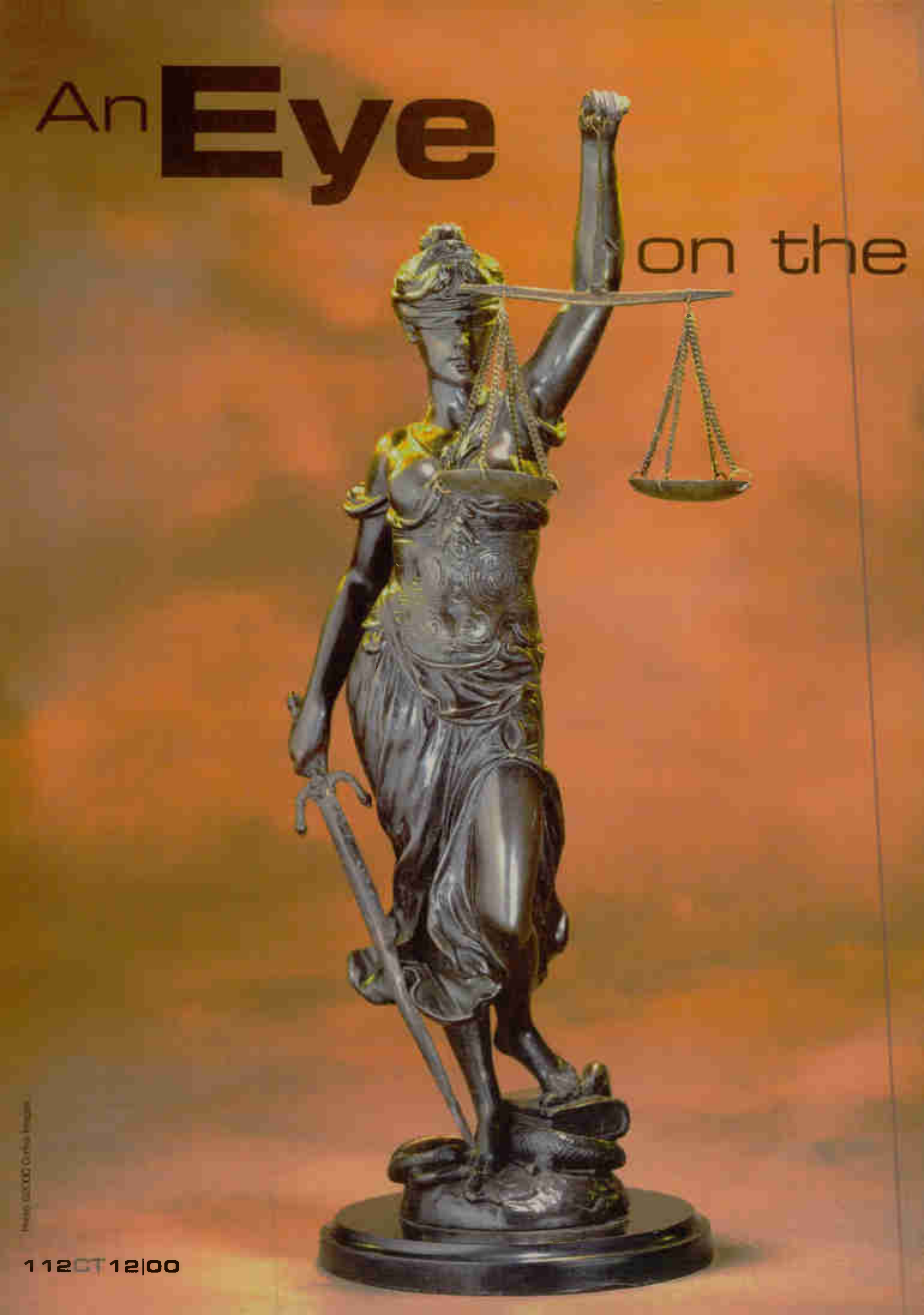
An Eye on the



Issues

Legal and Regulatory Roundup

By Jonathan Tombes

Converging industries, digital transition and innovative technologies are driving the cable industry forward. The price of such dynamism, however, is often measured in billable hours. Herewith is a sampling of cases and regulatory issues that have impacted operators and vendors—and their lawyers—over the past year.

Don't tell your cable modem subscribers, but the Internet is not a communications service. I mean, it's a cable, but not telecom service. Make that a telecom....

Confused? Federal courts have issued similarly contradictory rulings in a series of high-stakes cases.

In *Gulf Power Company v. the Federal Communications Commission*, the 11th Circuit Court of Appeals took another course, deeming Internet service neither cable nor telecom.

Decided in April in favor of Pensacola Fla.-based **Gulf Power**, the case arose from the utility's hiking pole rental rates from $5 to $38 per pole. **Cablevision of Panama City** received the big bill.

The case addressed the question of whether a utility company is bound by existing rate limits on cable lines that are used for both Internet and cable service. It turned in part on Gulf Power's challenge to the **Federal Communications Commission's** statutory authority, as determined by the 1996 Telecommunications Act.

Agreeing with Gulf Power, the Court of Appeals' panel clipped the FCC's power with the following syllogism:

"Congress... authorized the FCC to develop rent formulas for attachments providing cable and telecommunications services. Internet service does not meet the definition of either a cable service or a telecommunications service. Therefore, the 1996 Act does not authorize the FCC to regulate pole attachments for Internet service."

For various reasons, including its national importance and apparent conflict between circuits represented in the judicial panel, *Gulf Power*, the "pole attachment" case, is now headed toward the U.S. Supreme Court.

The Fourth Circuit Court of Appeals ruled otherwise in the more widely publicized "open access" case, *AT&T Corp. v. City of Portland*.

As a condition of transferring **Tele-Communication Inc.'s** cable franchises to **AT&T**, Portland required AT&T two years ago to provide nondiscriminatory access to other Internet service providers (ISPs). >

Gemstar first sued, then bought TV Guide.

AT&T filed suit and lost in U.S. District Court, but won last June at the Ninth Circuit Court of Appeals. The victory, however, was Pyrrhic, given the court's rejection of AT&T's contention that the high-speed Internet service, **Excite@Home**, was a cable service.

Labeling Internet-over-cable a telecom service instead, the Ninth Circuit potentially exposed AT&T to national telecom policy.

Meanwhile, a federal judge in Virginia concluded that Henrico County (suburban Richmond) was likewise out of bounds in ordering **MediaOne** to provide open access. The judge reasoned, however, that the operator's **Road Runner** service was a cable service, not a telecom one.

The Henrico case currently is making its way through the Fourth Circuit Court of Appeals.

Time for a definition

It was such legal ambiguity that led FCC Commissioner William Kennard to issue a formal notice of inquiry (NOI) into the open access issue in late September.

"Recent court opinions have categorized cable modem service in differing manners, which brings home the need for a national framework for treatment of such services," Kennard said in a statement.

Those who appreciate the FCC's heretofore market-friendly approach to open access take some comfort in an FCC white paper released almost simultaneously with this NOI. The Office of Plans and Policy (OPP) study defends the current practice of not regulating the international Internet backbone. (See related sidebar on page 118 for more details.)

Proponents of open access rules, however, criticize the FCC for not having moved sooner. Its relative inaction arguably has prompted the **Federal Trade Commission** (FTC) to enter this debate through its ruling on the **AOL-Time Warner** merger.

In the field, operators are moving ahead with attempts to resolve related technical issues. AT&T and Time Warner launched open access trials in, respectively, Denver and Columbus, Ohio.

Negotiating with ISPs may prove a greater challenge for operators than surmounting technical hurdles. But whether government-imposed or market-generated or a combination thereof, open access is looking like a foregone conclusion.

Vendors of highly integrated cable modem termination systems (CMTSs), for instance, assume this network requirement in their business models.

"The writing's on the wall," **Current Analysis** Senior Analyst Ron Westfall says. "Service selection will inevitably be part of cable offerings."

Converging on MTEs

Another issue on the open access and converging technologies front involves the lucrative multiple dwelling unit (MDU), or multiple tenant envi-

BOTTOMLINE

> An Eye on the Issues

Big legal and regulatory issues are shaping the cable industry. Here's a brief run-down:

Open access head's up

- The FCC is trying to define Internet over cable. Deadline for reply comments to its notice of inquiry: January 10, 2001.
- Two related cases: *Gulf Power v. the FCC* (involving a 600 percent hike in pole rentals) and the ongoing dispute between Henrico County, Va., and AT&T.

Choice for tenants

- The FCC has taken steps to open the multiple tenant environment (MTE) market and is seeking comments in a further notice of proposed rulemaking (NPRM).

Digital holding pattern

- Must-carry: a "surreal" policy either going nowhere fast or else headed for a train wreck.
- POD modules and (digital) host devices: waiting for a market.

Intellectual property agenda

- Technology generally trumps copyrights, but...
- Protect your copyrights; no one else will.
- Figure out how Gemstar's Henry Yuen does it.

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ronment (MTE) market, and the FCC's cable inside wiring rules.

Paul Glist, a cable lawyer with **Cole, Raywid & Braverman**, says that while the FCC declined to force open this market, some two dozen states took that step, resulting in piecemeal national coverage.

The status quo shifted when wireless carriers petitioned for rooftop access to MTEs. In June 1999, the FCC opened a proceeding aimed at the barriers that impede wired (or cabled) and wireless operators, namely landlords who can limit which firms install equipment into buildings and apartments.

While noting that the real estate industry had made progress in adopting best practices and model agreements, the FCC took the following actions in October:

- Prohibited exclusive contracts between telecom providers and landlords of commercial buildings.
- Established means of reducing competitive carriers' dependence upon incumbent local exchange carriers (ILECS).
- Determined that local exchange carriers (LECs) must afford competitors' access to conduits and rights-of-way located in customers' buildings.
- Extended the ban of restrictions on direct broadcast satellite (DBS) dishes to antennas receiving and transmitting data and other telecom.

The FCC also sought comment in a further notice of proposed rulemaking (NPRM) on such issues as its statutory authority regarding LECs, the commercial vs. residential MTE markets and definitions of "right-of-way."

Cable must-carry

National Cable Television Association (NCTA) Vice President of Communications David Beckwith describes the ongoing cable transition to a digital regime as a "bumpy road."

The related regulatory issues include digital must-carry, set-top retail distribution, encryption technologies and labeling of consumer electronic equipment.

Must-carry is the most contentious of these. In 1992, Congress mandated that cable systems transmit broadcasters' existing analog signals. The cable industry objected, but lost its protracted fight in *Turner Broadcasting System vs. FCC*, decided 5-4 by the U.S. Supreme Court in March 1997.

As part of its early effort to spur the transition from analog to digital, Congress also called for broadcasters to return their analog spectrum to the government in 2007, provided 85 percent of households were receiving digital signals.

In April 1998, pursuant to the 1996 Telecommunications Act, the FCC granted new digital spectrum to incumbent broadcasters. A few months later, the FCC launched its effort to require cable operators to extend the obligation of must-carry to new digitally broadcast signals.

Portland, Ore. (above), the site of litigation involving AT&T and "open access."

The FCC says landlords cannot restrict the multiple tenant environment (MTE) market.

The *Gulf Power* case arose from a 600 percent increase in pole rental rates.

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If you find this puzzling, you're not alone.

"Rather than using the digital spectrum that (broadcasters) were given, they want to piggy back their competing technology onto the cable platform," cable lawyer Glist explains.

> "Recent court opinions have categorized cable modem service in differing manners, which brings home the need for a national framework for treatment of such services."
> —FCC Chairman William Kennard

The broadcasters' ability to prevail in the regulatory arena makes this policy no less "surreal," Glist says.

"There's something really weird about allocating all that valuable over-the-air digital spectrum and then sort of throwing it away."

Must-carry, version 2

Must-carry has its DBS version, as well.

The passage of the Satellite Home Viewer Improvement Act (SHVIA), which granted local carriage rights to the DBS industry, also stipulated that if the FCC applies digital must-carry to cable, it should apply "comparable" requirements to DBS.

In June, the FCC proposed to implement SHVIA in markets, starting in 2002, where DBS retransmits at least one TV station. In late September, the DBS industry filed suit in federal district court, charging that SHVIA violated the First and Fifth Amendments as well as copyright laws.

Cable partisans may entertain pious hopes for a *Turner* reversal, but the DBS world sees that narrowly divided court decision as an opening to distinguish its own case.

In an October letter explaining its suit to Hill lawmakers, the **Satellite Broadcasting and Communications Association** (SBCA) said that the must-carry rules "go far beyond those applicable to cable."

American Enterprise Institute telecommunications Policy Scholar Tom Hazlett says that the SBCA may prevail. Yet he regards any type of must-carry as a "train wreck" and pushes the policy to its logical (if absurd) next step.

"We have this very strange policy for cable and satellite, but why not for the Internet?" Hazlett asks.

But with DBS must-carry in the courts and the original two-year-old proceeding stalled in the FCC, this policy train-wreck may still be in the station.

POD deadline met

The consumer electronics industry joined the broadcasters in the must-carry debate. But consumer electronics has other arrows in its legal quiver.

The 1996 Telecommunications Act, for instance, stipulated that cable subscribers be able to purchase their own equipment. Implementing the law, the FCC mandated that cable operators with deployed digital systems make removable security devices available to customers who want to buy set-tops at retail.

The deadline for producing what became known as point of deployment (POD) modules was July 1. A

> The FCC Study on the Internet Backbones: A Legal Commentary

Shortly after the **Federal Communications Commission** (FCC) released its Office of Plans and Policy study of the Internet backbone market, *CT* talked with cable lawyer **Paul Glist**, of the firm **Cole, Raywid & Braverman**.

CT: How do you read the OPP study?

Paul Glist: It says essentially: peering and transit agreements make the Internet work; they all grew up in an unregulated market-based environment, and it works fine. And if anyone tries to use them for anti-competitive purposes, market forces are going to correct for it and force them back.

CT: What's peering and transit?

Glist: The short form answer is that there are multiple networks that criss-cross the globe, and they all have to connect with each other. The high-traffic networks enter into peer-to-peer relationships where they basically hand off traffic on a no-bill basis. And if you are a very, very small network, and you want to rely upon very large adjacent networks for a lot of your transport, you enter into what's called a transit agreement. That might require you to actually provide some consideration, because you're not giving equivalent value, you're not really a peer.

But all of these things have been negotiated out in the private market. I remember back in the old days when **AOL** was something other than **Time Warner**, someone suggested that maybe transit and peering agreements should be regulated, and AOL filed comment saying, 'Are you crazy. Everything's working. Don't touch it, it's not broken!'

CT: What's the significance?

Glist: Everyone is talking about forced access, open access, all these fine issues. They say 'We can't trust market, it's never going to work.' And then if you step back and say, 'How exactly does the Internet work?'...well, it turns out it works on market agreements. It works great. And everyone who is a player is saying 'Oh, don't touch that part.'

CT: So it's a kind of reality check?

Glist: Yes. Do you really need 'non-discriminatory common carrier' agency regulation, and all that good stuff? What makes the Internet work? Well, all of not-that—that's what makes it work!

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week later, a consortium of cable operators, as well as Scientific-Atlanta and **Motorola's** Broadband Communications Sector, submitted its status report to the FCC.

The report summarized **CableLabs'** success at developing specifications to enable manufacturers to build digital POD modules and products in line with those specs within the FCC-mandated deadline. The authors also reported their compliance, albeit reluctantly, with the FCC's additional analog requirements.

Although CableLabs had published analog-separate security module specs, no manufacturer stepped up to the plate to build the analog module, and no retailer placed orders for a hybrid (analog/digital) set-top. The status report also notes that operators (with few exceptions) had "at the cost of scarce channel space" duplicated their scrambled analog programming on digital tiers, lest there be any disincentive to purchase digital boxes at retail.

But it appears that demand disincentives are less of an issue than the lack of incentives to supply digital hosts in the first place. "No retailers appear to have placed orders for digital set-top boxes," the authors of the report note.

Why no retail market?

In mid-September, the FCC ruled out one possible explanation. Against complaints that CableLabs' licensing of the Dynamic Feedback Arrangement Scrambling Technique (DFAST) violated its rules, the FCC instead determined that some measure of anti-copying encryption technology could be located within the host device.

The FCC went further and initiated a review of its 1998 rules on navigation devices (set-tops, remote control units and so on). But while the Commission might puzzle over the behavior of retailers such as **Circuit City**, whose advocacy had helped drive this legislation, cable insiders speak clearly.

"The CEA **[Consumer Electronics Association]** is stuck with the same rules they put on us," NCTA's Beckwith says. "They can either get that (cost plus 11 percent price regime) overturned, or try to extract revenues from us on a monthly basis."

The current faces at the FCC (l-r): Michael Powell, Susan Ness, William Kennard (chairman), Harold Furchtgott-Roth, Gloria Tristani.

Glist frames the issue in similar terms. Consumers are already getting digitized information from their personal computers (PCs), he says. "You can't make it happen on the TV set if the economics are not lining up there."

On another CEA-NCTA dispute, a lack of consensus over the labeling of digital television (DTV) receivers led the FCC to issue a mid-September ruling, designating three respective tiers of "Digital Cable Ready" connectivity:

- Tier 1: Requiring a POD but carrying no 1394 interface connector.
- Tier 2: Including the 1394 connector and able to support advanced services through a digital set-top.
- Tier 3: Receiving advanced programming through direct connection.

The FCC says it would have preferred a "comprehensive market-driven solution" to this issue, and neither side appears completely satisfied.

Copyrights and patents

A final category of legal issues is the welter of intellectual property disputes that characterize any technologically vibrant industry.

The file-sharing programs such as **Napster** or **MP3** that have created headaches for data network administrators and musical industry executives exemplify the latest threat. Yet this is a familiar song.

"With every single new technology, the copyright laws have been erected as a barrier to that technology by the copyright owners," Glist says. "And every single time, the technology forced a change in the copyright law."

Cable itself, Glist reminds us, was once a novel transmission technology facing similar roadblocks.

In other cases, competing new technologies are squaring off against each other.

Recent examples include **SeaChange International's** copyright infringement suit against video-on-demand (VOD) equipment competitor **nCUBE**, or **Gemstar's** various settlements against Scientific-Atlanta, Motorola, or **TV Guide**, which it ultimately acquired.

The SeaChange case is a cautionary tale of how a plaintiff can become a defendant when its intellectual property is at stake. (For more details, see "SeaChange Prevails in Court," November 2000, page 34).

Gemstar CEO Henry Yuen (who holds both a Ph.D. and a law degree) demonstrates the value that accrues to someone who assembles scores of patents on a strategic piece of real estate, in this case the electronic program guide (EPG).

While cable's legal eagles are clear-sighted on many regulatory issues facing the industry, how this billionaire's acquisition of TV Guide made it through FTC review unscathed remains something of a mystery. CT

Jonathan Tombes is deployment editor for Communications Technology. You may reach him at jtombes@phillips.com.

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A Technici Guide to Networks

Help Ease Customer Frustrations

By Tony Ghaffari

If you're not teaching your broadband installers and technicians about home networking, you're already behind in today's competitive market.

Cable customers are much more data savvy than they were 10 years ago. It's not uncommon for a broadband technician to arrive at a customer's home to install a cable modem and discover a network with a hub, a router or even a server already installed.

Of course, most cable operators don't support such home networks. They require that the technician simply tell the customers that they have to make the connection between the cable modem and the network them-

an's Home

selves. In fact, in my own recent experience, the technician handed me the modem, the cable, the network interface card (NIC) and the work order, and said I had to do the install myself. This took me the better part of a day, because I was missing some essential network parameters.

But, wouldn't it be nice if your technicians knew how the cable modem should be connected within a home network, and what role the different network components play? As the technicians are your directors of first impressions, it's essential that they have a basic understanding of home networks so that they don't appear completely intimidated. Plus, there is critical information they'll need to provide so that the customer may complete the installation successfully. Let's look at some common home network configurations.

What is a home network?

Internet and data are the fastest growing of all broadband services. More people are working from home, and more students are using computers for homework and research, not to mention online games. Not so long ago, a computer in the home was a luxury. We are now finding multiple computers in the home. But, customers still are reluctant to spend money unnecessarily. Instead of spending hundreds of dollars on separate peripherals at each computer (like printers, scanners, CD-ROMs and even modems), they are finding that a low-cost alternative is a high-speed home network. The home network allows each user to share all the resources on the network.

The most basic home network requires two computers, each with a NIC, and a crossover network cable to connect them together.

In a simple home network, each computer and its devices will be connected to the network through the hub (see Figure 1, page 124). The hub simply passes all the network information to all of the computers. It is the job of the NIC to capture only the data designated for that particular computer. The computers on the network are all assigned a unique Internet protocol (IP) address. This address is used by the NIC at each computer to identify what data to capture and what data to ignore.

Every computer on the Internet, just like the home network, has a unique IP address which is used for routing. No two computers on a network or the Internet can have the same IP address because conflicts would occur. Certain blocks of IP addresses have been reserved for private networking and do not exist on the Internet. The most common for home use are 192.168.0.0 through 192.168.255.254.

With the home network, each computer still needs a telephone modem to access the Internet. Theoretically, all computers could share one 56K modem. In reality, the limited speed of the typical dial-up modem would be too slow to allow sharing.

The cable modem's role

A cable modem provides a connection to the Internet through the local cable company. Most cable operators supply and support everything needed for one properly operating computer to access the Internet through the cable modem. Assuming all of the cable (RF) connections are made from the tap to the ground block, an additional coaxial line is installed to

BOTTOMLINE

> How Do You Support Home Networks?

With the proliferation of personal computers, home networks are becoming more common. When your technicians arrive at a customer's home to install a cable modem, they may discover a network with a hub, router or even a server already in place.

There are three basic types of home networks that technicians may encounter: those with a hub, those with a router and those with a server.

Unfortunately for the customer, most cable operators don't support such networks. While they allow customers with networks to access the Internet through their modems, technicians aren't allowed to install those modems in home networks, nor do customer service representatives support them.

Because many technicians are not trained to understand the basic components of home networks, they may appear intimidated to customers, and may fail to give customers the network parameters they must have to complete the install. Customers need information concerning computer name, domain name, proxy server, mail server, news server and gateway in order to get their modem up and running. All of this information is the same as it would be for a single computer install and is available to the technician.

the computer. The cable modem is connected to the coaxial cable. A NIC is installed in the computer and connected to the cable modem by a twisted-pair cable with RJ-45 connectors on both ends. Installing the software completes the process. The software configures the computer for networking with a cable modem.

During this configuration process, the computer's dynamic host configuration protocol (DHCP) functions are enabled. With DHCP turned on, the only information that

"Wouldn't it be nice if your technicians knew how the cable modem should be connected within a home network?"

needs to be entered is a host name (and in some cases, a domain name). The computer will then acquire all of the required parameters from the cable operator or Internet service provider (ISP) and configure itself. The software also includes a Web browser and associated Internet applications, plus help files.

Home networks meet Cable modems

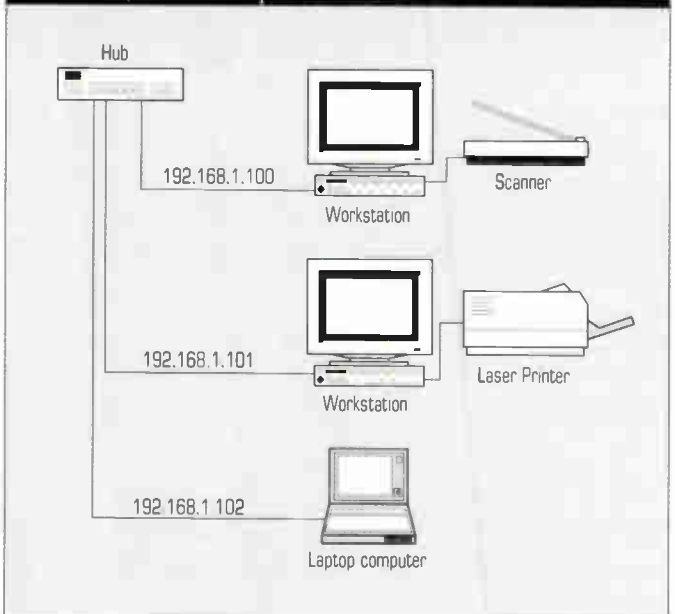
Most cable operators give their subscribers an option to connect additional computers to the cable modem for about $5.00 each per month. This option requires a home network (see Figure 2, page 126). The hub is connected directly to the cable modem and each additional computer is assigned an IP address by the cable company. Customers are allowed to connect up to three computers in this manner.

Some subscribers prefer not to pay the additional $5 a month, or they may need to connect more than three computers to the cable modem. Two options are available to them: dedicate one computer (a server) to act as a router (see Figure 3, page 126), or install a dedicated router (see Figure 4, page 126).

The server configuration requires the computer to be on all the time the home network is active because it serves as the interface or bridge between the home network and the wide area network (WAN) or Internet. Additionally, this computer needs two NICs, one to connect to the cable modem and the other to connect to the hub (home network). The hub then sends all data to all computers. Some may see this as a reduction in the overall speed of the network because all network traffic is sent to every point in the network, thus sharing the network capacity among all computers.

The router configuration is probably the better of the two options. A four-port router costs about $200, and does not need a hub because four computers may be

FIGURE 1 HOME NETWORK



> Common Home Networking Terms

Cable modem: An enhanced network interface card (NIC). It has an address and captures and rejects information just like an NIC. Unlike the NIC, its input is in the form of RF through a coaxial connection, and its output is data through an RJ-45 connection. It also may be controlled from the headend (turned on and off).

DHCP: The acronym for dynamic host configuration protocol. DHCP allows the headend server to dynamically assign IP addresses to users. DHCP also assigns the subnet mask, gateway address and domain name server (DNS) addresses to the users. This is advantageous because any changes made to the network automatically are updated to the users.

Hub: Similar to a splitter/combiner. It is the network computer where many circuits are brought together and either sent back to other computers on the network or multiplexed into a single connection to be connected to the wide area network (WAN), hybrid fiber/coax (HFC) network or Internet.

LAN: The acronym for local area network, which in this case is the home network.

Network interface card: Provides the physical connection between the network cables and the computer. NICs are now available in an external universal serial bus (USB) version.

Router: An interface, or bridge, between two networks. Routers are available in single-port and multiple-port configurations. Routers optionally can act as a firewall: a computer through which all incoming and outgoing packets must pass and only authorized packets are allowed. The router does not have the capacity to store any data except for its own configuration.

Server: A computer used as a repository and distributor of data. The server also may serve as the interface, or bridge, between two networks.

WAN: The acronym for wide area network, which in this case is the HFC network or Internet.

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FIGURE 2 | TWO COMPUTERS WITH TWO IP ADDRESSES

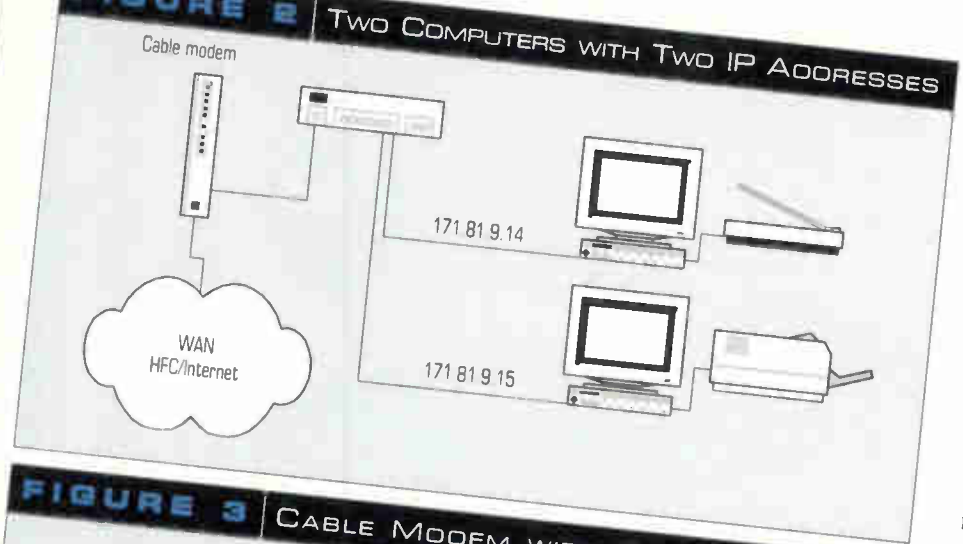


FIGURE 3 | CABLE MODEM WITH ROUTER

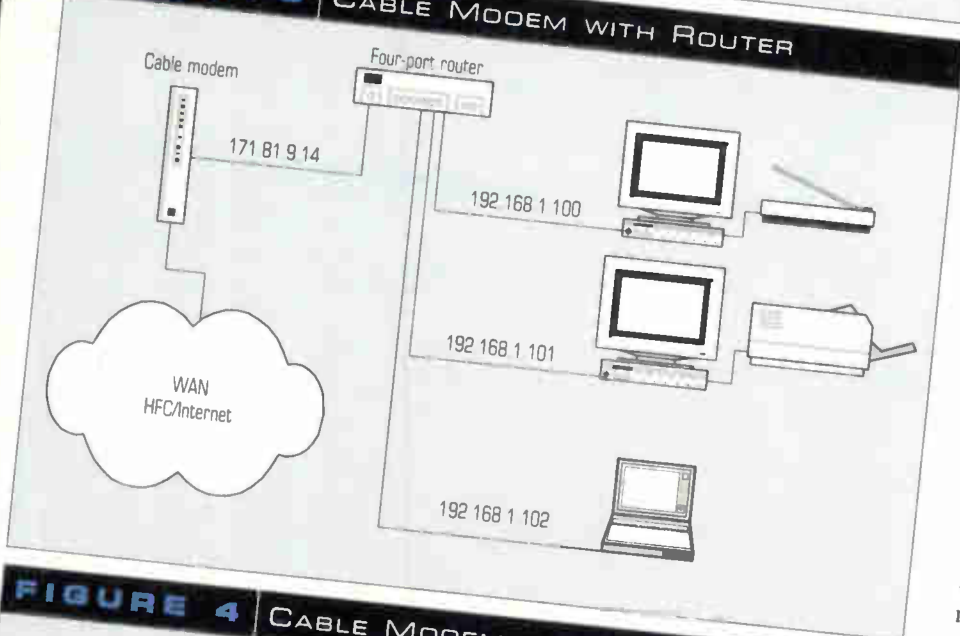
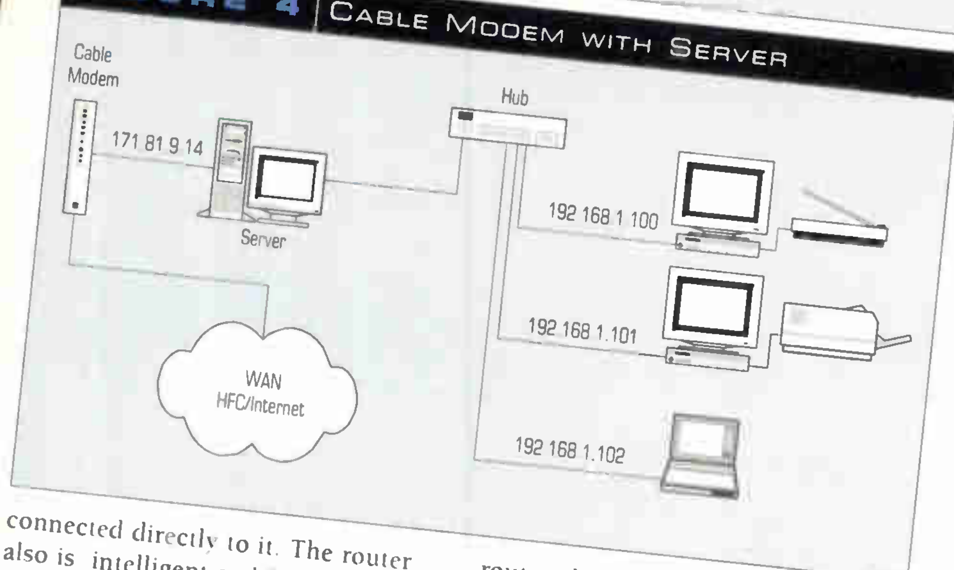


FIGURE 4 | CABLE MODEM WITH SERVER



connected directly to it. The router also is intelligent and "routes" data only to the destination computer. If a one-port router were installed, it would need to be connected to the home network through a hub. The router also may integrate firewall capabilities, which are an additional software cost with the server configuration.

On the Internet or wide area network (WAN) connection, the router takes on the identity of a computer, which the cable company has authorized for use with the cable modem. On the port connections (home network side), the router acts as a DHCP server and assigns IP addresses to the network computers connected to it.

Information requests from the user's computer are routed through the server or router to the cable modem. The responses from the Internet are routed back from the cable modem through the server or router to the requesting computer.

After contacting several cable operators, it seems that all of the configurations discussed are allowed, but generally are not supported by technicians or customer service reps. That's not surprising really, as a novice could go to Best Buy to purchase the equipment needed for a home network, not know how to install it, and spend hours on the phone with your call center trying to figure it out.

But, those customers will need information that the technician has in order to complete a cable modem install. Rather than implementing a totally hands-off policy regarding home networks, it would be beneficial to familiarize your technicians with the information they'll need to give the customer. All of the information is the same as for a single computer install and includes: computer name, domain name, proxy server, mail server, news server and gateway.

While you may not yet be ready to support home networks, the growing proliferation of such networks makes it essential that broadband technicians can intelligently provide users with the network information they need to complete the modem install. And, it will enhance your customer service. CT

Tony Ghaffari is manager of applications engineering and training for C-COR.net. He may be reached aghaffari@c-cor.net.

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Set-Tops Fight the Battle of the BULGE

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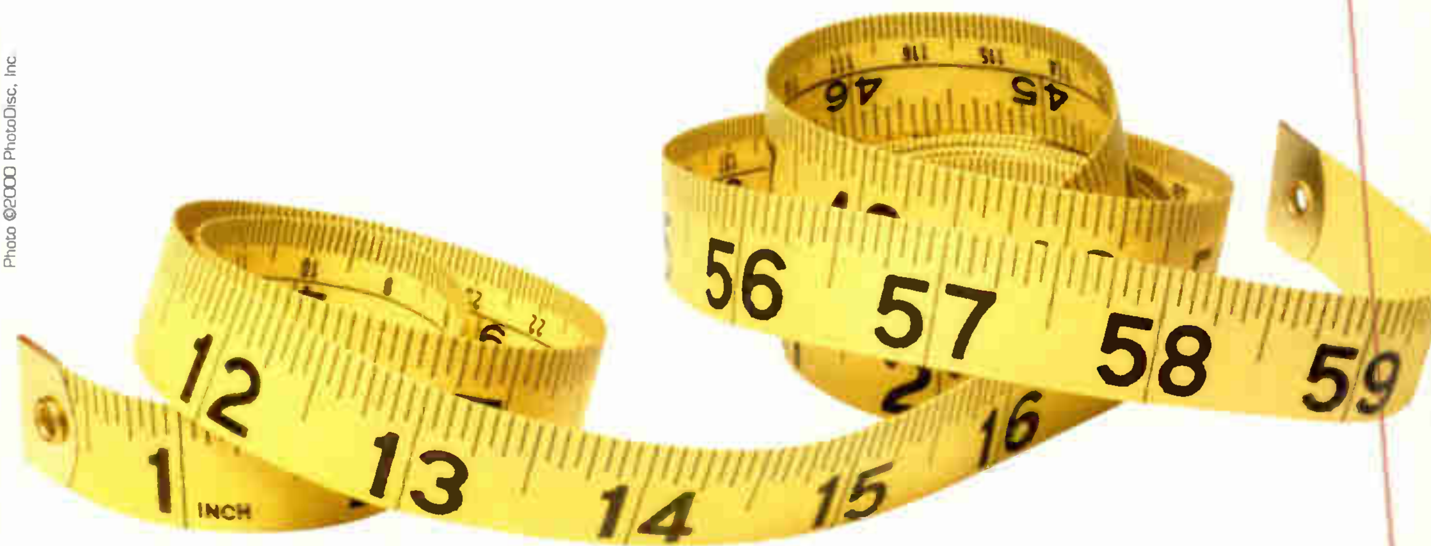

What's in Vogue—Fat or Thin?

By Arthur Cole

The cable set-top is poised to become a key component of consumer equipment, and the industry is gearing up by tailoring new hardware, software and standards for it.

Original photo ©2000 PhotoDisc, Inc.

BOTTOMLINE

> Evolving Set-Tops

Will the future cable set-top box be an ultra-fast gateway device delivering a wide array of services and features directly from on-board memory? Or will it de-evolve into a stripped down thin-client device running applications resident on a headend server?

At the moment, set-top manufacturers are focused on boosting the power of the machine to house the necessary apps for video-on-demand, Web access, media streaming and others. But there are growing legions of software developers and interactive TV platform developers who support the thin-client model in the fashion of most networked computers these days. Such an approach will allow a lower-cost of entry to most users and will make more efficient use of the cable infrastructure.

But the idea of the cable set-top evolving into a home gateway device—thus requiring more power—is appealing. By pushing the set-top in this direction, the cable industry could emerge as the dominant player in the broadband future because just about all digital devices—phones, PDAs, modems and so on—will have to route signals through the set-top in order to communicate with each other.

Regardless of how things evolve, it is clear that the need for standards will continue. The current focus is on middleware, the layer of software just above the operating system that launches the different applications. CableLabs is already ahead of the game with the soon-to-be-completed OpenCable Application Platform (OCAP) effort.

No matter how the hardware and software details are worked out, expect the set-top to be a key piece of consumer equipment for some time to come

TABLE 1 Set-Top Progression Plans*

Device	Data Processing	Memory	CE Interfaces
DCT-2000	n/a	RAM 6 BMB	n/a
DCT-5000	300+ MIPS	RAM 14+ MB HD 1.08 GB	S-Video SPDIF (AC-3) Ethernet USB PCMCIA IEEE 1394 (optional)
Explorer 2000	108 MHz	RAM 16 MB	Ethernet USB
Explorer 2100	130 MHz	n/a	USB
Explorer 3000	108 MHz	RAM 24 MB	Ethernet USB
Explorer 3100	130 Mhz	n/a	USB
Explorer 6000	480 MIPS (dual CPUs)	RAM 16+ MB HD 40 GB	Ethernet USB Dual IEEE 1394

*According to a Phillips spokesman, the company custom designs its boxes for individual deployments, and therefore does not have a product line progression.

toward more sophisticated set-tops or less—it is clear that consumers will be able to pull down an ever-increasing array of services from that little black box on top of the TV. Most people might not realize it yet, but it is the key to the broadband future. CT

Arthur Cole is a contributing editor to Communications Technology. He may be reached via e-mail at acole602.aol.com.

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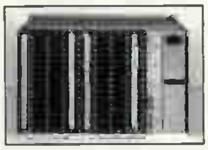

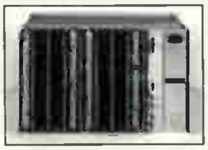

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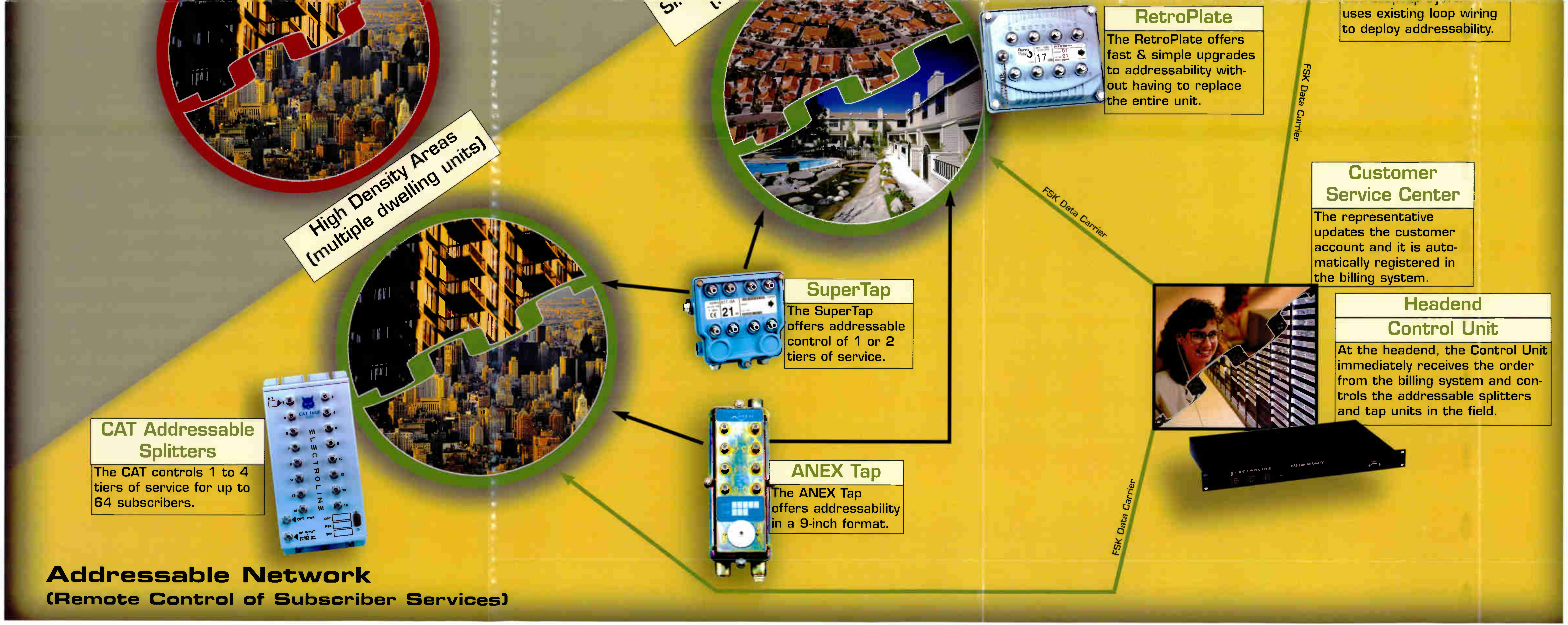

SAVINGS: \$120 to \$200/truck roll for extra technical staff time.

4. COST: DELINQUENT ACCOUNTS & HOOK-UP DELAYS

PROFITABLE SOLUTION: With its capability to interface to all CATV billing systems, the Electroline Addressable System is able to instantly disconnect delinquent accounts and to reactivate them just as easily. Plus, instant activation eliminates new customer hook-up lag time which typically takes 4 to 6 days.

REVENUE INCREASE: Immediate billing comes with instant connection (\$30/month or \$1/day/subscriber). Plus, the threat of losing customers during hook-up waiting periods is no longer an issue.

SAVINGS: \$60 to \$100/truck roll. Truck rolls are not required to disconnect delinquent accounts.

5. COST: LOW RETURN FROM PROMOTIONAL EFFORTS

PROFITABLE SOLUTION: With the Electroline Addressable System's port/subscriber management, targeted marketing promotions are less costly and more effective. The operator can offer potential customers free cable service for a trial period by remotely turning on their tap ports. Each new subscriber can be immediately added to the operator's subscriber list.

REVENUE INCREASE: Results indicate that this type of promotional activity increases subscriber count by 2% to 6%.

SAVINGS: \$60 to \$100/truck roll. Truck rolls are not required for temporary connections/disconnections.

Communications Technology

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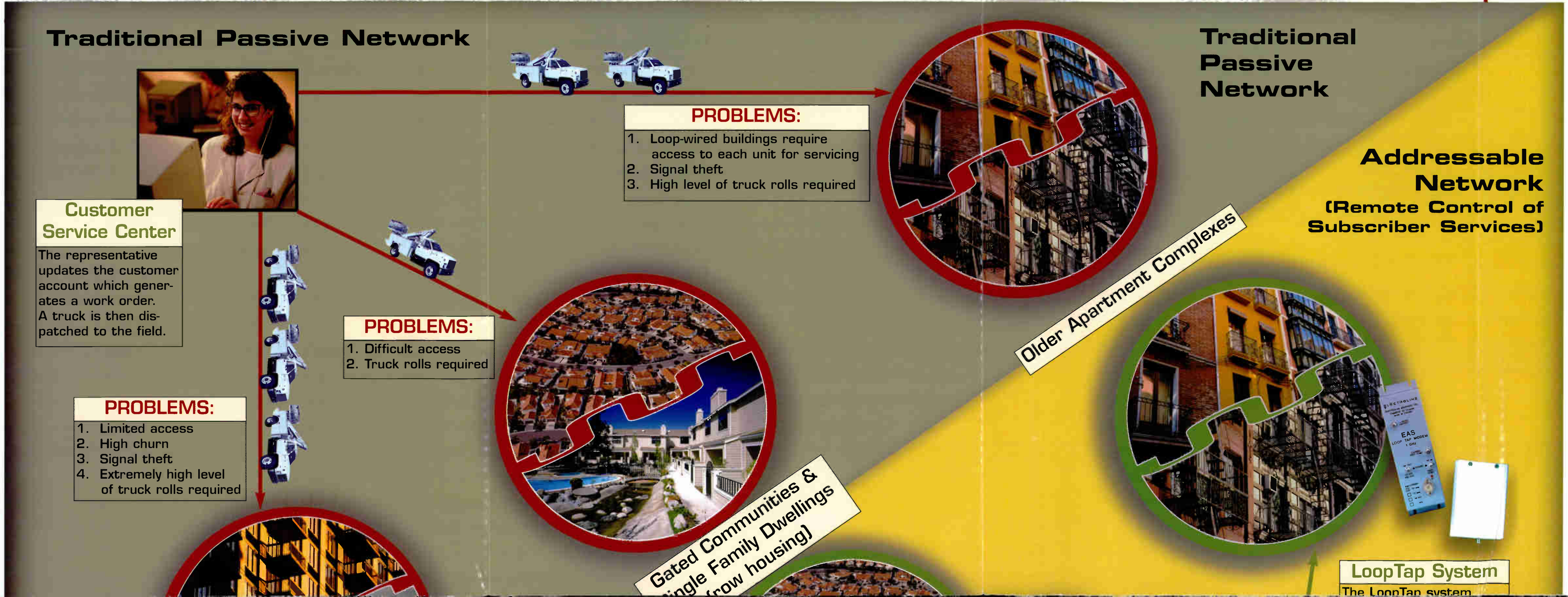
Maximizing Cable Network Operations To Increase

Maximizing Cable Network Operations To Increase Profit$

The Differences Between Traditional & Addressable Networks



5 Ways to Automatically Increase PROFIT$

1. COST: SIGNAL THEFT & DISCONNECTION ERRORS

PROFITABLE SOLUTION: To reduce signal theft, Electroline's addressable tap ports provide signals only when authorized by the cable operator's billing system. In addition, the system's remote operation can immediately disconnect tap ports of closed accounts to prevent disconnection errors/omissions by technicians. Services can no longer be stolen by simply connecting a loose drop cable or by removing an obvious security device.

REVENUE INCREASE: Converting unauthorized connections into paying subscribers represents an increase of \$30 to \$50/month/subscriber. With enhanced services, this value is substantially higher.

2. COST: TRUCK ROLLS TO HIGH CHURN AREAS

PROFITABLE SOLUTION: The Electroline Addressable System's ability to remotely control subscriber services eliminates the task of having to roll a truck for service connections or disconnections.

SAVINGS: \$60 to \$100/truck roll.

3. COST: SUBSCRIBERS IN DIFFICULT ACCESS AREAS

PROFITABLE SOLUTION: With the Electroline Addressable System's off-premise management, difficult access areas such as gated communities or rear easements, no longer require physical access. The extra time to gain access to this type of premise's tap is eliminated.

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The cable set-top box of the future is going to be an extremely powerful machine with blazingly fast microprocessors and ever-increasing memory capabilities that will act as the central switching station for virtually all of the consumer's telecommunications needs.

Or it will be a low-cost, dumbed-down piece of hardware with zero memory and only minimal processing capabilities that allows consumers merely to tap into the headend-based server where all the real network intelligence lies.

Or it will be something in between. Or all of the above. The fact is, no one really knows.

But no matter how the set-top evolves in the coming years, there is little doubt that consumers will be able to tap into an increasingly diverse set of applications through what is now considered to be a glorified channel-changer.

"The concept of numerous types of set-tops out there at the same time is probably accurate," Mark DePietro, senior director of marketing and systems engineering at **Motorola**, says. "Some will be clearly basic devices that will be used just to watch TV. Others will have more capabilities."

Set-tops bulk up

Today's current set-top models, most notably Motorola's DCT-2000 and **Scientific-Atlanta's** Explorer 2000, have enough processing power and memory for video-on-demand (VOD), Internet access and other basic applications. But take a look at the specs for the up-and-coming DCT-5000 and Explorer 6000 models (see Table 1, page 131), and suddenly you're vaulted into the realm of full-screen streaming media, online gaming, virtual VCRs and a whole slew of advanced services not even imagined yet.

"We see (set-tops) becoming more sophisticated as time goes by," Martin Gordon, spokesman for **Philips Electronics**, says. "Watch for more and more technology making its way into the set-top."

Of course, the central question is: Are consumers willing to pay top dollar for the hardware to get these services? The set-top manufacturers are betting they will. But there are others in the cable industry who argue that there is a better and cheaper way.

Clients slim down

By modeling the cable system on a thin-client architecture, in which a relatively simple set-top runs applications resident on a headend server, cable operators will be able to lower the entry cost to new digital subscribers and make more efficient use of the digital network.

"If you look at all the problems with operating systems and chip sets, designing thickness for the purpose of creating a TV browser doesn't work well at all," says Michael Collette, senior vice president of marketing at **ICTV**, a developer of interactive television platforms. "The dual-client or headend-based solution allows you to work in a standard environment and define the set-top as predominantly a display device."

This isn't to say that Collette believes set-top development should be frozen. He says there are plenty of areas in which the set-tops of the future could be improved, such as adding a second moving picture experts group (MPEG) tuner for picture-in-picture and graphic overlay purposes. A built-in cable modem would be a good idea, as well, he notes.

Gorging on gateways

The question as to what future set-tops could or should be is further complicated by the very term 'set-top.' Today, an analog set-top is used almost exclusively to switch cable television channels. First-generation digital models introduce interactive services, text and graphics, instantaneous video-on-demand and other services that are still largely coming directly from the cable system. But some designers say the set-top is destined to extend beyond its role as an advanced interactive tool to become a central home networking system through which customers may control other digital devices.

"As things evolve, the set-top will become a gateway that brings the broadband network into the home," Tony Wasilewski, chief scientist at Scientific-Atlanta, says.

Through wired and wireless connections, a customer could surf the Internet for downloadable music files, save them to an MP3 player in the car, forward e-mail to a personal digital assistant (PDA) still in the overcoat pocket and even check to see how the roast is doing in the oven. Talk about your ultimate couch potato.

The skinny on standards

Of course, all of this will take a certain amount of cooperation among leading hardware and software players. Fortunately, the cable industry has a good start with the OpenCable standard. But as in any industry, the continuous march of technological progress will require new standards

Viewers may surf the Internet using set-tops such as Scientific-Atlanta's Explorer 6000 (right) and Explorer 2000 (far right).

if the consumer is to have any hope of plug-and-play functionality.

The next level of standardization for the set-top space is middleware, the layer of software on which applications like VOD or streaming media run. **CableLabs** is due to wrap up a middleware specification called OCAP (OpenCable Application Platform) based around **Sun Microsystem's** Java technology. Sun, **Microsoft** and **Liberate Technologies** have been selected as lead contributors to the platform.

Another area of standardization involving the set-top is communication with other devices, particularly if the set-top is to become a gateway device. Advanced boxes like the DCT-5000 and Explorer 6000 already are outfitted with universal serial bus (USB) ports and 1394 interfaces, and set-top manufacturers will have to become increasingly involved in the computer peripheral industry if it hopes to keep up with the market.

Wireless interfaces are also becoming a high priority. BlueTooth and HomeRF are two of the leading standards out there and are likely to be incorporated into the OpenCable and Data Over Cable Service Interface Specification (DOCSIS) specs at some point.

Of course, all of this will be guided by a single overriding factor: consumer demand. Consumers will expect the latest and greatest offerings from their cable company, which will in turn look to the hardware and software manufacturers for the means to provide it.

"Ultimately, the things we build are focused on making new applications or services to generate new revenues," S-A's Wasilewski says. "If we can ID those (applications), we can figure out what technology is needed to make it run."

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Opportunities for Application Service Providers in Cable Networks

Capture New Revenue Streams

By Pablo L. Martinez

The always on broadband access provided by cable networks offers operators the opportunity to be application service providers (ASPs). In part two of our series on the relevance of the ASP model to cable networks, we develop a business case built upon the service models and architectures introduced in part one.

Internet access for e-mail and Web browsing is currently driving initiatives to upgrade cable plants to IP-centric platforms. However, the flexibility and ubiquity of IP technologies give cable operators the opportunity to offer new innovative services not only to residential customers but also to telecommuters, small office, home office (SOHO), and medium business customers. One example is application rental services, where end-users remotely invoke features from applications running on network-centric server clusters (see Figure 1 on page 134).

This network-centric service model simplifies end-user system requirements and maintenance. It provides cable operators the opportunity to offer application services that take advantage of the always on broadband access that cable networks offer. In this role, cable operators become ASPs.

Market trends

According to the **Yankee Group**, the ASP market will grow from $3.1 billion in 1999 to $14.2 billion in 2003, (see Figure 2 on page 134). According to this forecast, Web hosting and e-commerce are the key revenue generators.

A market segment of interest is income-generating home offices. By the end of 2002, **IDC** expects over 30 million U.S. home-office households with someone running a business. About 8.2 million U.S. households will be equipped with cable modems, out of which 6.2 million are expected to be home offices. This represents more than 75 percent of the cable modem customer base.

One of the elements driving home-based businesses to access and have a presence on the Internet is that it serves as a low-cost conduit for revenue-generating opportunities such as e-commerce. Also, the Internet is quickly becoming a strategic portal for business information and research, especially for small businesses, which tend to have a higher percentage of knowledge workers. This type of customer is cost sensitive, prefers to deal with local service providers and expects high-quality customer service. The ASP service model may help cable operators satisfy those needs.

Business case assumptions

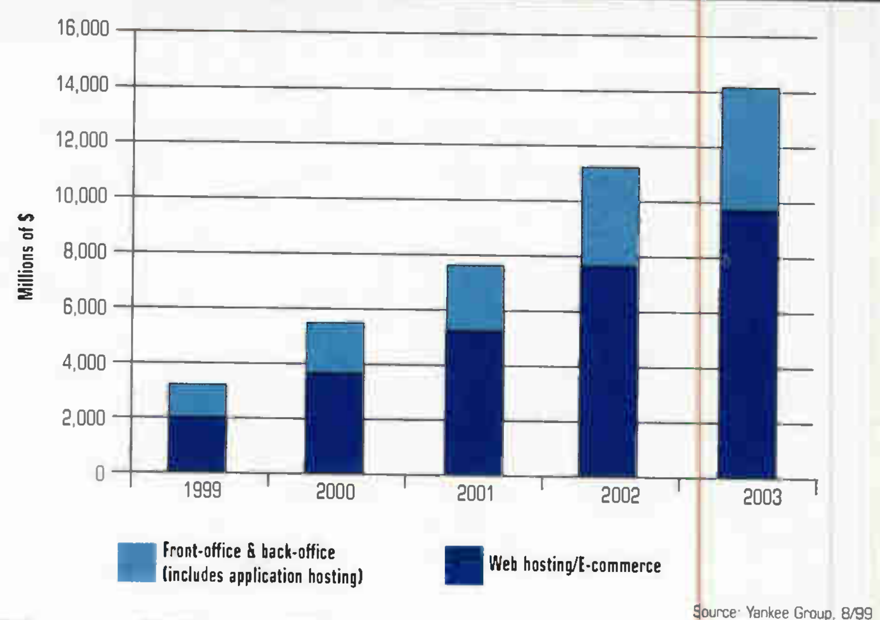
A business case built around a simple scenario is presented in Table 1 on page 138. A cable operator providing traditional Internet access services to residential end-users via cable modem wants to become an ASP. In this scenario, the cable operator built a data center capable of supporting a total of 50,000 end-users (20,000 end-users subscribed to ASP services and the remaining 30,000 end-users subscribed to regular Internet access services).

Another option would be for the cable operator to have a third-party service provider host the data center. This option reduces up-front capital outlays and allows faster entry into the market. But, for the purposes of the business case presented here, it is assumed the cable operator builds its own data center. The rest of the assumptions used to build the business case are presented in Table 1.

The business case assumes that the cable operator offers a simple set of ASP applications. Basic human resource applications, financial management, collaborative computing, sales automation, groupware and e-mail all are offered as a service bundle.

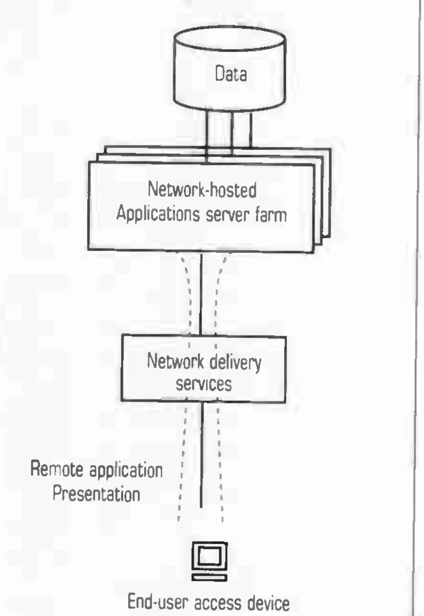
In addition, a simple pricing plan is assumed based on flat user per seat, per month fees. More sophisticated billing schemes are needed to support usage-based pricing either at the application level or at the transaction level. Determining the correct level of billing granularity depends not only on current technological capabilities, but also on ASP business and service arrangements for the application frameworks.

FIGURE 2 ASP MARKET FORECAST



Source: Yankee Group, 8/99

FIGURE 1 DELIVERING APPLICATIONS AS A SERVICE



BOTTOMLINE

Revenue Opportunities in a Network-Hosted World

Cable operators may increase their revenue streams and attract new customers by pursuing the application service provider (ASP) model. The ASP model also:

- Targets the growing home-based business market segment without the need to expand current cable plant footprint
- Helps overcome some of the upstream bandwidth limitations of the hybrid fiber/coax (HFC) plant
- Enables the offering of higher margin, converged voice/video/data applications and value-added service bundles
- Shifts pricing models toward subscription-based and transaction-based schemes, thus generating recurring revenues from end-users
- Promotes cable operators in the value-added chain to differentiate from traditional Internet service providers (ISPs)
- Creates opportunities to expand and complement service portfolios with professional services
- Allows cable operators to partner with other service providers and add value to their service offerings
- Increases end-user satisfaction and retention via a growing selection of hosted applications
- Adapts to end-user's need to switch services while still reducing end-user churn
- Simplifies the process of adding new end-users
- Improves end-to-end security in cable networks

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ASP pricing models

Figure 3 (at right) shows how ASP pricing models may evolve over time. The diagram shows a shift towards subscription-based and transaction models and implies that pricing models eventually may rely less on traditional software licensing.

The ASP service model offers applications to thousands of users on a monthly subscription basis. This requires adapting application-licensing schemes to fit a dynamic recurring monthly fee model. One example is software licensing utilities enabling ASPs to provision applications for rental without incurring up-front license fees. The software licensing utility measures concurrent usage of application software, and the ASP makes monthly payments to application software vendors accordingly. This utility may also apply tiered discounts as the ASP's customer base grows.

The flat-rate pricing plan used in this analysis is based upon application types. The pricing criteria takes into consideration application value and application configuration time. Other pricing plans are in use today, such as charging according to server type and configuration (shared vs. dedicated servers). This type of pricing plan may be broken down further into hardware and maintenance fees. Another example is charging according to end-user access rights to application data (read-only versus editing privileges).

FIGURE 3 Evolution of ASP Pricing Models

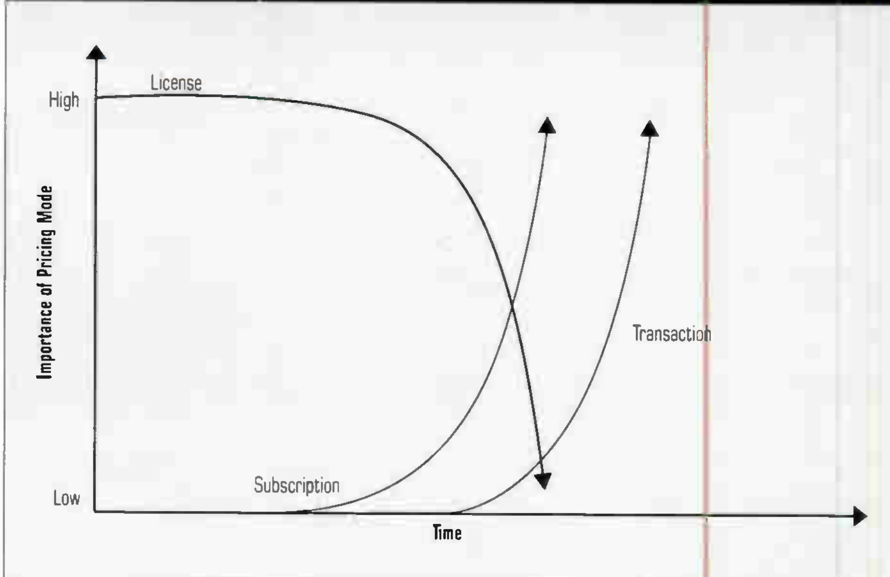
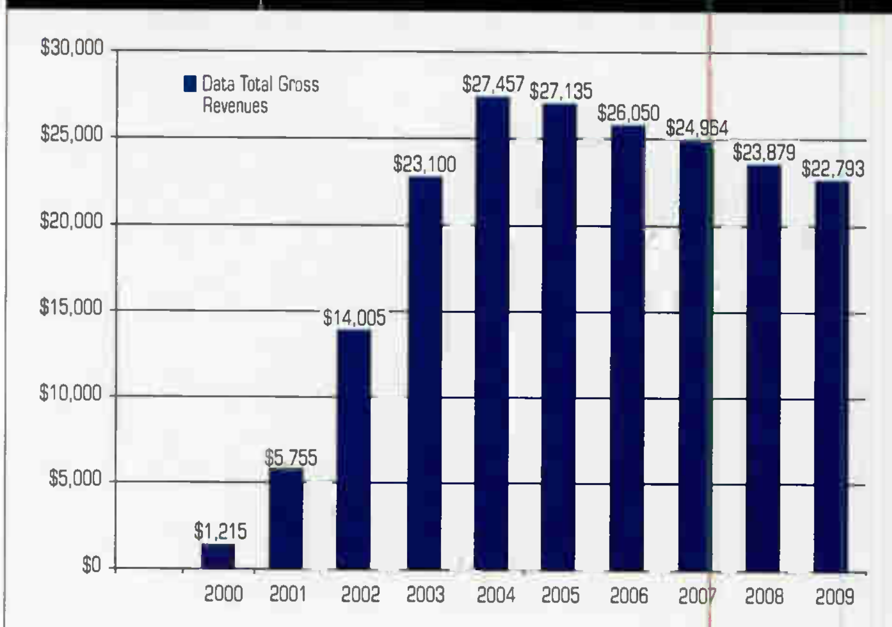


FIGURE 4 ASP Business Case—Gross Revenues



Projected revenues

The ASP service model rests on a pricing structure that generates monthly recurring revenues independent of the pricing plan used. ASPs have opportunities to increase these revenues. For instance, many existing applications are being "ported" to network-hosted environments. In addition, new network-hosted applications are emerging, creating opportunities to expand service portfolios and offer professional services. In fact, the ASP service model allows ASPs to cross-sell solutions from other ASPs. The service model simplifies adding new end-users as well.

"More sophisticated billing schemes are needed to support usage-based pricing."

In this business case example, gross revenues will grow from $1.215 million in 2000 to $27.457 million in 2004 (see Figure 4, above). After the fifth year, gross revenue begins to decrease. This is because of the assumption that there were no plans to expand beyond the capacity of the single data center deployed initially, and that service pricing decreases as technology matures. This means that after five years of steady customer base growth, either new data center facilities need to be deployed or the capacity of the existing center must be expanded. This, of course, depends on the growth-rate profile assumed in the analysis.

Anticipated expenses

In terms of expenses, there are several elements that must be considered. One element is the cost of implement-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ing data center facilities and an improved Internet protocol (IP) infrastructure. Storage costs are particularly important.

Another element is the cost of customizing application software. As mentioned before, customized software does not fit well with the one-to-many ASP service model. The time an ASP spends customizing an application for a customer is time that cannot be applied to serving the needs of other customers. Also, application customization may increase the time it takes to complete application software upgrades. Applications must be designed in ways that optimize their customization capabilities or at least expedite the creation of libraries of pre-customized application templates.

Other expenses include application delivery costs, application service trial costs, best practice implementation costs, the cost of integrating new applications into existing service bundles and information technology (IT) staff costs, such as hiring and training. In terms of IT staff costs, the expense is spread over a growing customer base, thus providing economies-of-scale benefits. IT utilization is "bursty" in nature when dedicated to one company. Once IT resources are shared among multiple customers, their utilization increases and maintains a more stable rate.

The total expense results for the business case are shown in Figure 5 (above). Expenses reach $2.011 million and climb to $6.859 million in 2004. Again, after the fifth year, the expense growth rate slows down considerably, corresponding to the data center reaching its maximum capacity at that time.

Cash flow analysis

Figure 6 on page 140 shows the results of the free cash-flow analysis of the business case. Again, after the fifth year, cash flow decreases, given the assumption that maximum capacity is reached at that point in the data center and there are no plans for additional growth. At the same time, annual service revenues keep decreasing while no additional investments are made. In

FIGURE 5 ASP Business Case—Total Expenses

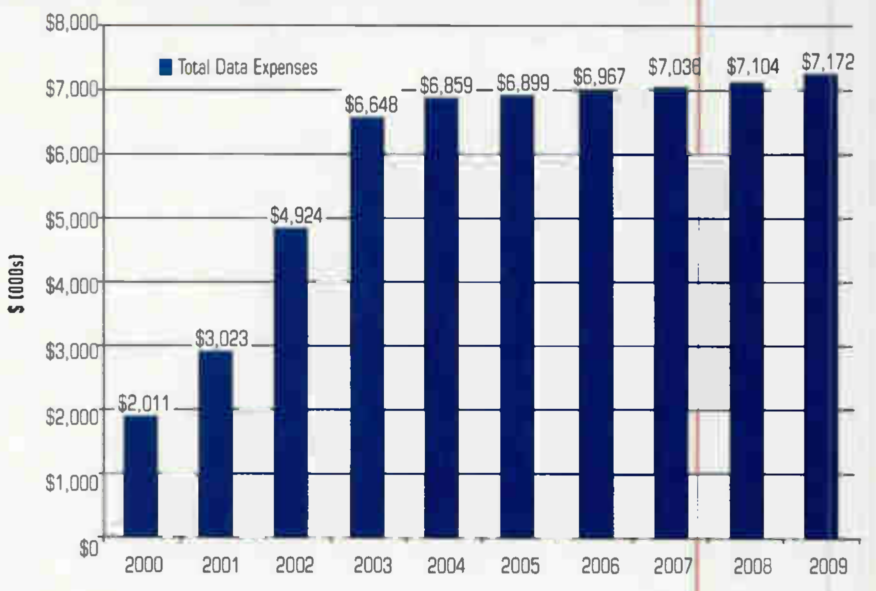

TABLE 1 Cable-ASP Business Case Assumptions

Item	Assumption
Market Size Assumptions	
Initial footprint (i.e., first year)	150,000 end-users
Growth rates	30 percent (years 1-3)
	25 percent (years 4-6)
	20 percent (years 7-9)
General Assumptions	
Weighted Average Cost of Capital (WACC)	12 percent
Terminal rate	4 percent
Tax rate	36 percent
ASP Service Penetration	
Initial penetration	1 percent
Annual increase	2 percent
Maximum	6 percent
Churn Rates	
Initial churn	12 percent
Incremental churn	0 percent (economically stable service area)
ASP Service Pricing	
Service revenue	$150/month/subs
Annual increase	-$5
Partner share	10 percent
Equipment Expense	
CMTS (incremental to support ASP subs)	$150/sub
ASP equipment (1 data center)	$1.7 million ($700K for software, $300K for servers, $400K for data networking, $300K for data storage)
Data Center Expenses	
Recurring expenses per year	$500,000 + 5 percent of gross revenue
Engineering & design	$200,000 (first year only)
Billing and OSS Expenses	
Recurring expenses per year	$250,000 + 3 percent of gross revenue
Customer Service & Support	
Recurring expenses per year	$30 x average number of subscribers
Sales and Marketing Costs	
Recurring expenses per year	$100K + ($150 x number of new subscribers)
General & Administrative	
Recurring expenses per year	$500,000 + 3 percent of gross revenue
Installation Costs	
Installer salary & benefits per year	$100K
Number of installations per technician per year	7,500

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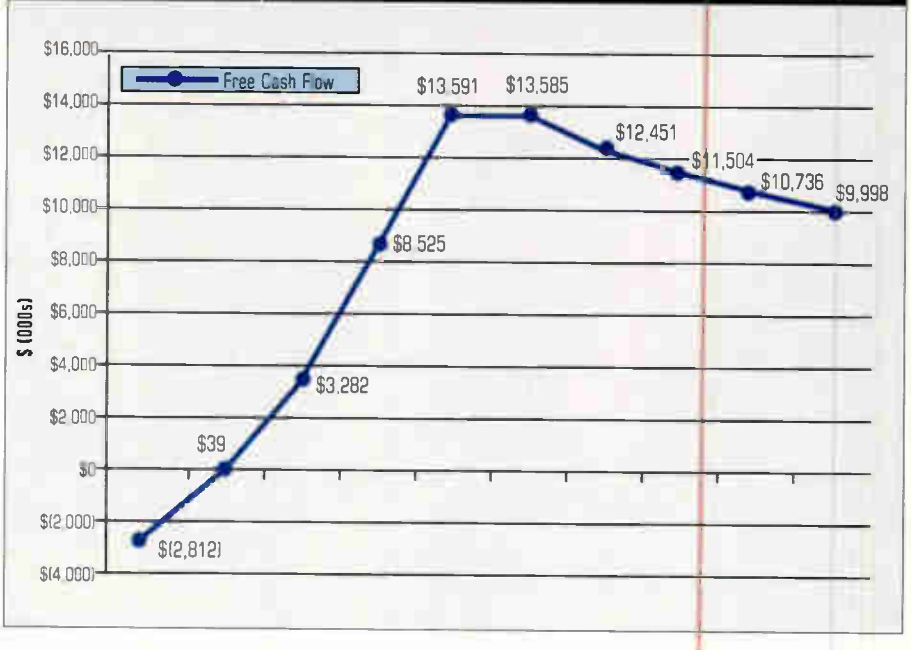
a more realistic scenario, the cable operator may plan for growth of both the customer base and the service portfolio. Also, technological advances that will increase infrastructure capacity and enable more profitable emerging applications will occur.

Figure 7 on page 142 shows cumulative discounted cash flow results of the business case. With an initial investment of $2 million, a relatively simple portfolio of application offerings and limited growth planned, the business case predicts more than $41 million in 10 years with the break-even point reached in less than three years.

The ASP service model and architecture provide cable operators the opportunity to differentiate from traditional Internet service providers (ISPs) and exploit their strengths in offering converged service bundles. This model moves application processing, security and quality of service (QoS) to the network and relays presentation functions to end-user terminals. Security and QoS treatments still are needed to guarantee proper delivery and application response times, but these may be provided in a more efficient and simpler way over the cable access network. End-user equipment gets simplified, which results in a reduction of truck rolls and overall maintenance support.

The ASP service model rests on a pricing structure that generates monthly recurring revenues. It creates opportunities to expand service

FIGURE 6 ASP Business Case—Free Cash Flow



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CTB	-75*	-61**	dBc
IP2	48	70	dBm
IP3	38	41	dBm
Gain	16.5	11.7	dB
NF	3.0	4.5	dB
DC voltage	5	5	volts
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*Measured at 30 dBmV output/channel, 83 channels.
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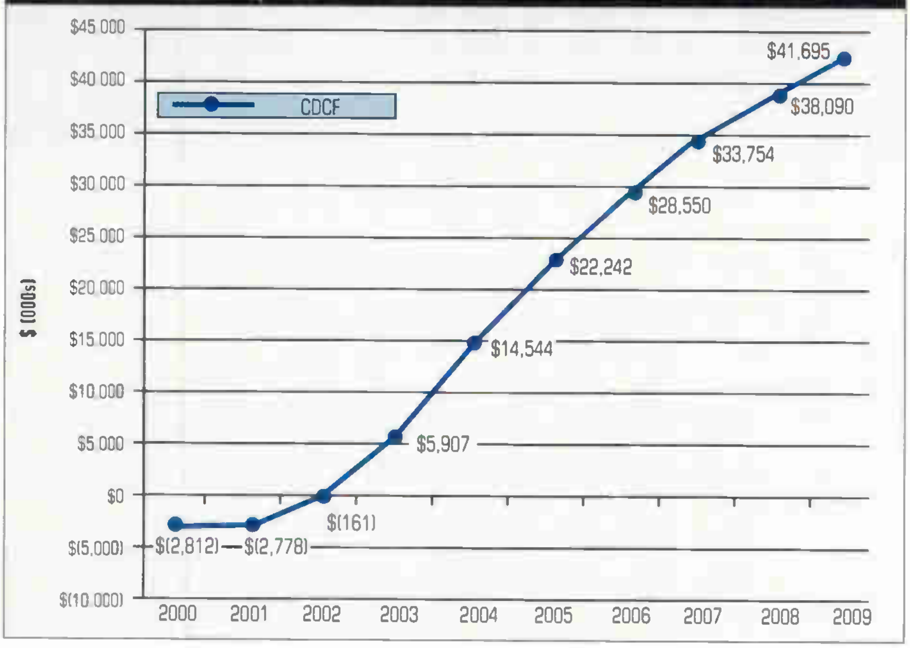
FIGURE 7 ASP BUSINESS CASE—CUMULATIVE DISCOUNTED CASH FLOW (CDCF)



portfolios, offer professional services and to cross-sell solutions from other ASPs.

There are some challenges, however, that need to be addressed. For instance, more sophisticated billing schemes are needed to support usage-based pricing. The level of billing granularity depends on technological capabilities, and the ASP business and service arrangements upon which application frameworks are implemented. Adapting application-licensing schemes to fit a dynamic recurring monthly fee model is another challenge. A third challenge is designing applications in ways that optimize their customization capabilities at reasonable costs.

Once these challenges are addressed, the ASP model will provide cable operators with additional revenue streams and the ability to attract a new segment of SOHO customers. CT

Pablo L. Martinez is solutions manager for Lucent Technologies' Broadband Access Group. He may be reached at pablo@lucent.com

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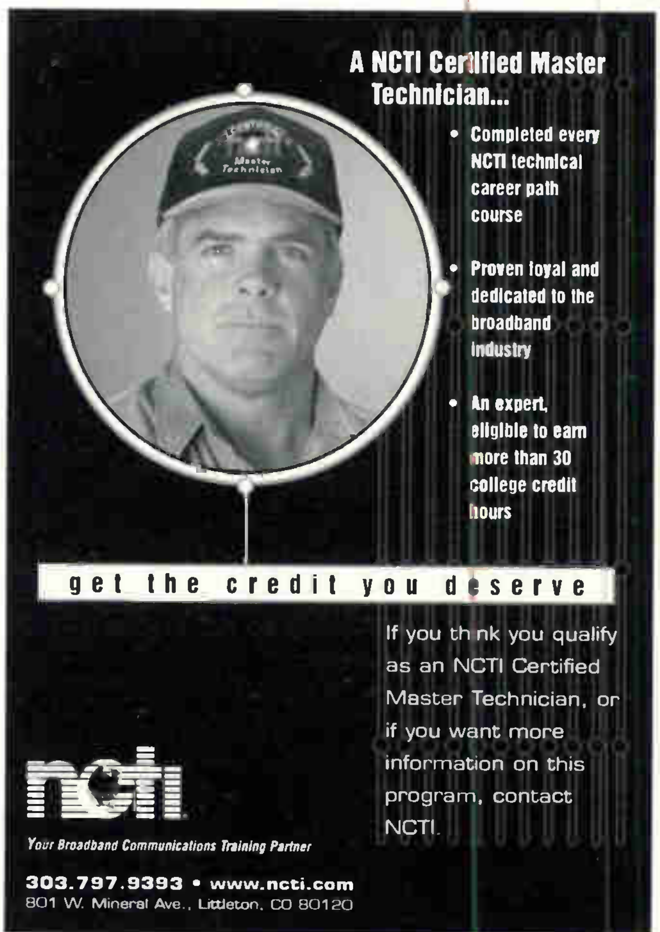

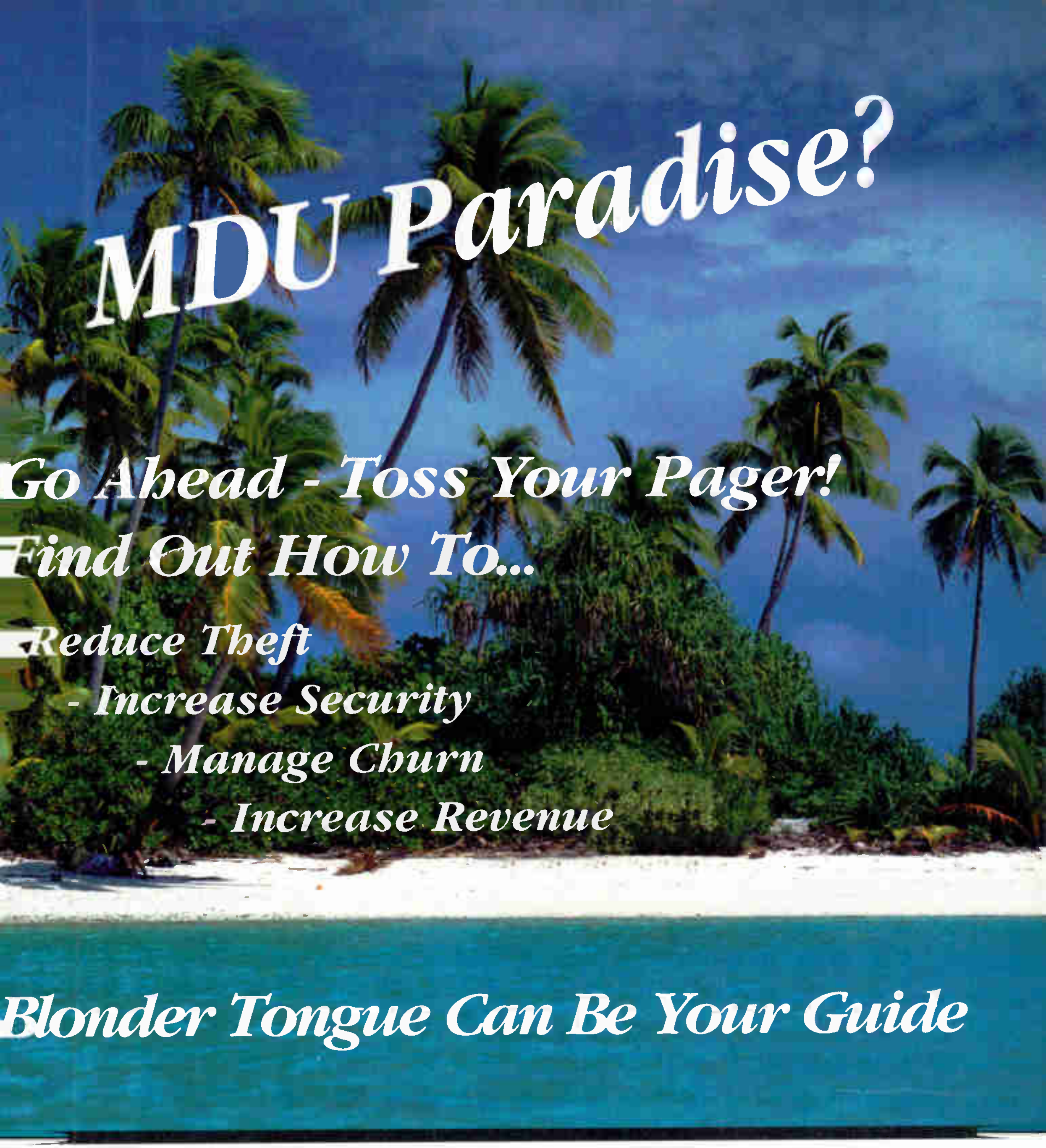

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Upgraded Cable:

What New Cables Offer and Old Cables Hide

By Paul Gemme and Christopher Gemme

Original photo ©2000 PhotoDisc, Inc.

Aging cable plants can hamper modern broadband network deployment, making replacement a necessary solution. How do you decide whether to patch your existing network or plunge into system upgrades?

Each year, highway maintenance is necessary to counter the effects of the environment. Fortunately for us, we are not responsible for making sure there are high-quality paths for transit—or are we? Coaxial cable, the RF boulevard of the broadband network, is the path of transit for providing high quality signals to customers. We must ensure those new services, such as digital video and high-speed data, can travel without damaging the RF vehicle.

While coaxial cable is forgiving, it is still susceptible to the effects of the environment and aging, which even the best system

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maintenance cannot prevent. However, a good maintenance program with a proactive replacement effort may minimize these effects on the system.

Getting older

Even the best maintained plant cannot overcome aging. Cables will start to show signs of deterioration and RF leakage. We have all seen it before—radial cracking of the outer conductor, squirrel chew, projectile holes, etc. The usual repair approach is to cut out the bad section and splice in a new section of cable. This is appropriate if a cable is fairly new, but always consider replacing the span as an alternative.

The more straight splices in a system, the greater the system performance degradation. Also, a repair can lead to early failure in a span, requiring another costly truck roll.

Yesterday's cable

Remember the days of the P1, P2 and CopperGuard? Unfortunately for many operators, these cables are diminishing network capabilities. Engineers make an effort to install the most advanced line gear and headend equipment, but they need to pay the same attention to the existing cable in the plant. While possible, trying to provide customers with an enhanced service broadband network through aged cables is difficult.

Those cables served their purposes well in the days of 300 MHz plants, but were only qualified to that bandwidth. Looking at the history of cable bandwidth qualification from 1971 through 1985, cable was only qualified for 5 MHz to 300 MHz. Then in 1985, qualification was extended to 450 MHz before changing to 600 MHz in 1988. The introduction of new amplifiers and the desire to make use of even more bandwidth changed the upper limit to 1 GHz in 1992, which remains the target today.

It is important to consider that the measurement of attenuation graphed in Figures 1 and 2 on page 148 is the measurement of new cable, not cable installed in a plant 15 or more years ago. For those numbers, you would also have to take into consideration structural return loss (SRL) damage, the change in the velocity of propagation (Vp) of the dielectric, water damage and corrosion. You'll need to perform sample testing of existing cable to the bandwidths anticipated for the new network to determine its capabilities.

When testing your older cable, keep the following in mind:

- Attenuation of cable is most accurately known below the frequency at which the cable was qualified. It is difficult to accurately predict how the cable would perform beyond the test range, although theoretical predictions do exist.
- The use of SRL measurements to evaluate cable is a standard practice. Unknown electrical performance issues beyond the frequencies at which they were originally swept and tested may exist in cables. The testing referred to provides SRL data inherent to the manufacturing process and does not predict field-created SRL.
- Thermal cycling adversely affects the molecular properties of the dielectric, which significantly changes the Vp. Aged cables more than 15 years old that have been tested have demonstrated this with a greater than 1 percent change in Vp.
- Water damage and corrosion have a significant impact on a cable's electrical performance. The resistance of a cable may be dramatically increased, which can create plant performance and reliability issues.
- Mechanical failures, such as radial cracking of the outer conductor, can lead to water migration, as well as signal ingress and egress.

Today's cable

Recent advances in coaxial cable engineering have made the economics of deploying them into the network worth the expense. They provide a more robust signal performance than their predecessors, having been designed with 1 GHz bandwidth, digital video, data, telephony and 90 volt

BOTTOMLINE

> **The Toll of Time**
>
> Aging cables can prove debilitating to the modern broadband networks being deployed today. Electronics engineering has provided the industry with the means to provide enhanced services, and the engineering and design of coaxial cables has kept in step.
>
> To take full advantage of the improvements made in broadband engineering, systems engineers and operators need to remain attentive to the key passive device that their network relies on for delivering the signal. Understanding that aging cables exhibit a plethora of ailments that can negatively affect that network and limit its potential, you need to consider replacing substandard cable as a solution with many benefits.
>
> Cables today are qualified beyond the 300 MHz of their predecessors and must meet tighter specifications out to 1 GHz. Coaxial cable engineering has also gone beyond just improving the electrical characteristics of today's cables and has made significant advancements in mechanical performance. Newer cables on the market today offer great advantages such as lower attenuation in a smaller lighter package, better flexibility, specific powering capabilities and corrosion resistance.

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FIGURE 1 ATTENUATION OF .500 CABLES

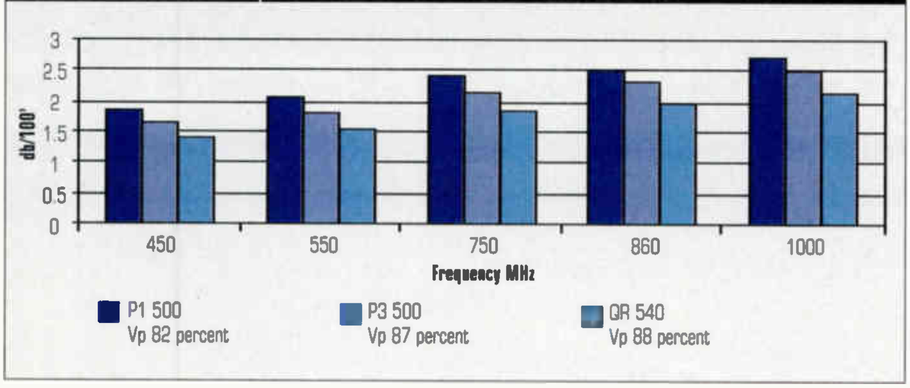
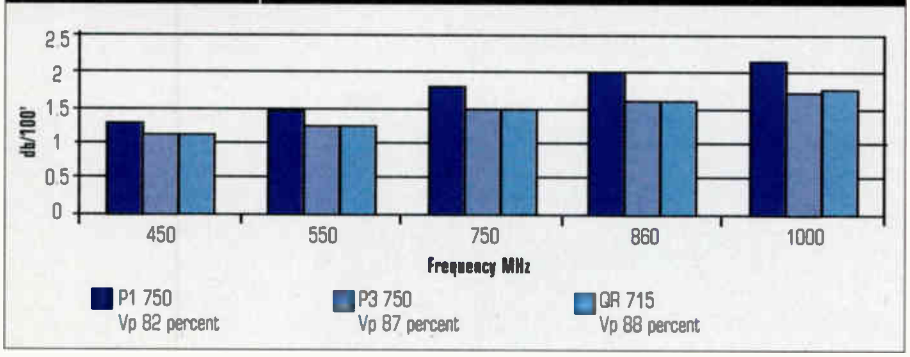


FIGURE 2 ATTENUATION OF .750 CABLES



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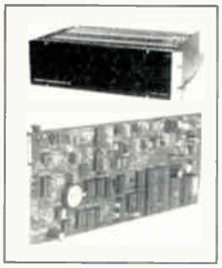

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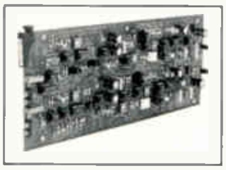

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powering applications in mind.

There also have been significant developments in cable's craft-friendliness. Complete systems have been introduced that consider connectorization critical and provide craftsmen with the ability to perform better and more reliable splicing. The advent of these "low-loss" cables provides a more flexible and longer-lasting cable in a smaller, lighter package.

The introduction of 90-volt powering has demonstrated a need for cables designed specifically for the task of powering today's broadband networks. Also, architectures employing centralized powering have been on the increase. These issues created a need for a dedicated power feeder cable. These cables are available on the market today, and are designed and engineered with a much lower resistance, allowing power to be carried further than ever before.

Drop cables have been particularly troublesome to system operators, especially when it comes to corrosion. Recent advancements in engineering have led to the development of non-corrosive center conductors and shields exceeding the **Society of Cable Telecommunications Engineers** (SCTE) requirements for corrosion resistance. Also available on the market are products meeting the new National Electrical Code (NEC) Article 830 requirements, which enhance safety in the deployment of telephony services.

In our competitive environment, reliability and quality of service is paramount. These new cable choices will allow you to provide these quality levels more consistently, at higher frequencies and with better reliability than was possible in the past. CT

Paul Gemme is vice president of plant engineering for Time Warner Cable. He may be reached at paul.gemme@twcable.com. Christopher Gemme is a technical services applications engineer for CommScope. He may be reached at cgemme@commscope.com.

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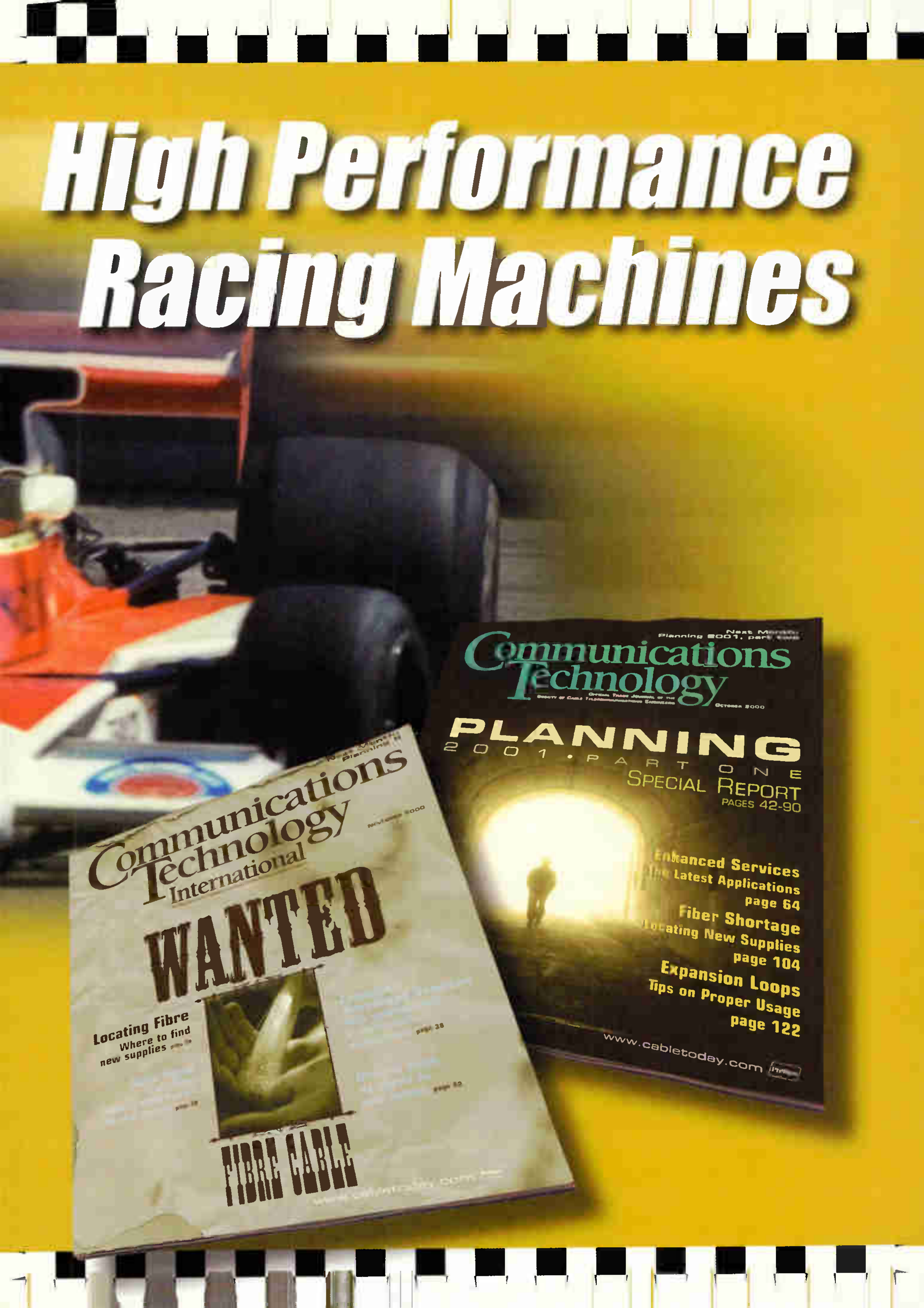

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Digital Signal

Pitfalls, Concerns, Considerations and Suggestions

John J. Downey

In this second installment of this three-part series on digital data, Acterna's manager for broadband training John Downey looks at modulation schemes, explains how new digital service influences existing analog channels and provides tips on placing your haystacks (digitally modulated carriers).

Many engineers don't realize that adding digital signals to the channel line-up could cause composite intermodulation noise (CIN). Because this is considered a distortion like composite triple beat (CTB), some believe that CIN adds on a 20-log basis. Increasing levels by 1 dB could make the CIN ratio worse by 2 dB. Doubling the cascade could make the CIN ratio worse by 6 dB. CIN will add to the regular thermal noise on a 10-log basis to give a worse carrier-to-noise (C/N) ratio for the existing analog carriers.

If we assume the digital channels will be between 550 MHz and 750 MHz, the simple mathematics of addition and subtraction would indicate that the worst area will be between 250 MHz and 400 MHz. This forces us to know the specifications of our transport equipment and to verify how it was specified.

There also could be out-of-band (OOB) noise to contend with, not to mention residual noise from "inactive" devices. Placement of haystacks and analog channels side-by-side could have a debilitating effect. It may be warranted to look at the device (modulator, modem, set-top, TV, VCR and so on) with a spectrum analyzer from 5 MHz to 1 GHz before installation. You may be surprised at what comes out of a supposedly inactive device (local oscillator leakage, harmonics, residual noise, and other spurious signals). Be sure

Carriage:

not to overload your analyzer with too much signal level. You could interpret the readings as a problem that is not actually there.

Anomalies affect digital Differently than analog

In the United States, the Federal Communications Commission (FCC) requires a 43 dB C/N for analog visual carriers on cable systems. Most systems are designed for 48 to 50 dB. You usually don't get much better than 50 dB or so C/N out of the fiber node.

Many believe that if the analog channels look good, then digital will have no problems. Digital data is very robust, and there's no noise hidden in the service like analog channels. It also can survive with a much lower C/N than analog, then reality hits, and you find that this ratio is very dependent on the type of modulation, adaptive equalization, forward error correction (FEC), and other factors.

For example, 256-QAM (quadrature amplitude modulation) requires a 34 dB C/N, assuming thermal noise, to achieve a 10-6 bit error rate (BER). That's one errored bit out of 1 million bits transmitted. This BER is a typical requirement for digital set-top boxes to operate reliably. Also, this is not taking into account intermittent problems that may not be apparent on an analog picture, but could cause slight tiling on a digital picture.

Let's look at one example: A 256-QAM digitally modulated carrier in an National Television System Committee (NTSC) system is 6 MHz wide and operates 10 dB lower than analog channels. The end-of-line C/N for the analog carrier is 48 dB. Digital data is added to the line-up and causes intermodulation noise that makes the carrier-to-composite noise ratio (CCNR) drop to 46 dB. (See Figure 1 on page 154)

The analog channel level is +15 dBmV out of the tap, making the composite noise in 4 MHz (15 - 46) = –31 dBmV. If the digitally modulated carriers' total power is 10 dB lower than the adjacent analog TV channels' amplitude, it would be +15 - 10 = +5 dBmV average power. This C/N ratio is average power to root mean square (RMS) noise in the corresponding bandwidth of the carrier.

Because the digitally modulated carrier has filter roll-offs, it isn't exactly 6 MHz-wide, because of the filter alpha. 256-QAM has a filter alpha of about 11 percent, therefore, 89 percent is the actual payload of approximately 5.4 MHz. The noise in 5.4 MHz would be; –31 + 10*log (5.4/4) = –29.7 dBmV. This makes the C/N of the data 5 – (–29.7) = 34.7 dB. This is very close to the 34 dB cliff we mentioned earlier. If we run the haystacks higher, they will have a better C/N, but there will be more laser clipping and CIN. Once again, we must know the consequences of our actions and know how to strike a compromise.

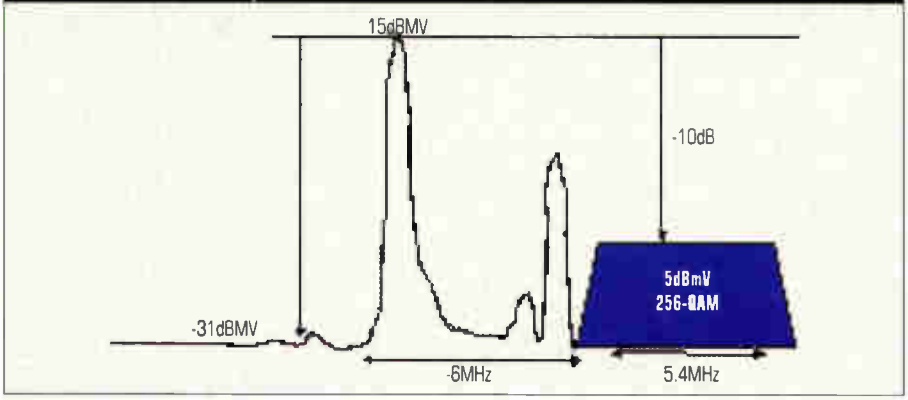
Standing waves And group delay

Another point to keep in mind is the effect of standing waves. Standing waves are created from impedance mismatches that cause signal reflections. These reflected signals will add in or out of phase with the original, causing a standing wave. Any defective component, low return loss connections, damaged cable, connectors, ground block, splitters, etc., can cause standing waves.

Most TVs have a poor return loss of approximately 5 dB to 6 dB, but the fact that we hit it with a relatively low signal (0 dBmV) actually protects us somewhat. Set-top boxes may buffer it also because they usually have better return loss than TVs and VCRs. Analog carriers have lived with this problem with little or no detrimental effect in most situations. Digital data is a different story. Remember, digital channels are either perfect, tiling or out. The difference between perfect pictures and none often is less than 1 dB.

For any analog type of problem (hum, ghosting, venetian blinds and so on) to show up on a digital channel, it must be in the house. Remember, the TV is more than likely still analog, and the digital signal is being converted back to

FIGURE 1 Digital Carrier-to-Noise



analog at the digital set-top box.

Ghosting from reflections and direct pickup (DPU) have a different effect on digital data than on analog carriers. Most customer premise equipment (CPE) will have a channel 3/4 selector switch to eliminate direct pickup from a local broadcaster operating on one of those channels. You should never have a strong, over-the-air broadcaster on both channels 3 and 4 in your immediate vicinity.

Adaptive equalizers are used in digital set-top boxes to mitigate reflection and in-channel tilt problems. Avoid the roll-off region of the amplifiers and diplex filters. Even though digital signals may work at a lower amplitude, they can't compensate for too much in-channel response or tilt. Most digital equipment is specified for < 1 dB per 1 MHz.

Diplex filters and improper amplifier alignment contribute to group delay problems. Chrominance-to-luminance delay on channel 2 is one such problem caused by diplex filters. The color part of the picture begins to smear away from the luminance, or black-and-white part of the picture. Sharp diplex filter roll-offs create group delay, which is aggravated by cascading amplifiers. This will create BER problems with return path data carriers located near this roll-off. Most data equipment is specified for between 70 ns to 200 ns of group delay.

Some suggestions to mitigate these potential problems would be to place narrow carriers near the roll-off, place robust carriers in the low end, stay away from multiples of 6 MHz (8 MHz in PAL systems) because of common path distortion (CPD) and stay away from 27 MHz because of citizens' band (CB). There's not much left here, is there?

Once the decision is made to carry digital services, you must decide where to place the carriers. The haystacks could be placed in a region that causes CTB from the analog channels to fall in the guardbands. (See Figure 2 on page 56) We would lose 1.25 MHz, but this may be good for any OOB noise, which could affect the adjacent channel audio or video. It seems there aren't many systems taking this approach, though.

Understanding modulation

We need to understand how digital data is transported on an analog system. We also must understand the effect of compression and higher order modulation schemes on robustness. This will maximize efficiency and proficiency of the technician who must maintain these networks.

Digital compression (moving pictures expert group, or MPEG-2, for now) can greatly reduce the number of bits per second required to represent a digital video signal with more than adequate perceived picture quality. Typically, 3 Mbps to 6 Mbps have been

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FIGURE 2 DIGITAL CARRIER OFF-SET

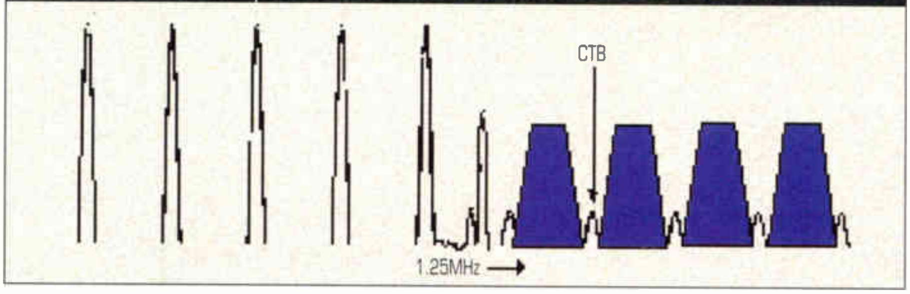
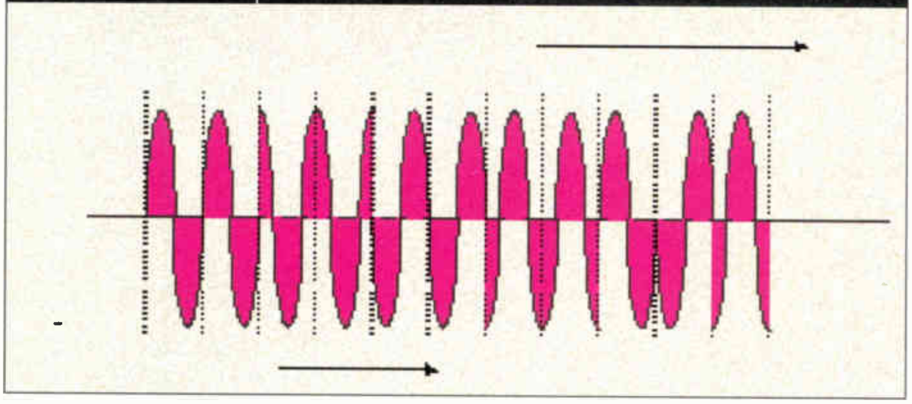


FIGURE 3 QPSK IN TIME DOMAIN



found to be sufficient for most programming material, and new compression techniques (wavelets and fractals) may reduce these numbers even more.

Still, baseband digital transmission would require between 3 and 12 MHz to transport these signals. The excessive bandwidth problem of digital video services is solved through the use of higher order digital modulation techniques. Many don't realize that the word "modem" is actually an acronym for modulator/demodulator. We modulate (manipulate) an analog carrier in amplitude, phase or frequency to represent binary digits (bits), then we demodulate at the other end to convert back to analog for conventional TVs and VCRs. This is the most efficient and economical way to send digital information on an analog plant.

QPSK in the time domain

Looking in the time domain as shown in Figure 3 above, you can see the four phase states of quadrature phase shift keying (QPSK) modulation. Each phase shift is 90 degrees. Every cycle represents a symbol. In QPSK, there are 2 bits per symbol. This would give a theoretical throughput of 2 bits per Hz. Other modulation schemes like QAM utilize amplitude and phase manipulation to achieve more bits for every cycle. This can be confusing because baud is symbols per second, which is different than bits per second bps.

In the case of QPSK modulation of an analog carrier, we may use 6 MHz for the whole haystack, which may actually be 5 MHz of payload because of filter skirts. This would be 5 MHz of bandwidth or 5 Msymbols per second (Mbaud). This also could be interpreted as 10 Mbps because QPSK has 2 bits for every Hz. The only time baud and bps are equal is when the modulation used only has one bit for every cycle (Hz), such as binary phase shift keying (BPSK), frequency shift keying (FSK), amplitude shift keying (ASK), etc.

As shown in Figure 4 (page 158), 64-QAM has 3 bits that go to the in-phase (I) side of the modulator and 3 bits that go to the quadrature (Q) side of the modulator. "Q" is 90 degrees out of phase from "I," hence it would be the Y-axis and "I" would be the X-axis. One of those bits is taken care of by a 180-degree phase shifter, and two of the bits would be covered by a four-level linear attenuator.

What we have is a four-level linear attenuator on the I and Q channel, and a 180-degree phase shifter on the I and Q channel. Bring them back together and we have a signal, or symbol, representing 6 bits. This is a cycle of an analog wave that would be phase and amplitude modulated and would look very distorted. Six bits equal two to the sixth power (64) with regard to symbol landings or different combinations of ones and zeros. >

BOTTOMLINE

> Readying for Digital

Adding digital signals to your line-up could cause composite intermodulation noise (CIN). If we run the "haystacks" higher, it will have a better S/N, but there will be more laser clipping and CIN. Once again we must know the consequences of our actions and know how to strike a compromise.

Note that for any analog type of problem (hum, ghosting, venetian blinds and so on) to show up on a digital channel, it must be in the house. Remember, the TV is more than likely still analog, and the digital signal is being converted back to analog at the digital set-top box.

Some suggestions to mitigate these potential problems would be to place narrow carriers near the roll-off, place robust carriers in the low end, stay away from multiples of 6 because of common path distortion (CPD), and stay away from 27 MHz because of citizens' band (CB).

We need to understand how digital data is transported on an analog system. We also must understand the affect of compression and higher order modulation schemes on robustness. This will maximize efficiency and proficiency of the technician who must maintain these networks.

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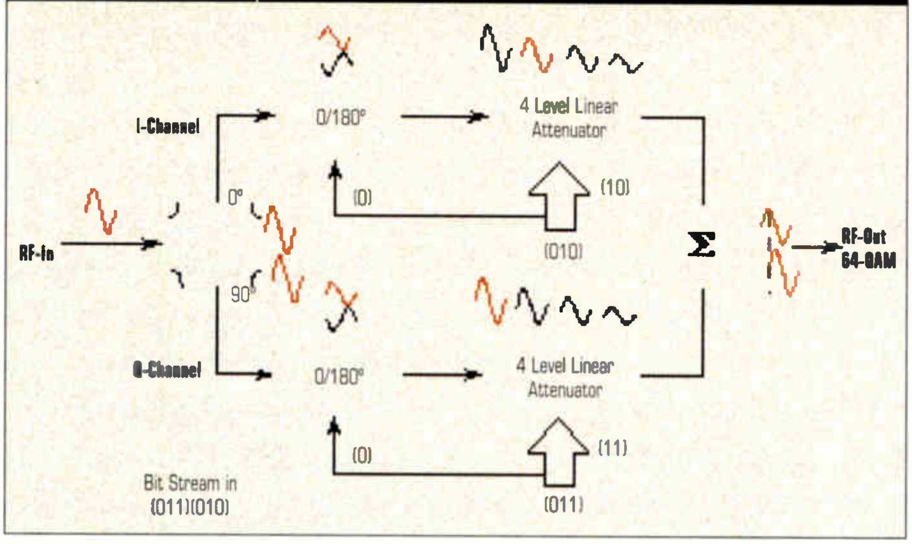
FIGURE 4 64-QAM SIGNAL MODULATION



Understanding the effect this new digital service will have on the existing analog channels eliminates potential pitfalls before money and time are wasted. There are many anomalies in our networks that may affect this new service differently than the analog service. To avoid some of these problems, systems may try a few tricks like placing the haystacks off-set from a standard frequency plan.

The TV set traditionally has been used as a piece of test equipment. Technicians could observe the analog picture or audio quality and make a diagnosis. Now with digital pictures being perfect, tiling or out, we can't use the TV set anymore because there is no in-between. We must use some type of test equipment that can demodulate the digital signal and give good, quantitative measurements, such as a QAM analyzer. These devices show the health of the signal that a TV set cannot.

There may also be problems on the network that have been there for a long time, but have been masked by the relaxed requirements of analog TV sets. A problem may appear on a digital channel that was never noticed on an analog channel. Now we enter another frontier in CATV troubleshooting. CT

John J. Downey is the broadband training manager for Acterna. He can be reached at john.downey@acterna.com.

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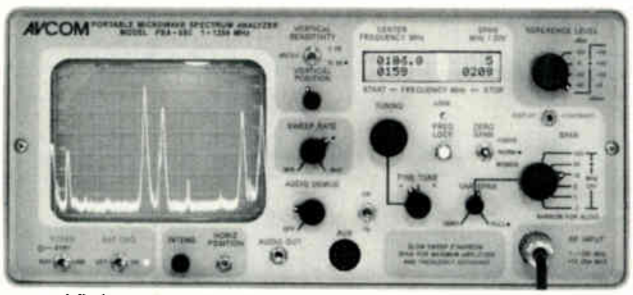

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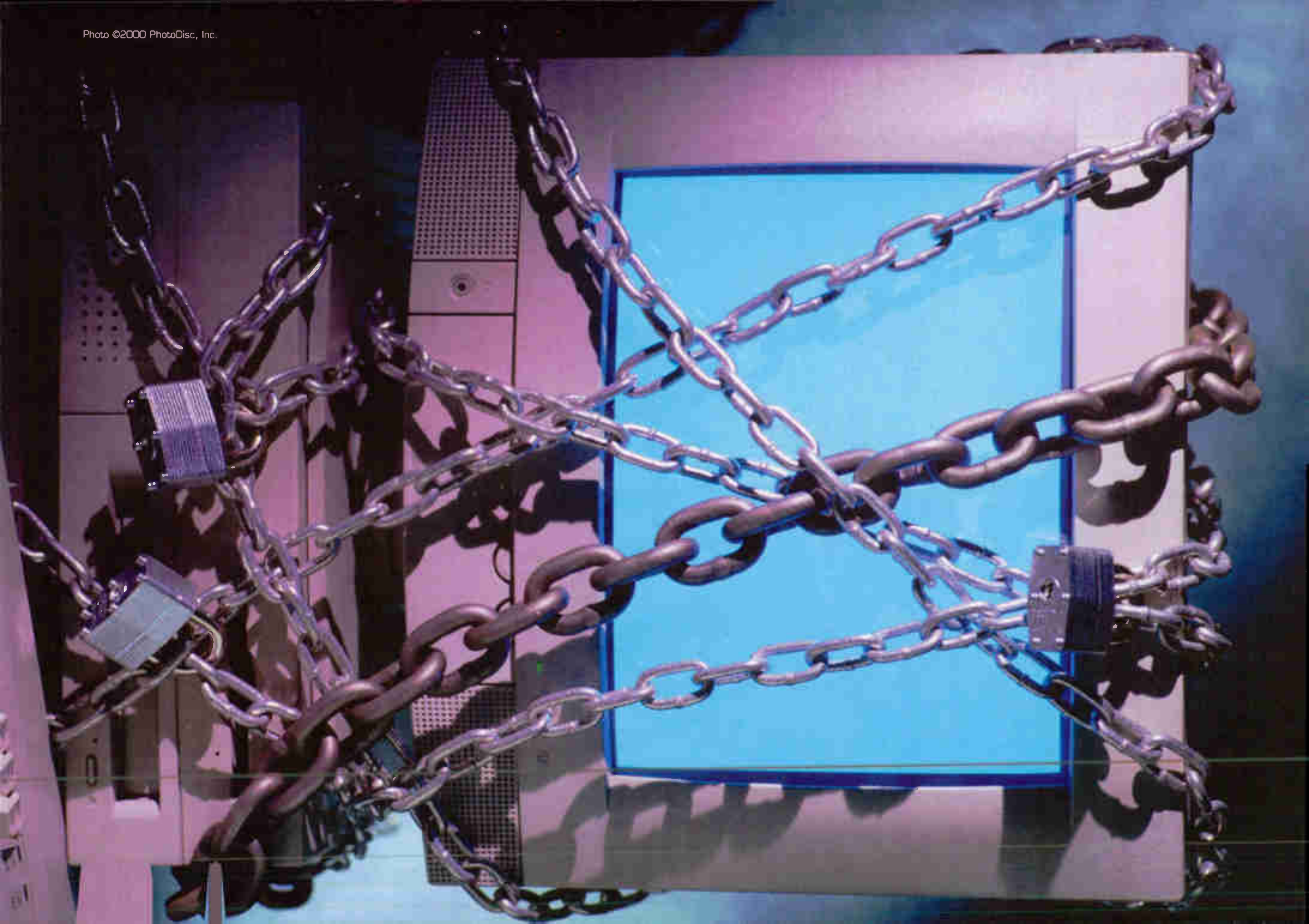


Virtual Private Networks

Cable's New Revenue Opportunity

By Mark C. Rodrick

When it comes to making money, cable operators have focused mainly on the consumer market. Yet a huge opportunity exists in the business sector. As remote offices proliferate, so too will the need for virtual private networks (VPNs) to securely connect telecommuters to the corporate headquarters. By offering VPN services, cable operators can differentiate themselves above mere "transport" providers.

It's no longer enough to be the first to grab market share. Instead, "time to revenue" has replaced "time to market" as a more relevant factor.

And so along with currently providing digital video, digital telephony, high-speed data and other last-mile advantages to a neighborhoods and business complexes, multiple system operators (MSOs) may now use VPNs to generate significant revenues from corporations.

The projections for growth are impressive. The **Yankee Group**, a Boston-based consultancy, estimates that by 2003, 70 percent of all businesses will run 90 percent of their data traffic over VPNs rather than private line services. **Frost & Sullivan** predicts the U.S. market for VPNs alone will reach $18 billion annually by 2004.

In short, a huge opportunity for MSOs to make more money now exists, and you ought to exploit it.

The benefits

VPNs afford an enterprise a secure wide area network (WAN) over a shared network, with all the pros of a private WAN without the expense. A private line network is not a new concept, but a private network over the Internet is new to the market. It offers a new business model for the digital age.

The network itself could be the infusion of an MSO's private backbone and exclusive hybrid fiber/coax (HFC) plant, and what is passed over the public domain of the Internet. Many technologies are involved to achieve the same goal—increased revenues.

MSOs may charge for VPNs with varying levels of management and service level agreements (SLAs). An SLA is a guaranteed level of service based on chargeable criteria and even compensation for nonperformance. Criteria may include latency, packet loss, packet delay, mean time to repair, port availability by percent and various performance guarantees. These services may be leveraged to expand on other value-added offerings that lead to bundling and customer loyalty.

The ability to add IP-based services such as voice, e-commerce, unified communications and Web hosting nurtures that partnership. Product differentiation that is feature-rich and allows for scalability improves margins for the MSO and productivity for the business subscriber. It's more evident that IP networks will function under a different economic model than the PSTN, and as such, the pricing and marketing strategies must be equally different.

The business subscriber

Companies with employees who work remotely from the corporate local area network (LAN) and all the valuable information and resources within it may enjoy the benefits of having a VPN. Enterprises with satellite offices or small office, home office (SOHO) scenarios may be linked securely to their larger entity. Small- and medium-sized businesses with telecommuters also may stay connected.

Those telecommuters will not only be on the LAN as in the office, but also have private branch exchange (PBX) extension functionality. Road warriors will need a dial-in capability, either through an 800 service or a local system offered by the same cable operator. These users may connect to the main entity via an intranet VPN for offices and access VPN for telecommuters and mobile users. All these entities may link to vendors, customers and partners with selective transfer of information and data via extranet VPNs. Outsourced partners may gain access to information on a "need-to-know" basis that is controlled by the business. That access also may be instantly severed by the business if need be.

The Internet economy is reshaping traditional work models. Businesses are merging, and LANs need to become WANs affordably. Resources no longer need to be localized, and information need not be kept within the immediate corporate walls. More employees work part-time or full-time from their homes. The cost savings for the virtual network is significant over traditional private lines as is the overhead savings from supporting office-based employees.

Subscriber requirements

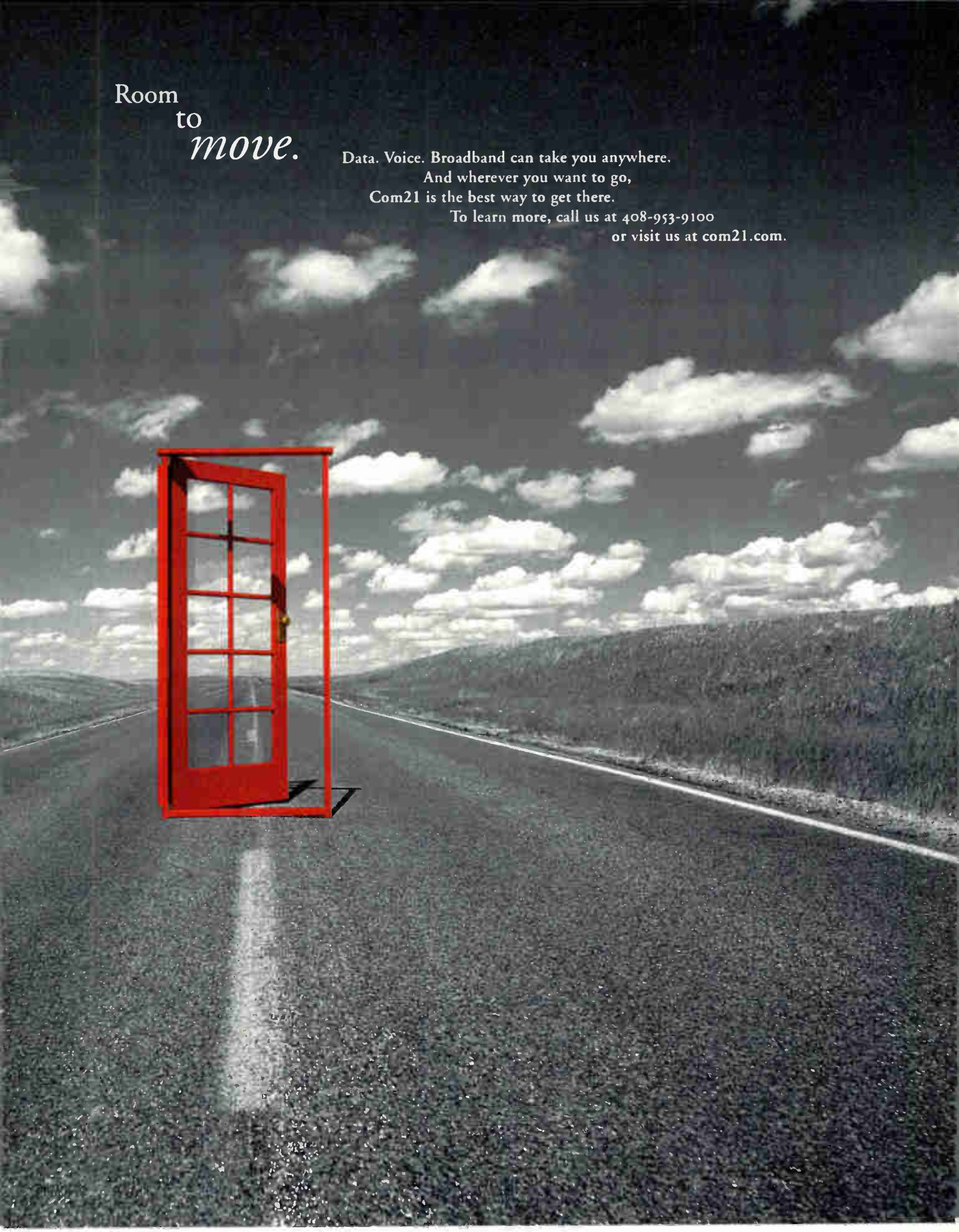
Let's assume subscriber requirements are demanding. What's it going to take to lead that subscriber to success? Basically, your service must be

> Benefits of VPNs: Quality of Service

Subscribers purchasing virtual private network (VPN) services want to be confident that when the shared hybrid fiber/coax (HFC) network gets congested, their employees will continue to receive at least a minimal level of service. Working together across multiple routers, the quality of service (QoS) mechanisms below complement each other through the VPN. They create a comprehensive end-to-end bandwidth management solution that must be integrated throughout every link of the VPN to be effective. Single-point solutions cannot ensure predictable performance.

QoS mechanisms include:

- **IP precedence** uses three bits in the IP header to indicate the service class of a packet. Enforced through the core, this class is set at the edge of the network.
- **Packet classification** provides the foundation for bandwidth management by classifying traffic for downstream application of QoS bandwidth management policies within the VPN.
- **Committed access rate** (CAR) enables mission-critical traffic to receive an appropriate share of VPN bandwidth, while limiting the amount of bandwidth dedicated to less critical applications (such as policing). When a threshold is met or exceeded, the network may be asked to take a variety of responses, from queuing packets at a lower service class to dropping them. Classification may be set by the multiple system operator (MSO) at the edge of the network or by the business subscriber and enforced by the MSO.
- **Weighted fair queuing** (WFQ) delivers congestion management and bandwidth allocation among specific applications and allows traffic to be sorted into flows or classes while allocating bandwidth to those flows or classes via sophisticated packet scheduling. Bandwidth allocation is driven by the weight assignments.
- **Weighted random early detection** (WRED) complements transmission control protocol (TCP) in predicting and managing network congestion on the VPN backbone and ensures predictable throughput rates. It is a congestion-avoidance mechanism, set to prevent overloading by monitoring traffic load on an interface, not to manage it. It selectively discards lower-priority traffic when the interface starts to get congested. It's well-suited for avoiding congestion on high-speed backbone links, and it slows down traffic flows before overcrowding occurs. It even slows according to service class, so low-priority traffic is slowed first.
- **Generic traffic shaping** (GTS) smooths out bursty traffic and "packet trains" to ensure optimal average utilization of VPN WAN links.
- **Security** goes beyond sophisticated firewalls. It may be managed by the subscriber at the enterprise or enhanced by the MSO. Its protection of information is based on tunneling at layers 2 and 3 and enables secure private communications over the Internet or any IP network. It integrates key features of VPNs, such as tunneling, data encryption, security and firewalling that provide a secure, scalable platform, to better and more cost-efficiently accommodate remote-access, remote-office and extranet connectivity using public data services.
- **IP security** (IPsec) is an open standard for ensuring secure private communications over any IP network. It ensures confidentiality, integrity, digital certification and authenticity for secure data encryption.
- **Multiprotocol label switching** (MPLS) is used to create an extended address to solve reachability and private addressing issues. Labels are applied at the edge, with no impact on the customer addressing or routing schemes. MPLS is a standards-based technology that was originally based on Cisco tag switching and was later ratified by many members of the Internet Engineering Task Force (IETF).
- **Data Over Cable Service Interface Specification** (DOCSIS) 1.1 will allow for improved upstream and downstream parameters with regards to layer 2 QoS over an MSO's HFC plant via a cable modem termination system (CMTS).



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> ## VPN Revenue Opportunities

A differentiation strategy, as the term implies, is focused on making products and services different and notably better, than those sold by competitors. Cable operators now may offer virtual private networks (VPNs) to business subscribers and their employees at a fraction of the cost of a competitor's private line service. But beyond the lower cost of equipment, implementation and maintenance of such offerings based on Internet protocol (IP), VPNs offer quality of service (QoS) features and service level agreements (SLAs).

Whether the MSO or business manages the network at its respective edge, both have the confidence of a secure architecture across a Data Over Cable Service Interface Specification (DOCSIS) hybrid fiber/coax (HFC) plant. This architecture scales easily as bandwidth demand increases and remains manageable and reliable as both entities grow. Consumers pay more for uniquely differentiated, superior quality products and services. MSOs may differentiate themselves even more now as the service provider of choice.

reliable, secure, manageable and of the highest quality—just as service offered within a corporate LAN. You'll need to provide quality of service (QoS) guarantees (see sidebar on page 162), high network availability with SLAs, fully or partially managed IP VPN services, integrated access VPN and dedicated VPN capabilities along with extended extranets across the public domain of the Internet. All this in addition to the core high-speed Internet access and e-mail capabilities already offered.

There's more. Your network must be scalable so that your business may grow along with your client's business but without expensive rebuilds or upgrades. Let's add provisioning, billing and centralized management, all from the same MSO. Corporations don't just need "me too" transport—they want new services.

It becomes difficult to differentiate your service offering if you provide only basic transport. One frame relay network is the same as the next, and you can't compete only on price. To maintain long-term competitive advantage, MSOs must focus on developing a full range of value-added services on top of their VPN network.

These value-added services that will set an MSO apart from other service providers are all IP-based—such as VPNs, voice over IP (VoIP), Internet protocol television (IPTV), Web hosting, unified communications and virtual call centers, to name a few.

Basic VPN architectures

The choice of which type VPN to use will be up to the subscriber and MSO. A hybrid design using multiple solutions is perfectly viable and may provide a better alternative for the MSO wanting to offer its customers a choice of expanded VPN services. That design architecture may be focused at the customer edge, cable operator edge or a hybrid solution. An MSO or enterprise chooses the kind of VPN its employees may use to access the Internet, and may block that access at any time.

Following is a list of basic VPN architectures:

- **Access VPNs** may link the telecommuter in his SOHO through the MSO's metropolitan area network (MAN) via cable modems on the HFC plant. The client may be software-based or have a hardware secu-

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rity appliance such as a small broadband router. When the MSO manages either method, the subscriber may be assured of SLA and QoS advantages. Cable market projections indicate up to 10 million cable subscribers by 2003 with 10 percent penetration in U.S. markets by 2005. The mobile user may dial in with a software client.

- **Intranet VPNs** may connect the entity via the direct broadband HFC plant as well as wireless point-to-point (PTP), wireless point-to-multipoint (PTMP), or simple wireless bridge connections. Also, the entity may use a private line connection such as T1, 10 Mbps, Ethernet, asynchronous transfer mode (ATM), or T3/fractional T3. Not just for homes and companies, hotels have expressed great interest in cable VPNs and other cable managed services because many hotel guests are telecommuters.
- **Extranet VPNs** connect the same as intranet VPNs to the MSO, but differ in that they link in noncorporate entities such as partners, vendors and customers. These connections may be long-term or short-term, and financial analysis may determine the most viable method.

The hardware vendor equipment usually consists of three or four elements. In general, a VPN has devices like concentrators, routers, firewalls, cable modems, broadband routers and software.

- The **VPN gateway** consists of one or more devices that sit on the customer's premises. It may include the following functionality: tunnel termination, firewall/packet filtering, telecommuter authentication, routing, network address translation (NAT)/port address table (PAT) or channel service unit (CSU)/data service unit (DSU) functions. This component may interface with existing routers and CSUs/DSUs, firewalls, dynamic host configuration protocol (DHCP) servers and lightweight directory access protocol (LDAP) servers.
- The **VPN security appliance** is a hardware-based device that resides at the telecommuter's residence. A security appliance typically handles functions such as initiating a VPN tunnel and hardware-based encryption/decryption and associated keys and/or digital certificates. In addition, this device also may provide routing, NAT/PAT, packet filtering or firewall and other capabilities.
- The **VPN client software** typically is a PC-based software client that processes tunnel management and encryption/decryption capabilities by first initiating a VPN tunnel.
- The **VPN element management system** is characteristically software that resides on a server in the network and can manage multiple hardware and software clients. >

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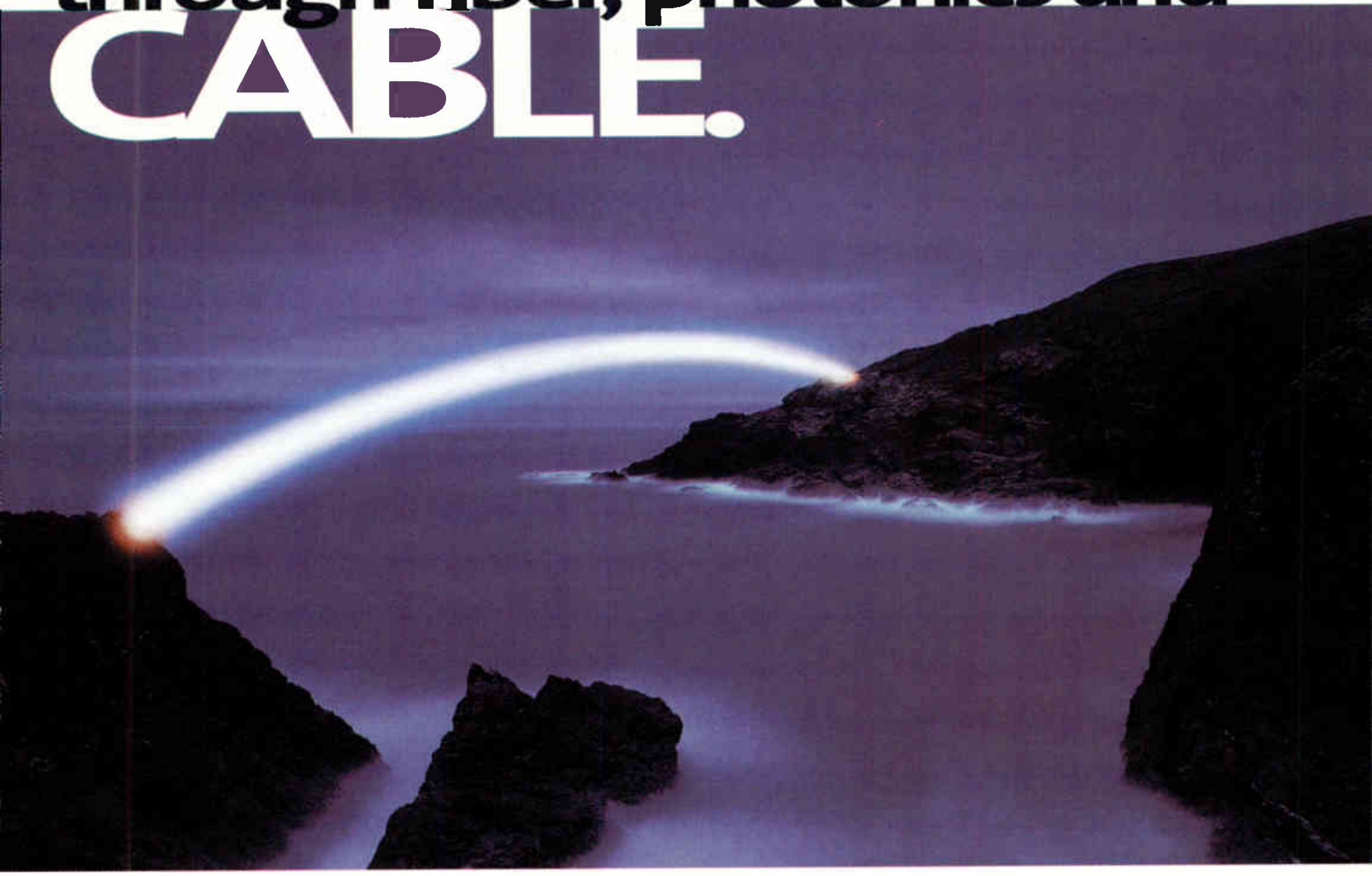

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Adding value

The cable network must offer the MSO and subscriber more than just the technical capabilities of routing packets—it also must offer profitability. By managing the planning, provisioning, operations and billing of your services, the MSO may realize more profitability from its network. The integrated use of management protocols across all platforms in the network provides the MSO with the capability to manage the VPNs for the customer and charge accordingly.

Provisioning an IP VPN service is slightly more complicated than simply provisioning an access port and circuits, but the benefits of providing automated provisioning far outweigh the difficulties.

The impact of adding each new business subscriber or service now must be considered across the total network. Scaling is a major issue to the deployment of VPN services. Traditional private line/network services will not scale well enough to support IP VPNs because of the configuration requirement at every endpoint. The growth of extranets into a vast web, with one enterprise in the middle, requires a scalable solution set that the MSO can provide. This enormous scalability feature is available to the MSO at a fraction of the cost of expensive rebuilds or upgrades of old services and equipment.

Service provider of choice

Because most new services and applications are being developed around the Internet and IP, cable operators may quickly port new services on top of their basic VPN offering, reducing capital and operational costs, while increasing margins. Cable VPNs are access VPNs with the shared infrastructure being a DOCSIS cable network and the MSO's network as a whole.

The building blocks for a VPN service are security, QoS, management, scalability and reliability. Businesses may reduce costs by bundling video, voice and data traffic onto a single service offering or network.

MSOs may generate new revenue streams by developing a range of value-added services in addition to the VPN transport service. Organizations may focus on core competencies while the cable operator manages their IP VPN network. The ubiquitous nature of the Internet and IP-based routed networks will allow businesses to extend their VPNs anywhere in the world via the Internet. All this can be made possible through their MSO. CT

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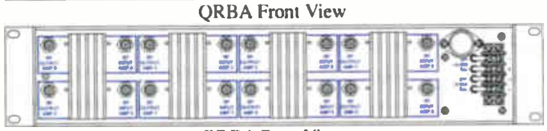
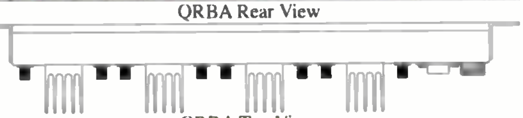

QRBA Rear View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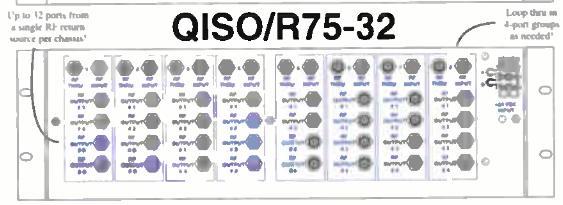

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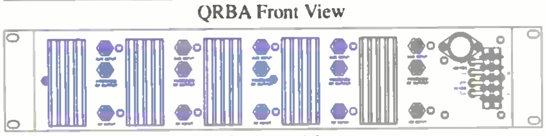
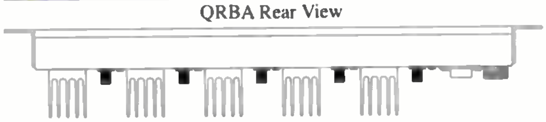

QRBA Rear View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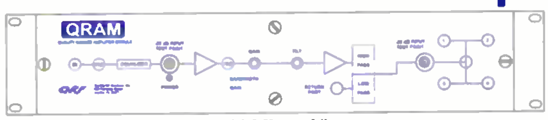
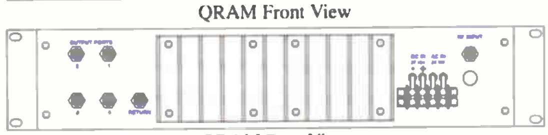
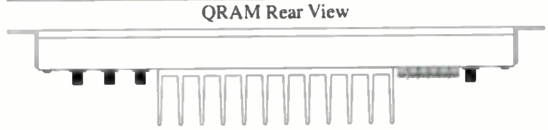


QRAM Front View


QRAM Rear View



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Examining Cable Telephony, Part 1

This month's installment begins a series on cable telephony service. The material is adapted from a lesson in NCTI's new Digital Installer Course. © NCTI

A cable telephony system interfaces with the public switched telephone network (PSTN) to provide phone service to the customer premises. Because the PSTN uses circuit-switching requiring a fully dedicated connection, pauses between bits (telephone conversations) go unused. Although only one person can speak at a time on the telephone, the full bandwidth for a two-way call is required during the entire call.

Internet protocol (IP) packet-switching maximizes the available bandwidth by sending video, voice or data signals that are broken into packets to the same destination address. These packets can travel over any available circuits and return to the destination address. Therefore, IP doesn't require a dedicated connection. Voice-over-IP (VoIP) enables a service provider to use IP over a private network to transmit and receive voice signals. A VoIP user can access VoIP with either a personal computer (PC) or a telephone.

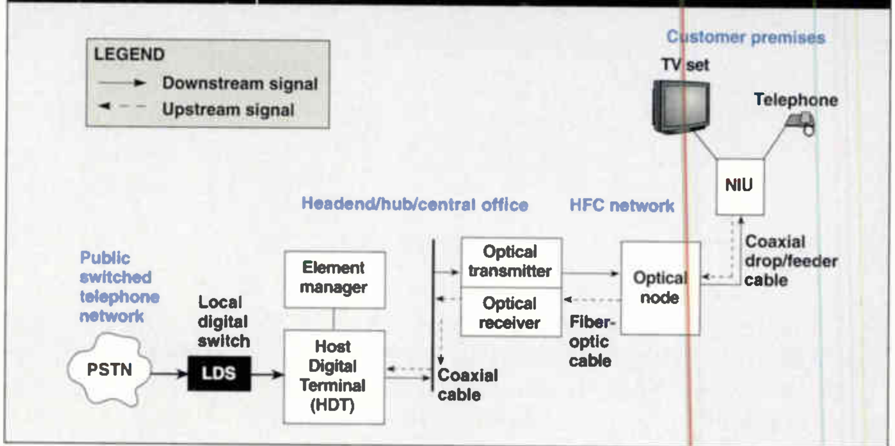
Introducing cable Telephony service

An understanding of the functions, powering, ranging and specifications of the network interface unit (NIU) also is helpful while installing and troubleshooting the cable telephony service at the customer premises.

Examining a cable Telephony system

A cable telephony system interfacing with the PSTN consists of a host digital terminal (HDT), the element manager (EM) software, a local digital switch (LDS), the cable company's hybrid fiber/coax (HFC) network, and the NIU. Their relationships are shown in Figure 1.

FIGURE 1 Cable Telephony System Overview



Explaining NIU functions

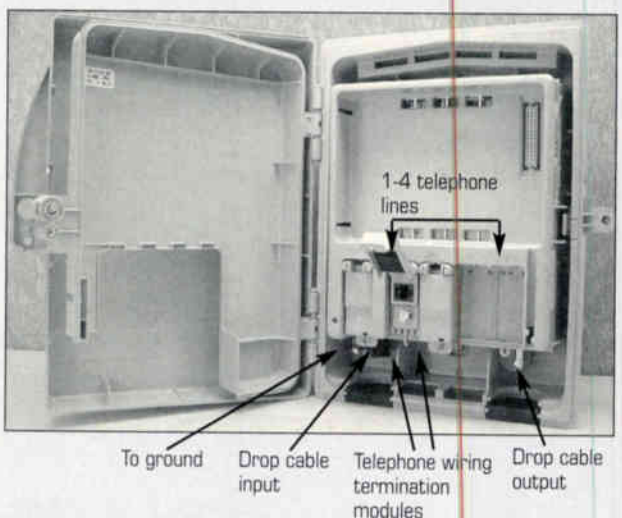
The NIU provides an analog telephone signal for up to four telephone lines. (See Figure 2.) The NIU is both an active interface device and the demarcation point between the HFC network and the customer premises wiring.

Network powering is one method of powering the NIU. In this case, power is provided to the NIU via a power-distributing tap and network powered drop cable through the coaxial cable input port of the NIU.

NIU ranging synchronizes the NIU modem with the HDT modem to establish communications. CT

Next month's installment will continue with an examination of telephone inside wiring.

FIGURE 2 Example of an NIU



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For more information, contact Allied Telesyn at (800) 424-4284 or on the Web at www.alliedtelesyn.com.

FAULT FINDER

The **RIFOCS** 263MT visual fault finder identifies breaks and bending losses in fiber optic cables terminated with MT-RJ small form factor (SFF) duplex connectors. The unit launches a 0 dBm (1 mW) 635 nm red laser into both fibers, which makes breaks, bending losses and other defects visible for up to one kilometer. It features continuous wave and one second pulsed output modes that help you see better in difficult lighting conditions. Insertion loss in the visible 630 nm wavelength region may also be measured with the continuous wave operation that provides steady output.

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

BENDING ATTACHMENT

GS Metal's Cleanshear bending attachment creates even radius bends for even, heavier gauge wire diameters, and works with the Flextray cable management system. The attachment can create a multitude of Flextray fittings. It works by placing the Cleanshear cutter with attachments between prepared sections of Flextray. By pushing the handles together, the tray bends evenly to the desired radius. The Flextray's wire mesh cable management system provides on-site flexibility and aids in faster installation.

For more information, contact GS Metals at (800) 851-9341 or on the Web at www.gsmetals.com.

SURFACE MOUNT FUSE

The TeleLink surface mount fuse for use in telecommunications equipment is now available from **Teccor Electronics**. The fuse is provides regulatory compliance for GR 1089, FCC Part 68, UL 1459, UL 1950, ITU K.20 and K.21 standards, and is designed to be used in conjuction with the SIDACtor Transient Voltage Suppressor (TVS).

TeleLink is designed to carry 100 percent of rated current for up to four hours and 250 percent of rated current for one second minimum and 120 seconds maximum.

For more information, contact Teccor at (972) 580-7777 or on the Web at www.teccor.com.

DATA CLEANSER SOFTWARE

M3i Systems' Connectivity Value Pack software is a front-line solution that addresses "dirty" data. The software addresses the degradation of data and poor connectivity in operations control rooms. M3i's solution analyzes, validate, tests and reports on geographic information system (GIS) data and network connectivity. The software also provides a graphical picture of the network and helps keep control in the control room.

For more information, contact M3i Systems at (450) 928-4600 or on the Web at www.M3iSystems.com.

SET-TOP BOXES

Digital set-top boxes are available from **Pace Micro Technology**. The home gateways will enable U.S. telecommunications companies to deliver video and interactive services over existing copper wires. The DSL4000 is compatible with U.S. NTSC broadcast standard and has Moving Picture Experts Group (MPEG-2) decoding, support for Java applications and an Ethernet interface. Internet protocol (IP) is used to deliver television services, which are video-server neutral. The unit also has improved network capability through video, positioning and scaling and minimizes network management costs by multicasting software downloads.

For more information, contact Pace on the Web at www.pacemicro.com.

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TABLE-TOP EDFA

The Model 5901 Erbium-doped fiber-optic amplifier (EDFA) is available from **Force, Inc.**, and contains an optical gain block. Wavelength and power stability are delivered by grating stabilization used in laser pumps suitable for both analog and digital applications. Erbium-doped fiber has gain flatness of ±0.5 dB in the 1535 nm to 1565 nm wavelength range for most input conditions. The device is a table-top unit that can be configured, can support applications such as wavelength division multiplexing (WDM), dense WDM networks, cable TV delivery, high-speed communications, long-haul telecommunications and optical fiber amplifiers.

For more information, contact Force at (800) 732-5252 or on the Web at www.forceinc.com.

T1/E1 TRANSFORMER/ CHOKE MODULES

Pulse has introduced magnetic modules for T1/E1 applications that integrate both isolation transformers and common mode chokes. This series includes the T1207-T1220, which provides common mode filtering, improved board space due to integrated chokes and isolation magnetics. The family is packaged in a surface mount module, the same footprint-size as discrete transformer-only products, and uses Pulse's patented InterLock base. The modules are available in tubes or tape-and-reel.

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ATHERMAL DWDM PACKAGE

3M's athermal package for optimized temperature stabilization is designed for dense wavelength division multiplexing (DWDM) Bragg and gain flattening gratings. The package compensates for thermo-optic and strain-optic effects that impact the optical performance of gratings with temperature. An important passive component in optical networks, the package maintains the optical performance, expanding use of fiber Bragg gratings to uncontrolled environments from -40 to +80 degrees C.

For more information, contact 3M at (800) 426-8688 or on the Web at www.3M.com/fibers.

OPTICAL POWER METER SOFTWARE

Kingfisher's KITS software allows users to control the its KI7600 optical power meter from their personal computer (PC). In one click, live data is transferred from instrument display to an Excel spreadsheet. Windows software using the latest VB/COM/ActiveX/OLE technology ensures long-term flexibility. Other features include instrument memory download, label printing, autotest support, hyper-linked online manual and file-merge facility.

For more information, contact Kingfisher's global distributor, SENKO Advanced Components, at (888) 327 3656.

BILLING SYSTEM

Complex broadband services, such as cable TV and high-speed Internet, may now be billed using the CableBridge Plus billing system. The new rating engine, produced by **Enhanced Telecommunications**, works with existing systems and provides flexible rating capabilities to deploy, bill and manage these services. The rating engine establishes rates for subscription services and automatically generates bills and exports the billing records into a simple flat file that may be processed by the host system.

For more information, contact Enhanced Telecommunications at (800) 332-1078 or on the Web at www.etisoftware.com.

INTERNET MANAGEMENT SYSTEM

A completely integrated Internet home management system that allows remote monitoring and control for homes and businesses will be available January 2001 from **Xanboo**. The system will be available through retailers, utility companies, cable service providers and security distributors and will allow consumers to keep an eye on homes and business. The system also sends notification when there is a power interruption, temperature change or motion on the premises. The system works over dial-up and broadband Internet connections.

For more information, contact Xanboo on the Web at www.xanboo.com.

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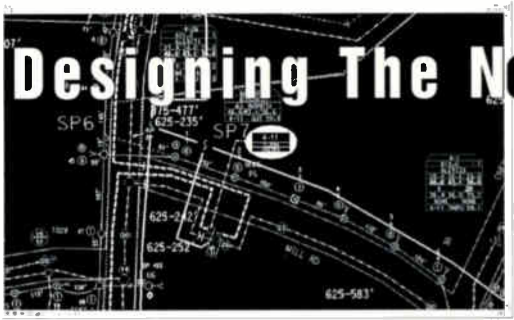

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PROTOCOL/QOS ANALYZER

An advanced protocol and quality of service (QoS) analyzer for voice-over-Internet protocol (VoIP) networks is available from **Sunrise Telecom**. The VoIP Explorer analyzer provides a complete solution for monitoring and analyzing VoIP networks and supports the key protocols for cable telephony deployments. The VoIP Explorer address the challenges of protocol/interoperability problems and voice quality, and offers live call trace, protocol decoding, call detail record (CDR), QoS monitoring event logs and audio monitoring.

For more information, contact Sunrise Telecom at (408) 360-2233 or on the Web at www.sunrisetelecom.com.

SOFTWARE PLATFORM

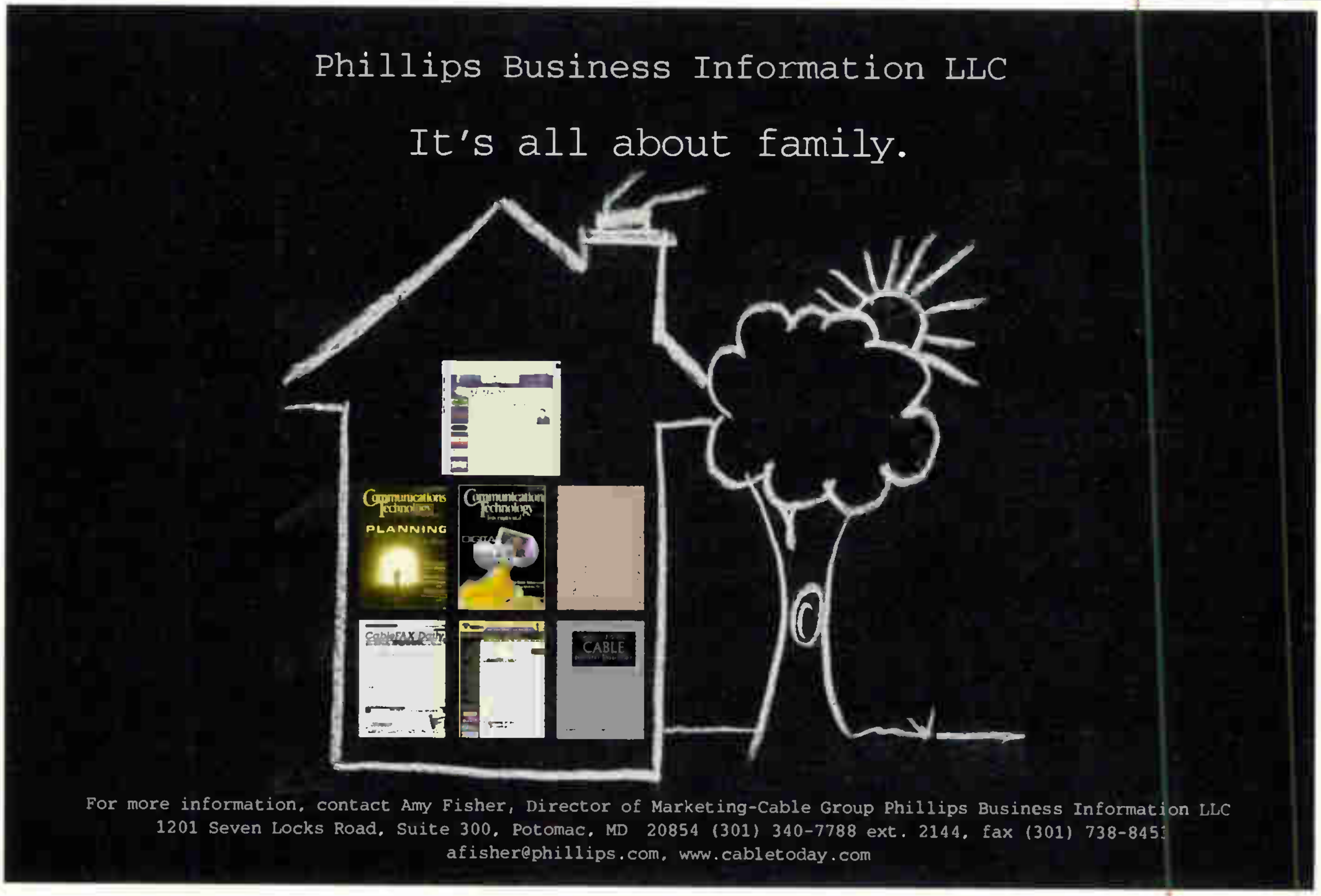
Sphera's HostingDirector 3.0 open and extensible platfom is geared toward the hosting provider industry. The system delivers global service automation and meets the operational demands of Internet service providers (ISPs) and application service providers (ASPs). The system provides provisioning, global license management, central domain naming system (DNS) management, usage-based reporting and billing integration, plug-in technology and open plug-in application programming interface (API).

For more information, contact Sphera at (212) 858-7770 or on the Web at www.sphera.com.

BACKBONE SYSTEM

A multimedia backbone for broadband services system is available from **BarcoNet**. The iLYNX digital fiber backbone system supports multiple service transport, including audio, data, Internet and video, and has multiple interface possibilities. The modular system also has self-healing management features and additional configuration options available through an open-system management interface. It is ideal for operators with video-over-backbone needs. Applications suited for the system include trunking for interactive TV, such as digital headend play-out for pay-per-view or near-video-on-demand (NVOD).

For more information, contact BarcoNet at (770) 590-3629 or on the Web at www.barconet.com.



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CO-LOCATION CABINETS

Hoffman's field-configurable, co-location cabinets feature reversible hinges and latching system, vertically-adjustable inside barriers, additional door mounting holes and rack angles that adjust front to back. Cabinets are available with completely perforated fronts and have a low-profile latching system, along with multiple keying options for individual security. Power-side outlets and data-side jacks improve cable management.

For more information, contact Hoffman at (800) 355-3560 or on the Web at www.ehoffman.com/co-location.

CHANNELIZED ACCESS SOLUTION

PMC Sierra offers the PM8316 TEMUX-84, a high-density channelized access solution that is ideal for metro optical access, multi-service switches and multi-protocol label switching (MPLS) edge router equipment. The device supports the global requirements for mapping, framing and multiplexing T1, E1, T3 and E3 channels into synchronous optical network/synchronous digital hierarchy (SONET/SDH) services and allows T1, E1, T3 and E3 access port card design densities to scale to OC-48.

For more information, contact PMC Sierra at (604) 415-6011 or on the Web at www.pmc-sierra.com.

BFLM SYSTEM

Blonder Tongue's broadcast frequency locked modulator (BFLM) system corrects and cures unacceptable flutter and moire patterns that manifest on viewer TV sets when local VHF broadcast channel assignments are used to deliver programming received by satellite. The BFLM system ensures an output frequency of VHF signals identical to that of local VHF broadcast carriers through its automatic frequency locking and tracking circuits.

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

ICTV

The Reality Behind Internet Speed

As a cable operator moving forward in the digital broadband era, one of your biggest concerns is losing control of the network you have so painstakingly created from the ground up. On the surface, it may appear that once you go digital, you provide your customer with the ability to view digital content from any source over your network, effectively cutting you out of the revenue-sharing loop.

This would be a particular threat to you as a cable operator because your bread and butter has always come from providing the best quality video on the planet. What would you do if someone with a Web site started offering high-quality streaming media over your network, gobbling up the real programming revenue while relegating you to the level of gatekeeper?

A frightening scenario to be sure, but fortunately the reality is quite different. In fact, as the broadband network operator, you will continue to have multiple points of control as to whose data gets through your system, at what rate and at what level of quality. That is, of course, if you have the correct browser in place.

To understand why this is so, there are a few things about the Internet you need to know, including how it relates to the realities of video distribution on a broadband television system.

Points of control

First of all, the worldwide network that we call the Internet is, by its very nature, a very narrow-band environment. The average speed is about 155 kbps, a rate which produces a great deal of jitter and thus does not support high-quality streaming video.

Therefore, the only way a third-party content provider can deliver anything more than a shaky, thumbnail-sized video service with poor-quality audio to your customers is through a private network—most likely a DS-3 or T-1 line, or maybe a satellite link—directly to your plant. This is a point of control for you because it requires the content provider to obtain your legal permission first, and this leads to all sorts of creative revenue-sharing agreements.

While this may be all well and good for the present state of technology, what can we say about future developments? Won't Internet speeds pick up once the demand for broadband data grows? Absolutely, although this could take a while. It's a big world out there and the very nature of the Internet, with its decentralized architecteture and the way it delivers data packets through numerous switching points, means that nearly all of the switches and transfer points will have to be upgraded to provide reliable broadband service. If you thought your hybrid fiber/coax (HFC) plant was difficult to build, imagine having to rewire the entire planet.

But even when network codecs do become more efficient and speeds increase, you have another point of control: the broadband connection between your headend and the outside world. Like the cable plant itself, this is a shared network in that bandwidth, and thus speed is determined by the number of users online at the same time. Too many users eating up too much bandwidth will cut the flow of data to a trickle. The most efficient way to maintain a high-speed environment is to place a cap on the amount of data a single user can download at one time, which means that only a certain level of video quality will be available unless some other arrangement is made, either with the user or the content provider.

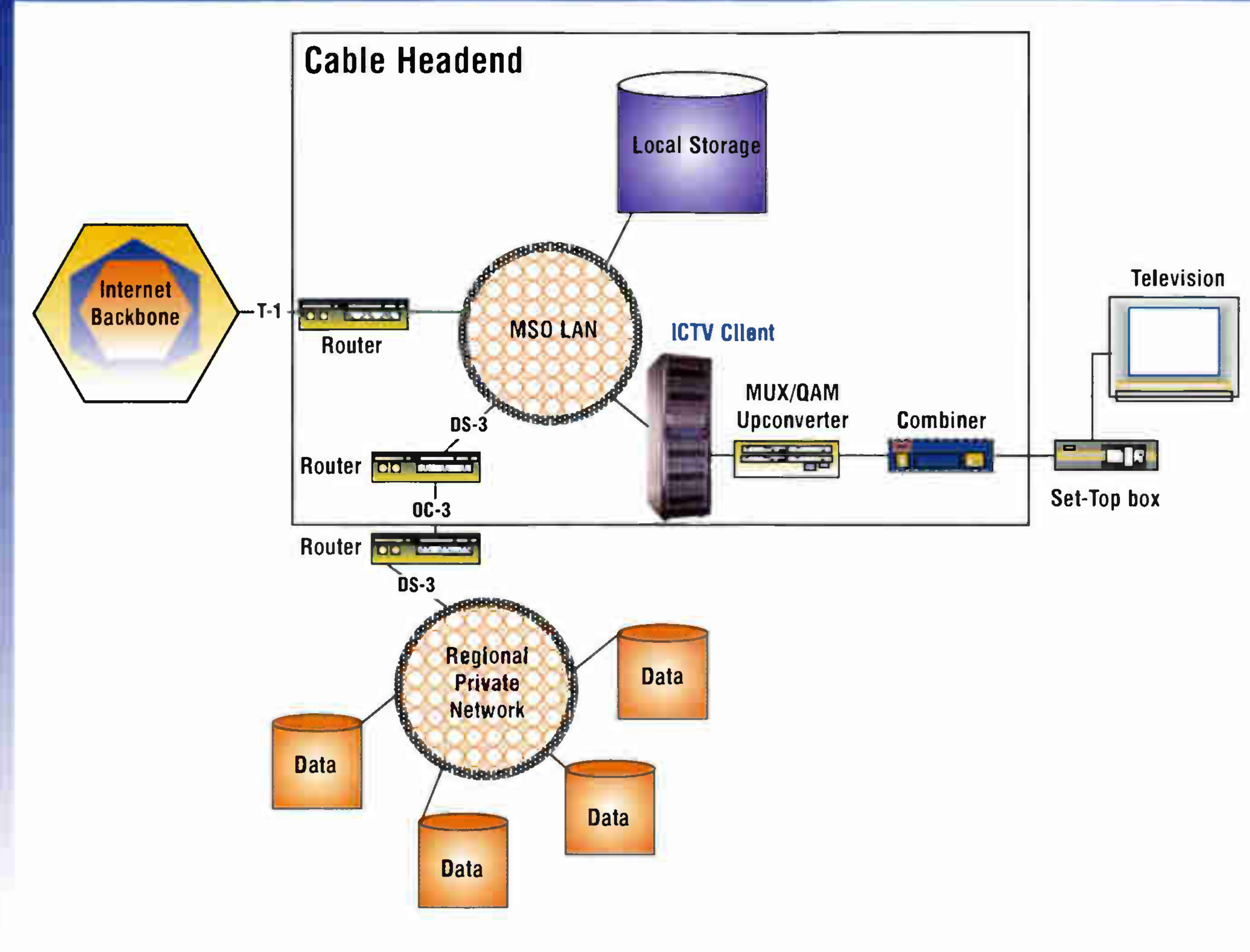
There is a third point of control in that you can simply assign higher and lower data rates to specific URLs, or block them completely. However, this is a crude approach and might not even be necessary.

Access to the end-use

In addition to finding ways to reduce the speed of "unfriendly" content, there are ways to improve the speed of friendly content. One of the best ways is to simply load it onto a server at the headend or provide access via a private network like RoadRunner or AtHome. With this approach, you are likely to find allies in the giant media institutions like Sony, Warner Bros. and others who are extremely anxious to find broadband media outlets capable of delivering high-quality content. Not only will these companies be willing to pay for private access to your network, they offer some of the most sought-after content that is highly valued by your end-user.

In the future, expect the major media distribution companies to build leading interactive television applications designed for private networks, regional networks or located at the headend itself. No matter which of these three options is chosen, the cable system operator is in the driver's seat when it comes to who gets access to the end-user and what the speed and quality of that access will be.

The point is, there is no way a third-party content provider can use your system for high-quality video services without your knowledge and permission. You control the access to your customers, and that means content providers have to come to you if they want a piece of the pie. ■



Headend Browsers vs. Set-Top Browsers

When it comes to providing high-speed, high-quality service on a hybrid fiber/coax (HFC) network, a lot of system operators overlook the importance of the return path. It's almost as if this function is carried out on some other portion of the network, separate from the reams of data flowing to the customer.

The reality, of course, is that data is data, and the data flowing along the fiber in your plant requires a certain amount of bandwidth no matter which direction it's headed.

That's why ICTV has designed its browser system to require the absolute bare minimum of bandwidth for the return path. We've done this by housing the actual browser at the headend, establishing a client-server relationship with the set-tops in the field.

By keeping the brains of the system at the headend, the ICTV system uses the return path for simple keystroke data as opposed to actual data files. In a set-top-based browser, the user types out an e-mail, for example, and then pushes the entire file upstream to the headend to be delivered.

The ICTV approach is to provide an extremely narrowband connection to the browser residing at the headend. As the user taps out an e-mail one character at a time, each keystroke is sent to the headend, even the command to send the document.

Not only does this approach ease the strain on the entire system, it has the dual benefit of lowering the cost for entry-level users. Since the set-top merely has to act as a client terminal in the home, there is no need for expensive storage options or high-powered processors that characterize the more expensive units that will soon hit the market. These more advanced devices will probably benefit the user in other ways, but they won't be a requirement for broadband customers. With the ICTV system, users can jump into broadband at a very low cost, and then upgrade to more advanced services when it suits them.

This client-server system offers the best of both worlds to you and your customer. ■

Maintaining Copy Protection in a Broadband Environment

As discussed in the previous article, cable operators will continue to hold the keys when it comes to delivering high-quality digital video over broadband networks, regardless of developments taking place in worldwide data communications.

So even as new Web sites hit the market touting digital movies and video programming, there is no threat of a rogue Silicon Valley-based content provider competing with the cable operator for delivery of high-quality video. At best, you will see more of the grainy 56k jukebox services coming in over the public backbone.

But just as the cable operator has nothing to fear from the brave new world, neither does the content or video-rights holder. The Internet industry has been abuzz lately with news of Napster, the digital audio file-swapping service that allows users to obtain CD-quality music files without having to pay the copyright holder. Even though the service is on the verge of being shut down by the courts as of this writing, there is growing concern that audio files are just the tip of the iceberg--that digital video files are next on the hit list.

The previous article addresses the fundamental technical and economic points of control over streaming video and arrives at the conclusion that professional networks and professional controls can and will be maintained in the cable industry. But what about downloading digital video files? As the networks grow faster, will we create a video version of Napster?

More control issues

Under a television browser environment such as that provided by ICTV, where the browser actually resides at the headend, rather than the set-top (see sidebar), users will not be able to swap broadband digital video files because they will not actually control them. Under ICTV's platform, an MP3 file is downloaded to the headend and then converted to an MPEG stream, which is then delivered to the TV screen. Nothing is saved on the set-top and so nothing can be forwarded to another user. End-users may view the content as many times as desired and can pause, fast forward, rewind and so on. But they never gain control of the copyrighted material other than to view it in the privacy of their own home.

In the future, there will be two kinds of Web communications in play: broadband TV and broadband PC. If you look at user trends over the past 10 years and compare the amount of time people spend with their cellular and pda interfaces, their computer interfaces and their televisions, there seems to be a correlation between the time spent with each device, the size of the screen and the distance between the screen and the user. That is, the larger the screen and the farther away the user is, the more time spent with that device. From this standpoint, the television is the hands-down winner.

Secondly, there is the very nature of the way we will use our broadband infrastructure. Traditionally, network applications that have required a high degree of interactivity were geared toward the PC, but that is changing. As with on-line gaming and digital program guides, more and more people are willing to interact intensely with the television. The degree to which people are willing to interact is more a question of the internal logic of the content, rather than the environment.

The "rights" benefit

How does all this benefit the rights holder? Well, if content is king, then it follows that content will proliferate in the television environment because rights-holders do not have to worry about losing control of their intellectual property due to rampant copying. Broadband television will provide a completely safe, secure environment for users to enjoy copyrighted material, while the rights-holder can rest assured that each user who is viewing the material has paid the appropriate fee for service.

Of course, all this can only take place in the appropriate browser environment. With ICTV's client-server architecture, everybody wins. Subscribers get the services they pay for, cable operators are protected against misuse of their network and rights holders are ensured of a safe environment to deliver their content. ■

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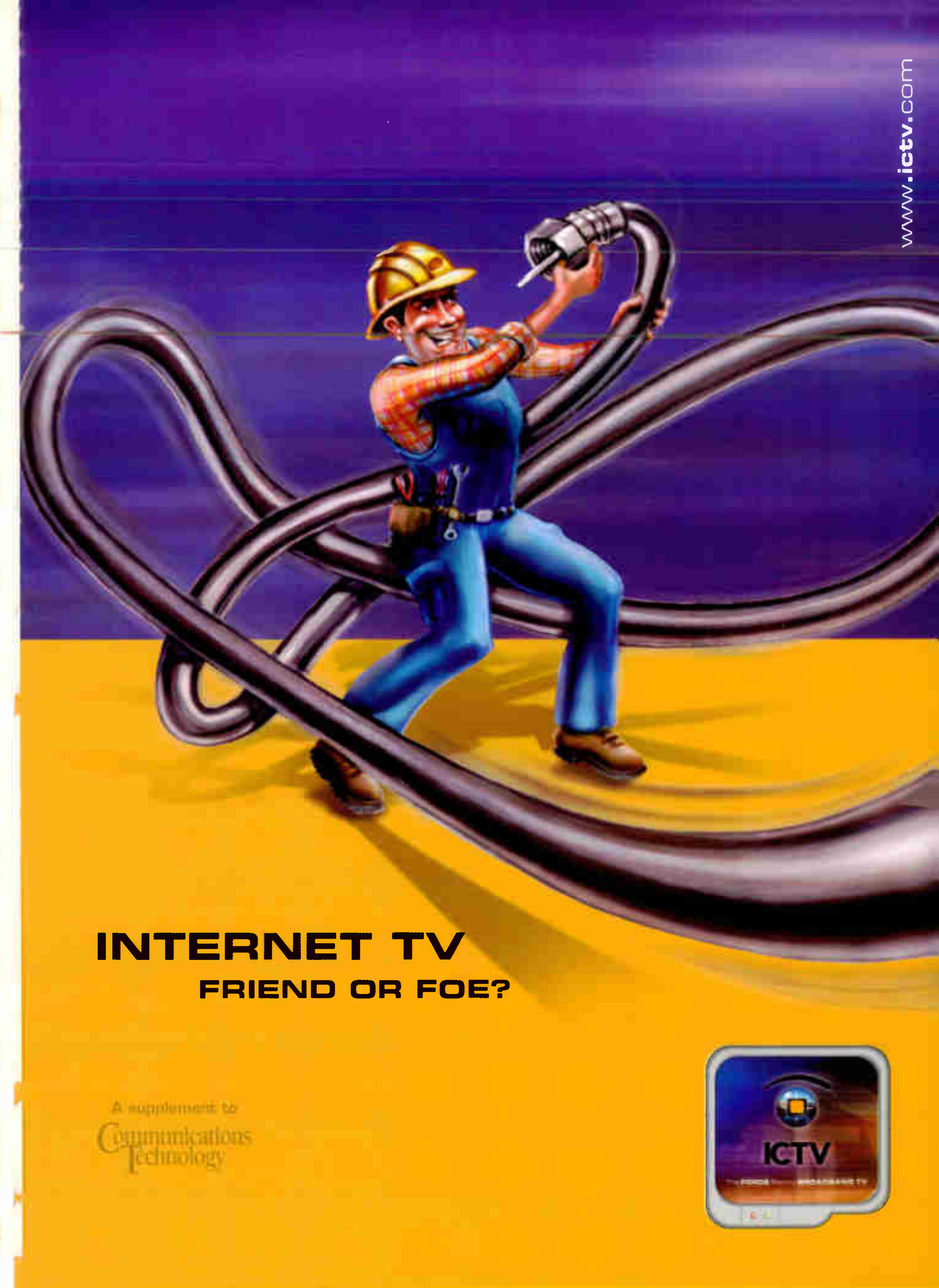

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VOD ENABLER

The Digital Content Express suite from **TVN** enables video-on-demand (VOD). TVN's proprietary ADONISS content management system provides content owners and distributors with the ability to securely control, manage and deliver digital assets independent of vendor hardware to multiple distribution platforms. A secure satellite transmission (SST) system offers reliable, secure transport of content by using a proprietary layered network that ensures content delivery in its entirety only to authorized sites. Major studios have endorsed the company's comprehensive encoding process.

For more information, contact TVN Entertainment at (818) 526-5000 or on the Web at www.tvn.com.

FACEPLATES AND MODULES

Ortronics has expanded its line of residential and small commercial faceplates and modules for applications such as Category 5e voice and data, audio, video, fiber optics and coax. The TracJack and Stylistics faceplates are streamline and feature a smooth finish and are built of durable material. They are modular in design, accommodate front removeable multimedia modules and come in white and light almond to blend with existing electrical outlets. The TracJack wall plate holds up to six snap-in modules in a single plate. The Stylistics faceplates are available in single, dual, triple and quad plates.

For more information, contact Ortronics at (860) 445-3900 or on the Web at www.ortronics.com.

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Full-frequency agile status monitoring transponders designed to defend against network outages are available from **Scientific-Atlanta**. The device assign radio frequency (RF) between headends and transponders in remo locations, and provides preventative and rapid restoration protection for high-speed networks. Monitoring o operational parameters of the nod and amplifier are possible with the transponder, which provides remote control of certain node functions. T transponder is designed to receive any frequency between 47 MHz and 174 MHz in downstream direction and transmit between 5 MHz and 65 MHz in the upstream path.

For more information, contact S-A at (770) 236-2179 or on the Web www.scientificatlanta.com.

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

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FIBER-OPTIC AND DSV KITS

Greenlee Textron is offering two lines of tool kits for cable and telecom contractors. Complementing **Datacom Textron's** fiber-optic testers, one new line includes the fiber-optic cut and strip kit,

the fiber-optic handtools kit, the fiber-optic termination kit and fiber-optic consumables kit. The termination and consumables kits contain commonly used consumable materials for epoxy and polish connector terminations.

Greenlee Textron's line of data, signal and voice installation (DSV) kits provide contractors with Greenlee tools and **Progressive Electronics** testers necessary for installing and maintaining cable TV systems, local area networks (LANs), voice and Category 5 data, coax Ethernet, and other networks.

For more information, contact Greenlee Textron at (815) 397-7070 or on the Web at www.greenlee.textron.com.

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CALENDAR

December

6: Badger State Chapter Technical Seminar, Fond du Lac, Wis. Contact Randy Bunnell, (920) 339-8056.

12: SCTE Seminar Cable 101, Chicago, Ill. Contact Ned Fenimore, (503) 631- 2101.

14: Wheat State Chapter Technical Seminar, Wichita, Kan. Contact Joe Cvetnich, (316) 262-4270, ext. 139.

January

8-10: Emerging Technologies Conference, New Orleans. Contact SCTE, (800) 542-5040.

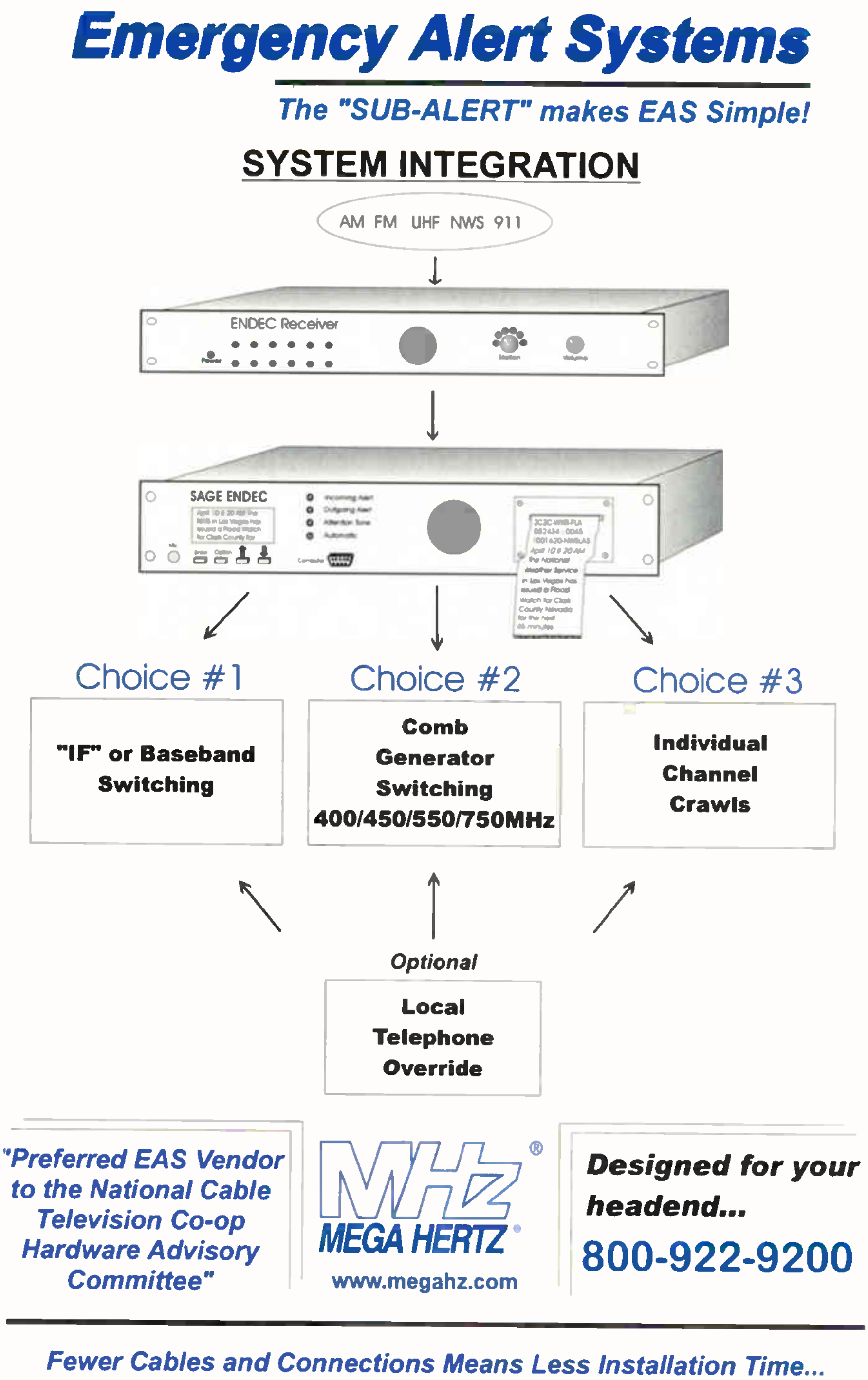
10: Data Standards Subcommittee, New Orleans. Contact Dr. Ted Woo, SCTE, (610) 363-6888.

10: SCTE Certification Testing, Exton, Pa. Contact SCTE (610) 524-1725.

15-18: BICSI 2001 Winter Conference, Orlando, Fla. Contact BICSI at www.bicsi.org.

17: Piedmont Chapter Technical Seminar, Raleigh, N.C. Contact Mark Eagle, (919) 573-7083.

Jan. 29-Feb. 1: COMNET Conference and Expo, Washington, D.C. Contact Molly Smith, (212) 445-8227.



PLANNING AHEAD

> ***Feb. 23: SCTE Chapter Leadership Conference***
> Contact SCTE, (800) 542-5040.

> ***Feb. 26-27: Passive Optical Networks***
> Las Vegas. Contact IQPC, (800) 882-8684.

> ***Feb. 28-Mar. 1: Texas Show 2001***
> San Antonio. Contact Jessica Dattis, SCTE, (610) 363-6888.

> ***April 18-20. WBT Producer Conference Expo 2001***
> Anaheim, Calif. Contact Influent Technology Group, (800) 333-9088.

> ***May 8-11. Annual Engineering Conference & Cable-Tec Expo.***
> Orlando, Fla. Contact SCTE, (800) 542-5040.

> ***May 28-30. Satellite 2001***
> Washington, D.C. Contact Satellite Today, www.satellite-today.com/SAT2001.

> ***Mar. 13-14: Northern California Vendor Day***
> Concord, Calif. Contact Steve Allen, (530) 622-2856.

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Digital Video Standards Development

SCTE Digital Video Subcommittee (DVS) recently developed a step-by-step definition of its point-of-deployment (POD) module in DVS 266 revision 2 and DVS 267 revision 1, which together characterize the POD features and download.

DVS 266 revision 2, titled *Point-of-Deployment (POD) Module Generic Feature Contribution*: One function of the POD module is to provide communication and control between the headend and the host. One aspect of this involves the common features that may reside in many different host devices. These are called generic features. There are several parameters associated with these generic features; as a result, the cable operator may want to mandate certain features or potentially give the user total control. Upon this allowance, the user of the host may modify parameters within a generic feature that will influence the operation of the host and/or the POD module. This document defines the interface that is used to exchange the settings of the parameters for these generic features. Inclusion of a generic feature in this standards document in no way implies a requirement for either the host or the cable headend to support this feature.

The standard creates a new resource for the host, and is known as the Generic Feature Control. It enables the host and the POD module to exchange parameters belonging to a set of generic features. One use of this resource is to provide a mechanism in which generic feature parameters may be controlled by the headend to disable user control of these parameters.

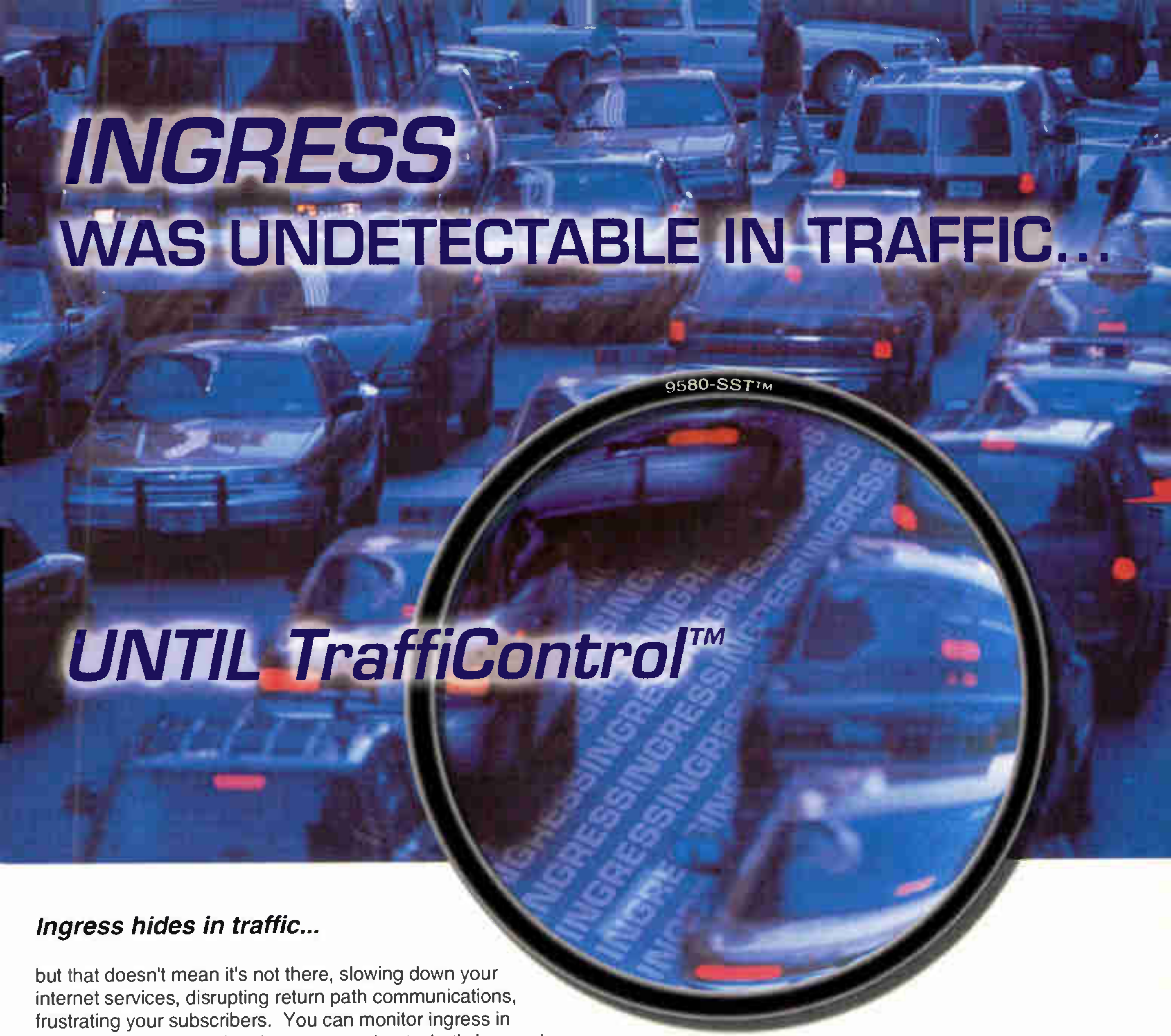
"A POD module may be designed with the capability of having its firmware reprogrammed."

DVS 267 revision 1, titled *Point-of-Deployment (POD) Module Emergency Recovery and Firmware Upgrade Resource*: This standard introduced that there is a small chance that the POD module's firmware may become corrupted. There is currently no method in the POD interface to inform the host that the POD module has had such a catastrophic failure and is not able perform its operation, but it is capable of recovering from this state. This proposal is to provide a resource allowing the host to recognize this state, perform the necessary operations and allow the POD module to recover and operate correctly.

A POD module may be designed with the capability of having its firmware reprogrammed. Typically, this is implemented with flash memory or battery-backed-up RAM. On the rare occasion firmware is being reprogrammed, it is possible that an outside occurrence, such as a power failure, may cause the firmware to become corrupted. If this occurs, then the POD module is incapable of performing all of its functions. The design of devices with downloadable firmware generally provides some method of executing a minimum set of firmware to allow for recovery in the field. In flash memories, a special sector of code (often called Sector 0) is designed so that it cannot be reprogrammed. In systems with battery backup, this function can be implemented using ROM, which is also incapable of being reprogrammed. Generally, this memory is fairly small, and since it is not reprogrammable, it must be carefully designed and verified.

This special memory will contain a special program (in DVS 267 it is referred to as a boot-loader) that is called upon reset. It first performs basic initialization operations, and then tests the main program memory to ensure that it is valid. If it is valid, it starts executing out of the main firmware memory. If the main program memory is not valid, then a mechanism needs to be implemented allowing for the recovery of the main firmware. For this rare, emergency condition, the boot-loader will contain firmware that will allow the POD module to not only inform the host of the situation, but also will allow for recovery. If the user activates the host, then the host will inform the user that the POD module is not available. CT

Ted Woo is the SCTE's director of standards. He may reached at twoo@scte.org.



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Standards Explosion

To say the SCTE standards department has expanded is an understatement, and doesn't seem to offer suitable justice. Since SCTE received **American National Standards Institute** (ANSI) accreditation in 1995, the number of companies contributing to the standards-developing process has steadily grown each year.

One of the earliest and most significant events in the SCTE standards department's growth occurred in March 1996, when the industry standard *F Port (Female Outdoor) Physical Dimensions* was submitted to ANSI for recognition as a new American national standard. In December 1996, this became the first American national standard for the cable telecom industry.

The origination of this standard sparked a flurry of activity and the immediate growth of the number of contributors in the standards departmental process.

Active membership in SCTE standards development has steadily increased over the last five years. In 1996, SCTE had 120 people from 27 organizations contributing to standards development. As we enter a new millennium, subcommittee attendance has exploded to 703 people from 214 organizations, and it is projected that there will be more than 1,000 individuals contributing to standards development by 2002 (see Figure 1).

The first of the newer groups to assemble formally was the Digital Video Subcommittee (DVS) in May 1996. there were only four attendees at its inaugural meeting, and now there are more than 90 attendees per meeting. The Interface Practices Subcommittee, Data Standards Subcommittee, Construction and Maintenance Subcommittee and Emergency Alert Subcommittee also have enjoyed healthy attendance increases.

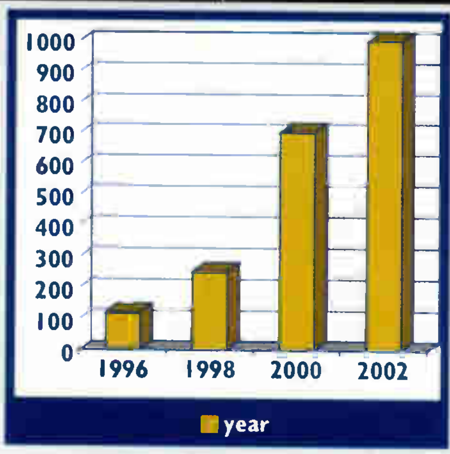
The Hybrid Management Sub-Layer Subcommittee and the Material Management Subcommittee were both established in 1998 to accommodate larger turnout. Recently, the Cable Applications Platform Subcommittee has been established, along with the National Electrical Code Subcommittee.

The growth of attendance directly corresponds to a major spurt in standards development documents. At the end of 1996, only 45 documents were being produced. In 2000, there are 208 standards documents. At this rate, more than 350 documents will be produced within the next two years (see Figure 2).

Having seen what the last four years have produced, it is exciting to think what the next four will hold for SCTE standards development. If you and your organization would like to get involved, please contact SCTE Director of Standards Dr. Ted Woo at (610) 363-6888, ext. 228, or twoo@scte.org, or visit www.scte.org. CT

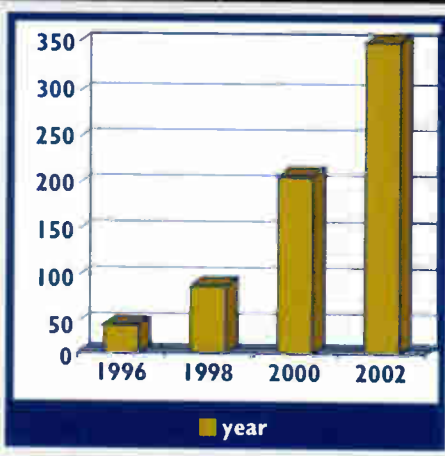
John Clark is president and CEO of the SCTE. He may be reached at jclark@scte.org.

FIGURE 1 SCTE STANDARDS DEVELOPMENT ORGANIZATIONS' ACTIVE MEMBERSHIP



- In 1996, 120 people from 27 organizations
- In 1998, 250 people from 55 organizations
- In 2000, 703 people from 214 organizations
- In 2002, more than 1000 people projected

FIGURE 2 SCTE STANDARDS DEVELOPMENT PRODUCT DOCUMENTS

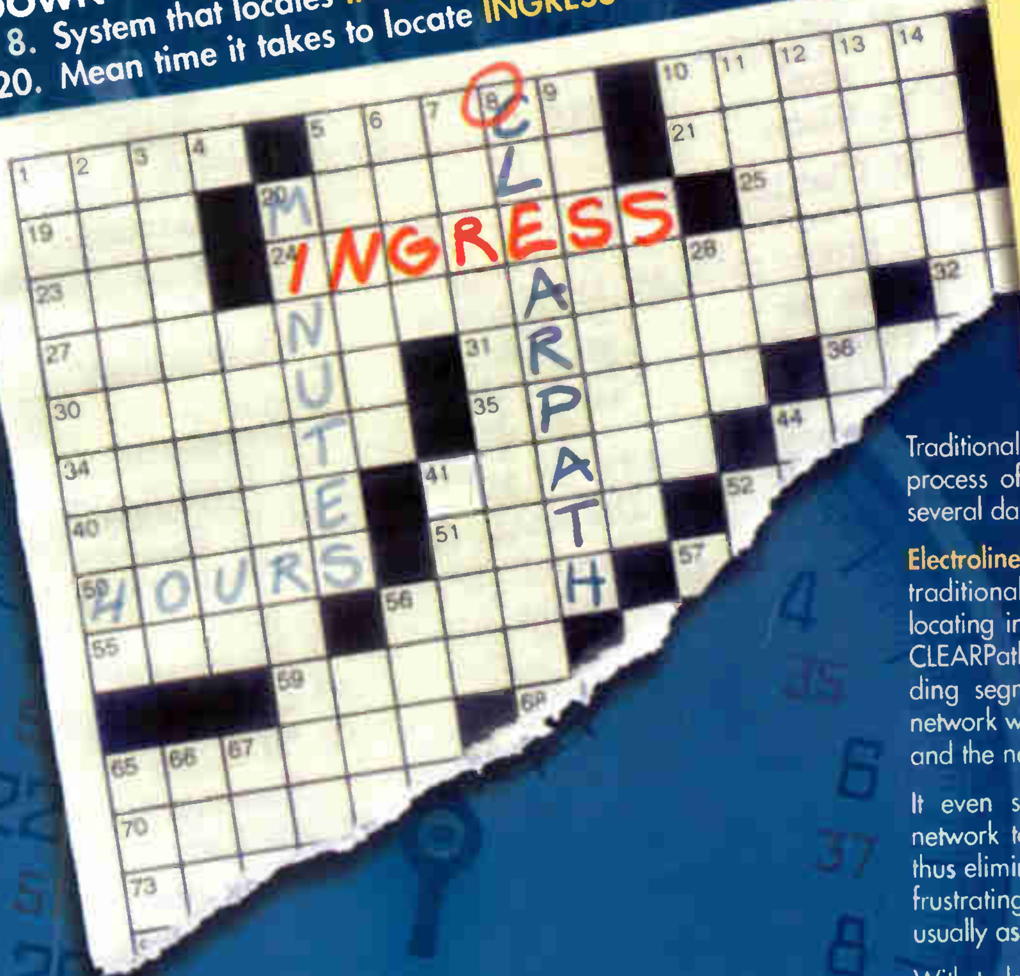


- In 1996: 45
- In 1998: 86
- In 2000: 208
- In 2002: 350 (projected)

Stop wasting time chasing INGRESS

ACROSS
24. Cause of major service disruptions in the return path
50. Mean time to locate INGRESS using traditional methods

DOWN
8. System that locates INGRESS and goes BEYOND THE NODE
20. Mean time it takes to locate INGRESS using CLEARPath™



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