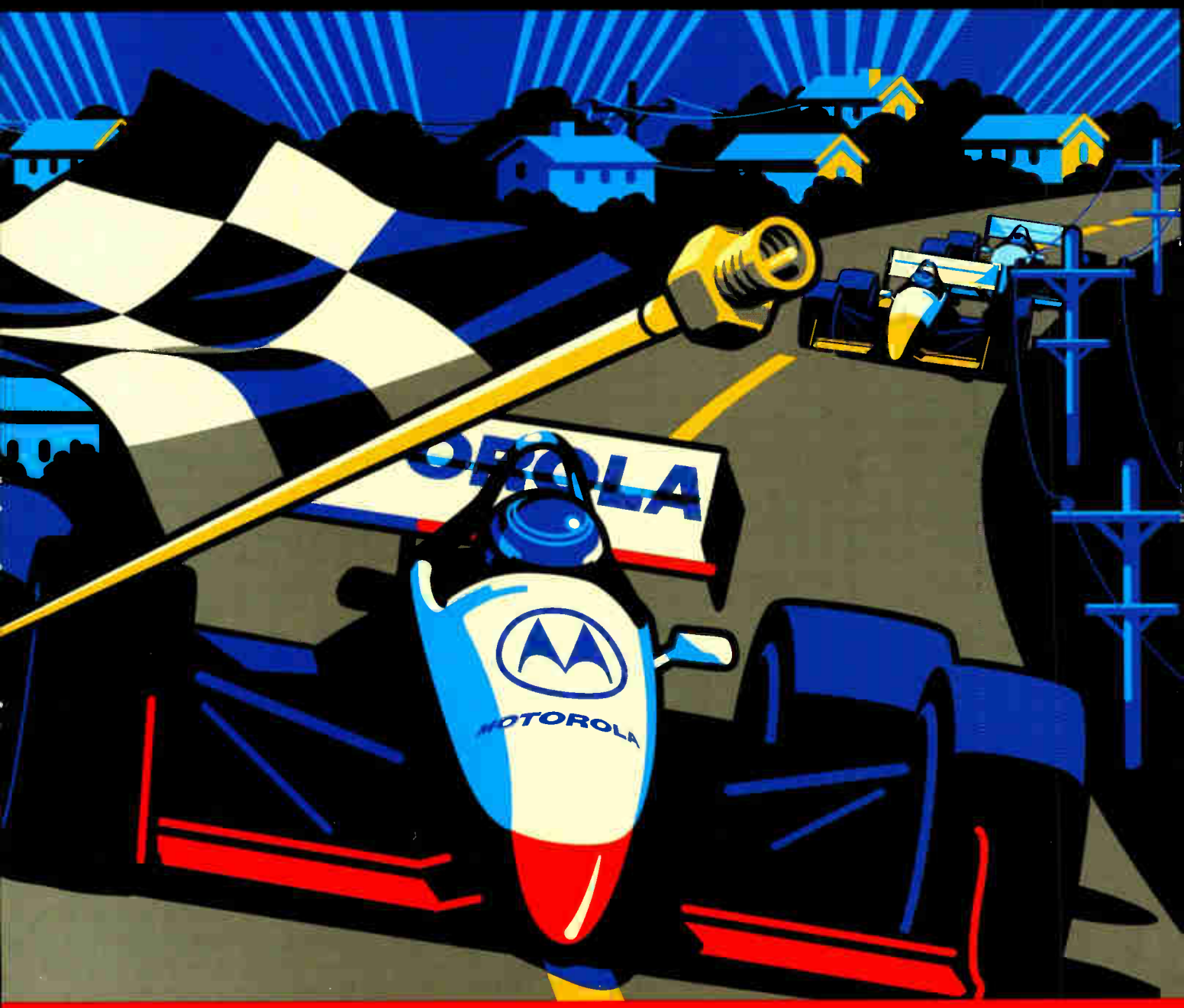

CED
COMMUNICATIONS ENGINEERING & DESIGN
THE PREMIER MAGAZINE OF BROADBAND COMMUNICATIONS
DECEMBER 1996
CED
Return path 102
256 QAM testing
Powering options
OSS:
A total
management
package

Bandwidth Gave Cable Operators the Pole Position.



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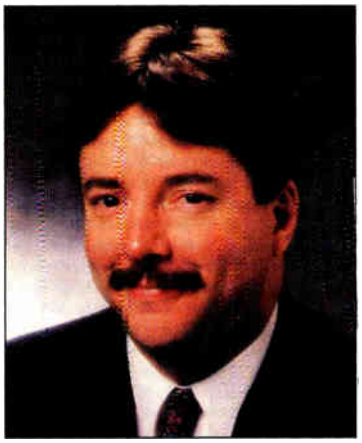

RBOCs: Slapping their best customers

Are these guys *really* ready to compete? Several of the Regional Bell Operating Companies have been causing quite a stir by arguing that they need new per-connection fees from Internet Service Providers because, get this, business is *too* good. This is exactly the kind of thinking that has some of the RBOCs, unable to keep up with increased demand for more lines, cellular and other services, in trouble with local utility commissions.

Specifically, Pacific Telesis, US West and Bell Atlantic are pointing to a new Bellcore study that says the increasing popularity of the Internet is clogging the nation's telephone lines, making it much more likely that callers are greeted with fast-busy signals instead of a cheery "hello" at the other end.

Calls made to access the Internet average 22 minutes in length (and are bound to grow), vs. four minutes—the average length of a voice call. The frequency of these longer calls is chewing up telephone network capacity and causing the RBOCs to take a new look at their historical traffic models. For example, PacTel took a close look at calling patterns in one area of the Silicon Valley and concluded that something like 16 percent of all calls did not connect, compared to the more typical one percent rate. The problem could be exacerbated now that America Online intends to allow unlimited access for a flat fee.

Instead of embracing the new demand, the telcos seem to want to quell it by charging the ISPs–in advance–to build more capacity through a network upgrade. To gain support from regulators, the telcos predictably put a dark spin on the problem, suggesting that lives could be in danger because emergency 911 calls might not be able to get through.

But some have already seen through the smokescreen. Already, the service providers are crying foul–and so are several of the telephone companies' largest customers.

Intel, Microsoft, IBM, Compaq, Apple, Netscape, Digital, America Online and AT&T WorldNet, among others, have formed the "DATA Coalition" to fight the new fee, which would ultimately have to be passed on to the consumer. Such fees would create a chilling effect and reduce Internet demand, or so the coalition says.

Telecom experts say the problem can be fixed by building more capacity or routing data traffic over frame relay networks. In other words, the telcos could simply take some of their record-level profits, plow them back into their networks, and make even more money by selling more services.

The Telecom Act promised competition in telecommunications. The RBOCs will survive the new era primarily because of their girth. But incidents like this show that their corporate cultures, based on monopolies, will take a long time to change.

Roger J. Brown

Roger Brown
Editor

CED MAGAZINE

VP Group Publisher
William McGorry

Publisher
Robert C. Stuehrk, Rstuehrk@aol.com

Editor
Roger Brown, Rbrowner@aol.com

Managing Editor
Dana Cervenka, Dlcervenka@aol.com

Associate Editor
Michael Lafferty, McLaffrt@aol.com

Contributing Editors
Leslie Ellis, Ellis299@aol.com
Fred Dawson

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Classified Sales Manager
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Assistant to the Publisher
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Address
600 S. Cherry St., Suite 400
Denver, CO 80222
303/393-7449; Fax 303/393-6654
Web site: http://www.cedmagazine.com

Circulation Director
Maria Gottlieb; (212) 887-8565

Associate Circulation Manager
Shawn Green; (212) 887-8564

Subscriber services
CED
P.O. Box 10728
Riverton, NJ 08076-0728
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Photo by Mark Sims

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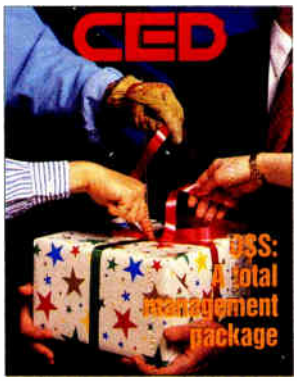

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Photo by Mark Sims

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Is ingress making your return path a road to nowhere?

Ingress is the major roadblock to getting your return path up and running. Fortunately, there's the new HP CaLan Sweep/Ingress Analyzer. It's the only test gear that allows you to quickly and accurately troubleshoot your system, regardless of the presence of ingress.

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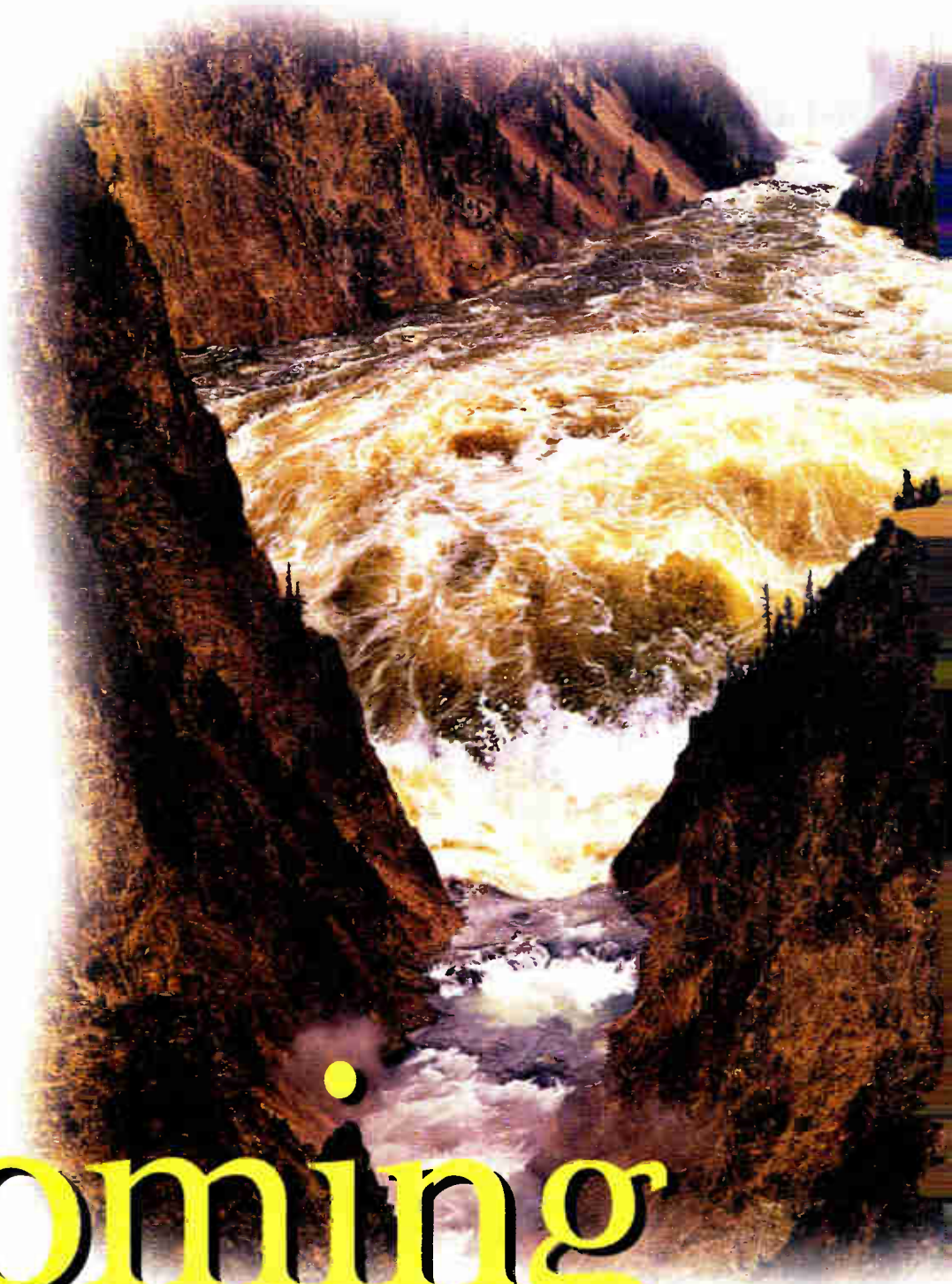

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S-A enters high-speed data market, offering telco return unit for $199

Scientific-Atlanta's new telephone-return high-speed data modem, dubbed the "dataXcellerator," will debut on the market next year.

Convinced that the time is right for a low-cost, telephone return data modem, Scientific-Atlanta announced it plans to build such a unit and sell it for $199 in volume, beginning next year.

Dubbed the "dataXcellerator," the unit has been designed to utilize existing, proven technology in order to allow cable operators to offer high-speed data services over their networks and realize a quicker return on investment, according to Thomas Steipp, VP and GM of high-speed data systems at S-A.

Although the company has entered the modem race late, Steipp says the entrance appears to be timed perfectly, as more and more operators are preparing to offer data services soon and establish a competitive beachhead, rather than waiting until their networks are two-way operational, and interoperable modems appear in the market.

In fact, S-A's decision to offer telco return represents something of a trend, as General Instrument, Zenith Electronics and Hybrid Networks have also developed similar products.

The new unit, the first in a planned family of products that will eventually include a unit with RF return, features a 1.2 Mbps (megabits per second) downstream signal speed that most users will find more than adequate because most personal computers can only handle a 3 Mbps input at best, says Steipp.

S-A decided earlier this year not to offer a "me too" product based on quadrature amplitude modulation downstream and QPSK upstream. In the wake of some operators pulling back on their capital expenditures, Steipp says the decision was a good one because it allows them to offer a low-cost product that operators can deploy, and get a return on their investment within 24 months.

Not only is S-A offering the modem, but the company is also touting its ability to provide a turnkey service, including Sun servers, a modem pool from Ascend Communications, a router from Cisco Systems and headend software based on Hewlett-Packard's OpenView system. Furthermore, through a Florida network operations center the company already owns, S-A could also perform remote network monitoring functions, further reducing an operator's initial capital outlay.

Field trials of the units are expected to commence shortly, with undisclosed operators, says Steipp. Volume production of the units should be available in the first quarter of 1997.

GI, Rogers test 256-QAM in field

Although cable operators are struggling to deploy digital set-tops in their race to offer increased channel counts, work continues to improve those devices and provide even better economics of scale.

General Instrument, not content with the de facto industry standard 64-QAM scheme, recently field-tested 256-QAM over several cable systems owned by Rogers Cablesystems, and announced the tests a complete success. The higher-order quadrature amplitude modulation method effectively gives cable operators 44 percent more channel capacity through more efficient use of the spectrum.

The tests, which were performed in August, were conducted at 21 different sites served by five different headends in and around the Toronto area. Areas tested included those which were recently upgraded with fiber optic gear, including one fiber link of 55 kilometers, to a system with no fiber and 38 amplifiers in cascade. Fifteen-minute tests resulted in error-free performance, while overnight tests averaged 99.9 percent error-free performance, with worst-case of 99.5 percent.

The results thrilled Nick Hamilton-Piercy, Rogers' senior VP of engineering and technology, who has already ordered a large quantity of set-tops that make use of the modulation scheme. "It worked beautifully," says Hamilton-Piercy. "The only place it didn't work was where analog doesn't either."

In fact, Rogers is enamored enough with the product that it plans to delay its digital launch until next year, when the set-tops are available. Not only that, but the company will digitize its entire channel lineup to make sure customers don't see a difference in quality between an analog and digital tier. "If you can get 30 percent to 40 percent more bandwidth, why not?" asks Hamilton-Piercy. Today, 256-QAM boxes cost about $20 more than their 64-QAM cousins, but that could drop to about $5 per box in time, he notes.

Other operators, while interested to hear the tests went well, plan to deploy 64-QAM technology first and save the additional bandwidth gains for the advent of HDTV.

(For a more detailed discussion of the tests, see the story on page 78 of this issue.)

In a related announcement, GI said it would offer, without royalty fees, its patents to other manufacturers who desire to conform to the ITU and SCTE standards for digital cable transmission. Those standards, agreed to in recent weeks, will allow cable operators to purchase set-tops, modems and other customer premise equipment that interoperates. The agreement gets around long-standing proprietary approaches that created widespread compatibility conflicts.

Specifically, GI will offer up its QAM modulation and forward error correction technology to companies that agree to cross-license, on reciprocal terms, any relevant patents they may have which are necessary to conform to the standard.

Industry observers applauded the move, calling it necessary for the recently-adopted standard to gain market acceptance among multiple manufacturers, making more units available to cable operators.

TCI begins rollout of digital video

Nearly four years after promising the world cable systems of 500 channels or more, Tele-Communications Inc. finally began deploying digital video to residents in West Hartford, Conn. in late October.

The roll-out of "ALL tv" is considered as a watershed event, though the news has lost its

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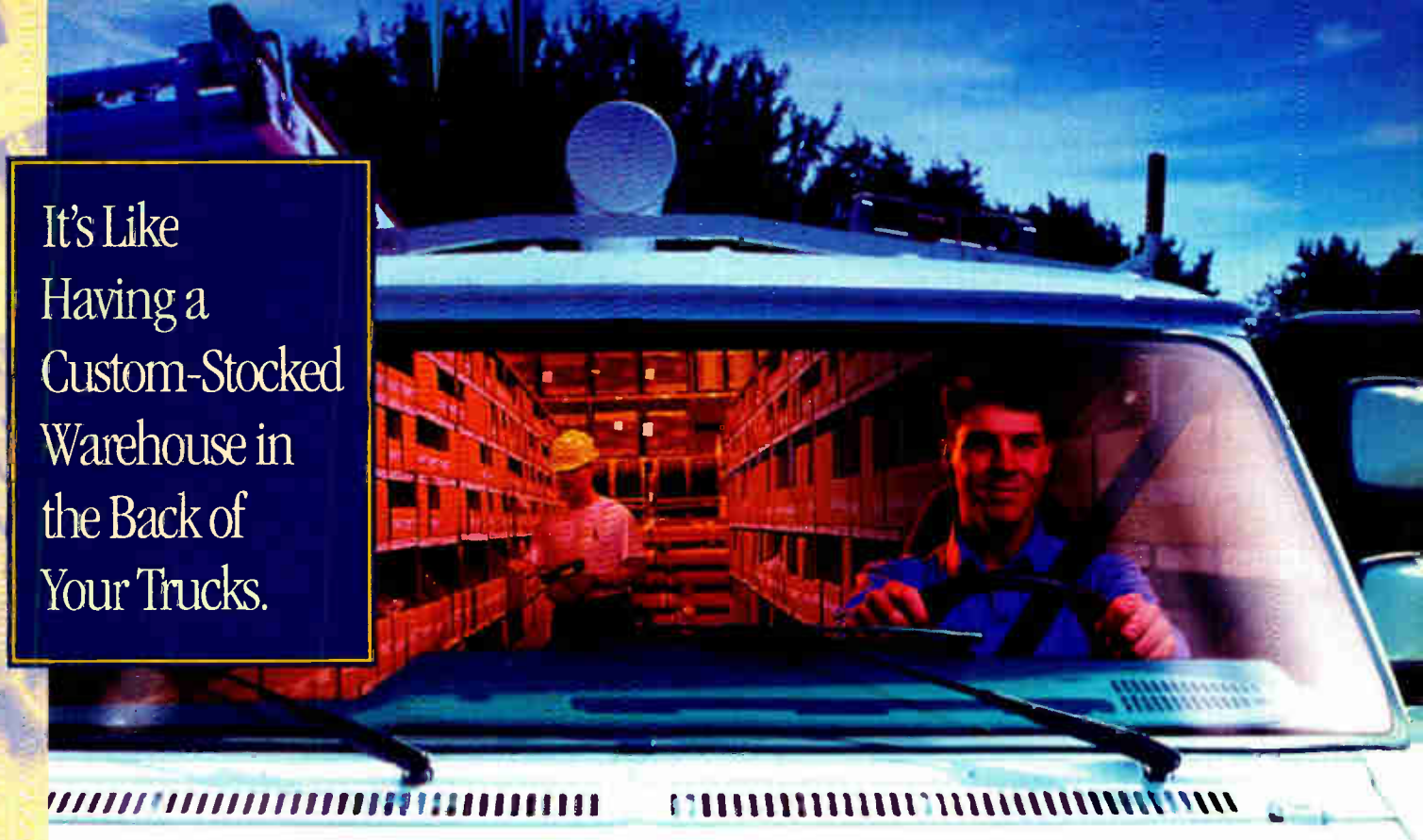

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luster over time as the cable industry was plagued with numerous delays. In fact, the cable industry lost its digital lead years ago and has had to witness DBS services deploy the technology sooner.

The name for the new service was chosen because it offers consumers more choice, more parental control and a new interactive program guide, according to TCI executives. Along with the traditional expanded basic lineup, the new service offers 25 premium movie channels, 18 special interest channels, 40 channels of Digital Music Express music and 37 enhanced pay-per-view channels with movies starting every half-hour.

The Prevue Interactive program guide is also offered. It provides updated programming information, impulse purchase of PPV events and movies, program reminders and easy browsing of all the channels.

In a separate announcement, the company said it was splitting its cable operations into three separate groups in order to better organize its systems into units that share similar needs.

Group A will consist of large urban and metro systems that are preparing to offer new services over advanced cable systems. Barry Marshall, who had been executive VP, will be president of this group.

Group B will consist of systems that are ripe for the ALL tv digital service. Marvin Jones, a 38-year cable veteran and formerly of Liberty Media and United Artists, will head this group.

Finally, Group C will encompass the Hartford, Chicago and San Francisco systems, where All tv, "People Link by TCI" (a wireline telephony service) and @Home (high-speed data service) will be offered over the same network. Barbara Mowry, presently senior VP of customer satisfaction, will preside over those systems.

The company is expected to announce management and organizational changes to fit into the new structure, and will announce which of its systems will be placed in each group.

The new structure appears to fit with TCI's recent announcements to Wall Street, which said the company would scale back its capital expenditures on expensive network upgrades in an attempt to shore up its financial performance. Creditors are close to rating TCI's stock at the "junk" level, which could have serious financial implications for the country's largest cable MSO.

In response to those concerns, TCI has already announced a wide-ranging way to improve its cash flow to include reducing capital expenditures, a rate increase, leaning on programmers for price breaks and asking programmers and service providers like @Home and TCI Telephony Services to help pay for network upgrades or set-tops.

Finally, TCI has licensed a suite of interactive telecommunications patents from Ronald A. Katz Technology Licensing to process interactive transactions. Other major patent licensees include American Express, First Data Corp., MCI Communications and Home Shopping Network.

Katz is the holder of more than 30 patents, primarily in telecommunications and computing. Katz formed Telecredit Inc., the nation's first on-line, real-time credit and check cashing authorization system.

5 MSOs commit to test TV On-Line

Five major cable TV network operators intend to field trial the "TV On-Line" data service from WorldGate Communications, starting in January.

Comcast, Cablevision Systems, Adelphia, Charter and Telewest Communications Scotland (owned by TCI and US West) have all agreed to test the Internet access via the TV service using existing General Instrument and Scientific-Atlanta analog addressable set-tops that are capable of receiving data at 100 kilobits per second. In addition, plans are being made to test the service over digital set-tops, which allow data to be sent as fast as 27 megabits per second.

TV On-Line will allow television viewers to gain access to the Internet and the World Wide Web without having to purchase or use a personal computer. Instead, the vertical blanking interval and cable-TV set-top boxes are used to send and retrieve the data, along with a small, inexpensive wireless keyboard.

In addition, viewers will be able to interact with TV program content as advertisers hyperlink their commercials to their Websites. Also, TVOL will offer access to the "Community Cyber-Center," which offers a variety of localized content and information on local schools, churches, restaurants, theaters, retail shops and classified ads.

Separately, WorldGate licensed Spyglass's Web Client Software Development Kit to provide browser technology for the TVOL service. The Spyglass technology will allow TVOL to implement Web browsing on existing set-tops, making expensive hardware upgrades in the home unnecessary. Spyglass is a well-known licenser of Web client/server technologies.

GI breaks ground on new corp. campus

Driven by tremendous growth and a need to consolidate its operations from the 11 buildings the company now occupies, General Instrument's Communications Division broke ground on a new, 70-acre site that will soon feature four linked buildings in a campus-like environment. The company hopes to begin a phased move-in beginning at the end of 1997.

The 390,000-square-foot facility, located in Horsham, Pa., not far from the company's present headquarters building, will roughly double the amount of space the company now occupies, but will bring employees closer in proximity while organizing them by business

General Instrument broke ground last month for its new Eastern Operations headquarters. The $70 million project will include separate buildings for the company's analog, digital and transport business units.

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units. The new construction represents an investment of nearly $70 million by GI, according to Ed Breen, president of GI's Eastern Operations division.

When it's finished, the new site will be able to accommodate about 1,300 employees. If growth continues, the company has an option on a contiguous 20 acres and could construct yet another building, says Breen.

In the new facility, the company will have more room to do engineering and research and development work, says Breen. For example, engineers will be able to construct end-to-end systems and test them—something that is nearly impossible to do in the present facilities.

Blonder and S-A in patent squabble

Details are few, but Scientific-Atlanta has filed a lawsuit against Blonder-Tongue Laboratories, alleging patent infringement related to the development of B-T's "VideoMask" interdiction equipment.

The interdiction gear is used by video signal providers to "jam" signals to unauthorized homes, making those signals unwatchable. S-A developed an interdiction system several years ago, but cable operators never really embraced the technology because of powering, cost and signal theft questions.

B-T's product has been chosen by Pacific Bell Video Services for deployment in northern California. This lawsuit is not expected to affect that purchase order, according to company sources.

Blonder-Tongue issued a press release acknowledging S-A's complaint, but said that outside patent counsel had reviewed the suit, the product design and prior art and advised B-T not to expect any liability.

PrimeStar set to go to high-power service

Spurned in its efforts to acquire satellite licenses from other interests both here in the U.S. and in Canada, PrimeStar partners and Tele-Communications Inc. plan to launch a high-powered direct-broadcast satellite at 119 degrees west longitude sometime next year.

The company is already preparing one of its two Loral satellites for a February launch from Cape Canaveral, Fla., according to a statement issued by the company.

PrimeStar was forced to use the 119-degree orbital slot after U.S. and Canadian trade agencies were unable to reach an accord regarding the Tempo/TeleSat transaction. The FCC rejected TCI's bid to use Canadian slots for a U.S. DBS service.

By launching and parking the bird at 119 degrees, PrimeStar will have access to 11 transponders, allowing it to offer between 70 and 80 channels to subscribers who install a 13.8-inch dish. With new, more efficient compression algorithms on the horizon, PrimeStar officials say they will be able to offer more than 150 channels ultimately.

In the meantime, PrimeStar intends to nurture its medium-powered service, which boasts nearly 1 million subscribers. The company's plan to launch a successor to the GE-2 satellite is still set for late January 1997, which will allow it to offer about 50 new channels.

Zenith selects OS for Americast box

The Americast digital set-top box that Zenith Electronics will be building is beginning to take shape. Zenith recently completed a technology agreement with DiviCom Inc. to design the box and will use its manufacturing facilities to integrate its power supplies with DiviCom decoding and modulation equipment, along with Microware Systems Corp.'s DAVIDLite operating system.

The Americast consortium consists of Ameritech Corp., BellSouth Corp., GTE Corp., SBC Communications and Southern New England Telecommunications Corp. The group recently contracted with Zenith to purchase up to 3 million units in a deal that is worth about $1 billion as each of those companies begins to roll out video services. The set-tops will be designed with network interface modules so that they can be integrated into MMDS, DBS, hybrid fiber/coax or switched digital video networks.

DAVIDLite is a small-footprint version of Microware's OS-9-based DAVID operating system that is used in several interactive TV applications. The "Lite" version allows for reduced interactive capabilities.

As of presstime, Zenith had not announced which access control and encryption it was planning to use.

Jottings

Joe Van Loan has landed on his feet again. After a short sabbatical caused by the buyout of Cablevision Industries, the well-known engineer has taken a job with startup cable operator **MediaCom** as its senior VP and chief operating officer. You can find him in Middletown, N.Y. at 914/692-9090 . . . Electrical connector firm **Thomas & Betts Corp.** is poised to acquire **Augat Inc.** for about $550 million. The acquisition, expected to close by the end of this year, will make Thomas & Betts one of the five largest connector companies . . . **Nynex CableComms** has chosen to use **Motorola's** CyberSurfr high-speed data modem for a field trial in Britain. The trial will initially involve 200 modems and associated equipment in Nynex's northwestern franchise areas and Manchester . . . **Turner Broadcasting Corp.** has chosen **Scientific-Atlanta's** PowerVu digital video compression system to deliver programming to Latin America. Turner will transition The Cartoon Network and TNT Latin America to PowerVu from B-MAC by the end of the year . . . MMDS operator **American Telecasting Inc.** will work with **MCI Telecommunications** to test high-speed Internet access via the wireless spectrum. The test is expected to occur in Colorado Springs and other locations to be determined . . . **CellularVision** of New York has finished installation of two new LMDS transmitters, giving the company seven such sites. The new cells serve roughly 340,000 residences in midtown Manhattan and Northwest Queens . . . **The International Conference on Consumer Electronics** is accepting technical paper submissions until January 15, 1997. The ICCE is held annually to promote a technical exchange between engineers and scientists in the consumer electronics industry. The conference is scheduled to occur in Chicago, June 9-13. For information, contact Diane Williams at 716/392-3862 . . . Scientific-Atlanta has been selected by **Gulf Power Co.** to provide two-way, interactive advanced energy management through its MainGate technology. The system will be rolled out to 40,000 northwest Florida homes over the next seven to eight years, beginning next May. The MainGate system allows communication between customers' homes and the utility to manage energy sales during peak usage times. Customers are connected via a VHF paging interface, with a telephone return back to the utility . . . Speaking of S-A, the company was recently awarded with an **Emmy** in recognition of its work in digital video compression systems . . . **NextWave, MCI** and **Lucent** will demonstrate and test Lucent's CDMA-based PCS equipment. Digital mobile service trials have already started, and MCI has already installed a demo system at its Washington, D.C. headquarters . . . **Oak Industries** has purchased a 17 percent interest in **Gilbert Engineering** and has agreed to acquire the 15 percent interest held by Gilbert managers. . . . CED

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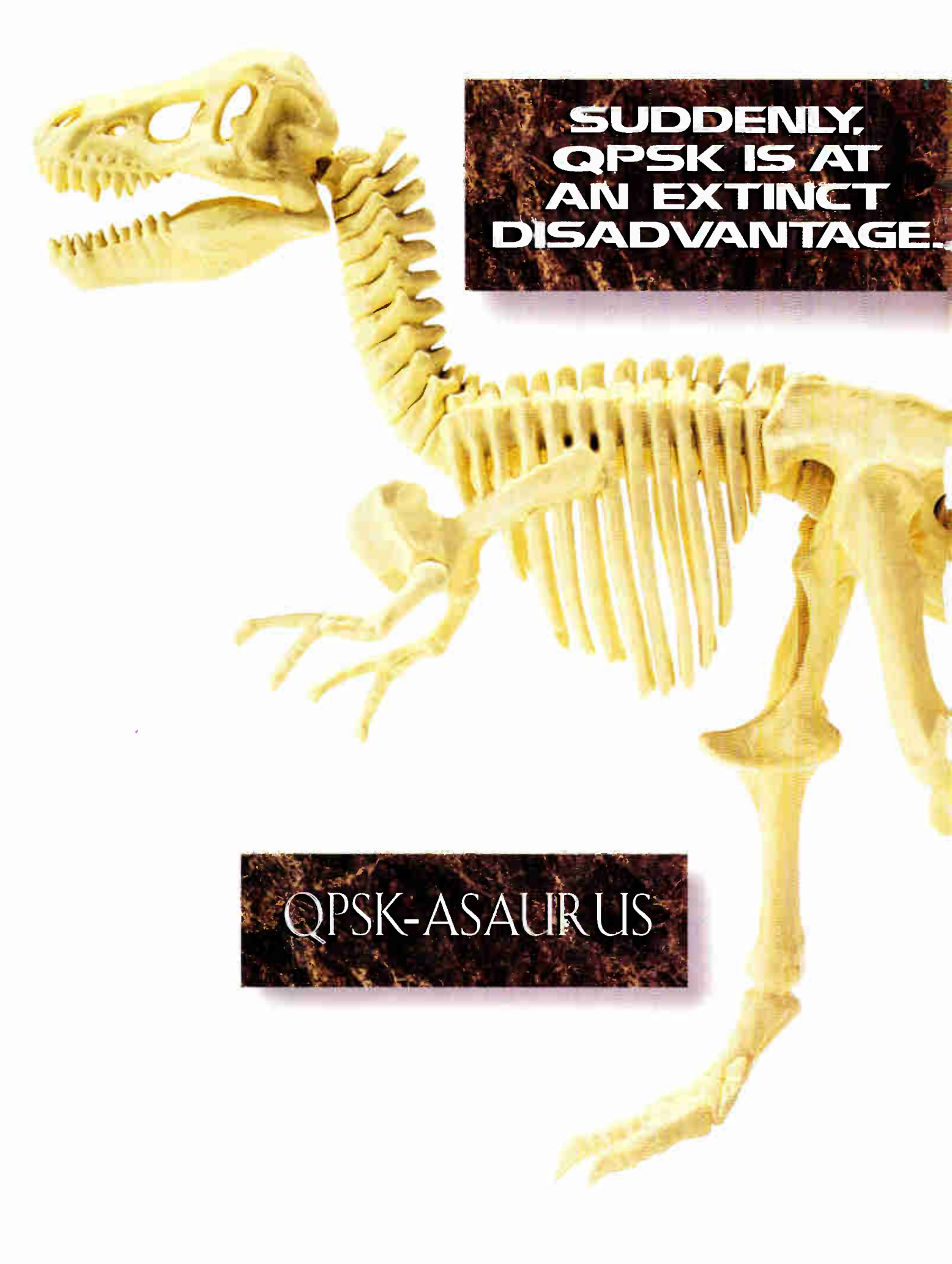
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Laubach: Solving the standards puzzle

Mark Laubach

Mark Laubach became a firm believer in standards and interoperability early in his career. While pursuing a master's degree in computer science at the University of Delaware, part of his thesis consisted of a project that would cause many lesser humans to rip their hair out: finding a way to link a proprietary e-mail system to the Internet, enabling e-mail messages to pass back and forth, where no gateway had previously existed. "I adapted (an existing) protocol," recalls Laubach, "and wrote I don't know how many thousands of lines of Pascal in order to port the system so we could get mail in and out it."

Apparently that experience marked him for life, because today, as vice president, chief technology officer and co-founder of cable modem supplier Com21, Laubach has thrown himself wholeheartedly into the standards process, working with groups like the IETF (Internet Engineering Task Force), the IEEE (in its 802.14 committee) and the SCTE.

"I have always been a believer in standards, especially for the Internet," says Laubach. "It's the only way to get things to begin to interoperate." That commitment is proven out by a number of accomplishments, including Laubach's authoring of an IETF international standard, "Classical IP and ARP over ATM." He has also acted as a liaison between the ATM Forum's Residential Broadband Working Group and the IEEE 802.14 CATV MAC and PHY Working Group.

In his present role at Com21, Laubach handles the analysis and specification of the company's current and next generation modem system architecture. Essentially, he's responsible for how the protocols, the interfaces and all the rest of the pieces fit together—and that includes the design of Com21's media access control (MAC) protocol.

A firm believer in ATM (asynchronous transfer mode) technology, Laubach clicked with Com21 founder Paul Baran (the inventor of packet switching, which led to the Internet) when David Farber, Laubach's professor and mentor, introduced the two in 1994. "We know that ATM forms a general purpose, scalable architecture that supports a variety of services," explains Laubach. "And we have a passion at Com21 for wanting to enable integrated services."

Technology ambassador

Laubach has more than 15 years of experience in computing and networking technologies, the bulk of which were spent with Hewlett-Packard, where he started out as a technical writer. From that position, he launched himself into becoming a design engineer, a systems architect, and finally, senior engineer/scientist with HP's Media Technology Laboratory in Palo Alto, Calif. In that post, one of his final projects was designing an end-to-end systems architecture for next generation interactive video and community networks. Partly as a result of that work, Laubach began to see the promise of broadband data access directly to the home, and consequently, the allure of joining Com21.

And once Com21 becomes a household word in cable modems, can Laubach take a breather? "It's not like a pen, or a mousetrap, or a zipper," he notes, "which people can invent and retire off of it. This is a technological jungle, and you constantly have to improve on the product, until you can figure out the market and what's going to sell for the longterm: new products, new features, new differentiation, while still trying to keep in mind the best interests of cable operators."

With the aim of furthering those interests, Laubach advises that operators should judge cable modems in terms of flexibility, scalability and ease of use: "Does it help them get their business done better? The cable modem system has to be synergistic with their environment. Does it help them do additional things, like manage their upstream plant? Is there some robustness in the future, that allows them to add new services, without having to buy yet another set of hardware?" he explains.

Communing with "The Tick"

Without a doubt, Laubach has a lot on his professional plate. "I don't want to say that standards meetings have replaced my social life, but . . .," his voice trails off in laughter. "I'm trying to get back to having a more balanced life."

One of the balancing forces in Laubach's life is Lindy, his seven-and-a-half-year-old, floppy-eared Doberman, who keeps him "sane." Another is a fondness for good animation, honed, he says, by growing up on quality cartoons like the original "Looney Tunes" series, with its trademark overtones of adult humor. These days, when he wakes up bleary-eyed on a Saturday morning, Laubach tunes into "The Tick," while he pays bills and checks his e-mail. (For the uninitiated, "The Tick" features a variety of somewhat twisted super heroes, including the title character, who battle the forces of darkness.)

Laubach, who was the first engineer hired at Com21, is looking forward to the day when he can revisit some of his hobbies that have fallen victim to Silicon-Valley-startup-company syndrome. In his former life, he pursued adrenaline rushes via skydiving, piloting small planes and scuba diving. Now, because of time constraints (or maybe it's the adrenaline rush from those standards meetings), Laubach is more likely to roller-blade and ride his bike around the bay and mountains where he lives.

But sacrificing a few hobbies to achieve his goals doesn't seem to bother him a bit. Laubach sums up his wish for Com21's modem offering: "That we develop a system which best matches the flexible and entrepreneurial spirit of cable operators."

–Dana Cervenka

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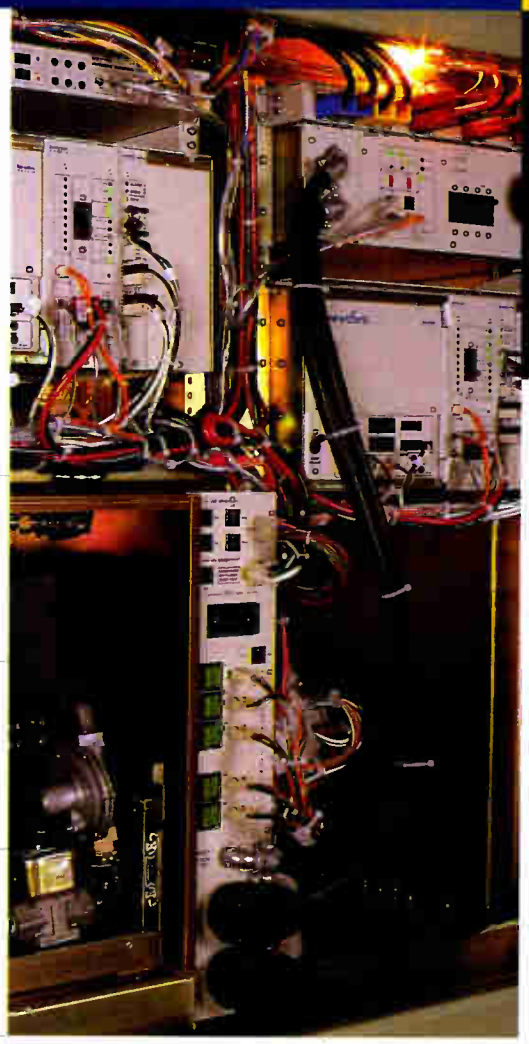

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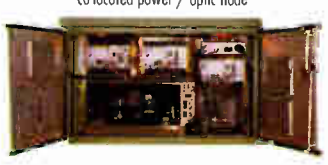

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Bailey's wish list for the cable industry

By Wendell Bailey, VP of Science and Technology, NCTA

It seems that every year about this time, people who write columns are accosted by their editors with the plea that they produce a Christmas wish list. Where do people who are trained in the journalistic arts get this urge? Anyway, here we are at the Western Show, and here I am with my Christmas wish list for the cable television industry.

First, I wish, hope and pray for the successful completion of the cable modem standards by the first moments following the dispatch of the wrapping paper from under the tree. The work of CableLabs and the MCNS group is more important for our future than most of us know. The world is waiting for this product, and we are the ones who can deliver it.

I know that there are a few cable people who don't think that this is necessarily the best way to go, but think about it this way: If we get cable modems, and data turns out to be a loser of a business, will you have done anything to your plant that causes you problems later? Probably not. Will you have done anything to your engineering, customer service and marketing departments that will be useful for whatever business you wish to pursue? Probably so. See what I mean? This is a win-win deal if the standards get completed, and the vendors make the modems, and the retailers sell them to everyone who wants one.

Santa: Please, some sanity

Next, I would wish for a massive and multiple release of digital set-top boxes from any and all vendors who make them. There is an agreement in place that sets some standards for the basic operations of these boxes, and a few are actually in paying customers' homes. Many more will be there by the time you see this article, and many million are "on order." It really is quite simple—the more of these things that we have in our subscribers' homes, the fewer of those subs who will consider going to an alternate provider of video programming.

While I'm on the digital kick, how about a wish that the digital standards-setting groups will coalesce into a single committee with no more than 10 engineers involved? There are literally hundreds of committees involved in setting digital standards for somebody, and each of them pulls together at least 100 engineers (and a few lawyers) every time that they meet–and they meet regularly. Just keeping the information book up-to-date is a daunting task. Trying to actually figure out what each of these committees is doing, and to whom, is all but impossible. Yet as impossible as that seems, the prospect that *you* or *we* might not know is an even more troubling thought for the future. So, please, Santa, bring some order and sanity to this little spot.

Having all of these wishes granted will only help us along a certain amount to wherever we might be going. We can and will go further if we have more two-way plant in place. So for this wish, I would ask for a vigorous and sustained push by our industry to provision and activate two-way plant everywhere we can. Today, some folks say that the amount of two-way activated plant in our industry represents about 20 percent of our subscriber base. If that is true (I think that it might be), then we have a good start on what we need to accomplish here.

It's not just that we can offer better pay-per-view or shop-at-home or telephony or more exciting Web surfing, it is all of those things and more. True, two-way plant takes the cable infrastructure out of the forward-biased model that we have and opens up the possibility to sell not just entertainment but commercial services, long-haul interconnects and other cool things. We have an infrastructure that is more capable than any ever built. Making it complete by making it two-way just makes sense.

I would also wish for an end to the endless wrangling over the FCC-ordered interconnection rules. The RBOCs need to stop whining and get on with the game. They started this; they promised more blue-sky stuff in the last two years than the cable television industry promised in the last 30 years. So enough, already. The FCC proposed a set of rules and regulations that faithfully implemented the intent of Congress. It's time to put up or shut up, and I would appreciate it if Santa would tell them so.

I'm sure that you all can anticipate this next one—an end to the compatibility negotiations. We have made some remarkable progress in the last few weeks, and at the Western Show, we will have what I hope are the meetings that will move us ever-closer to the end of the longest ad hoc committee assignment that many of you have ever accepted. The effort is now entering its twelfth year. Please Santa—make it stop.

I could also ask for a little understanding from the FCC on the issue of Emergency Alerting Systems (EAS). We all care about the need for participation in this important national effort, but thousands of dollars for headends that serve only 100 subs is asking too much. The Commission usually understands the issues that our smaller operators have, but in this particular case, we wonder if it understands the impact of rules crafted to fit one concept of a cable system, when those rules are applied to any and all cable systems.

Peace, understanding and digital

In the end, maybe all I could wish for is a little more understanding from the FCC, and a little more understanding from our management about the next request that we put through for anything digital. CED

Have a comment?
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Reader Service 12

Seasonal colors and bandwidth reduction

By Jim Farmer, Chief Technical Officer, Antec

At this colorful time of the year, what could be more appropriate than continuing to discuss bandwidth reduction in the early years, by looking at how color was added to a black-and-white television system. OK, so a lot of things are more appropriate, but I'm a bit strange.

The second National Television System Committee (NTSC) was convened in the early '50s to add color to the existing black-and-white television system. From film work, it was known that one could fool the eye into seeing almost any color, if the eye was presented with the correct proportion of three colors known as the primary colors. When one is talking about producing three colors and combining them, the primary colors are red, green and blue. (Hey, two are Christmas colors! I knew there was a tie-in somewhere.)

An easy answer would have been to simply transmit three pictures: one of the red scene content, one of the green and one of the blue. But if you do that, you take up three channels, where you had one for black-and-white, so this doesn't seem to be such a good idea. Alternatively, you could sequentially transmit a red picture, a green one and a blue one. If you do it fast enough, the eye will put the three together as one color picture. In fact, such a system was our national standard, but only for a short time.

So how does one cram three pictures in the spectrum of one? One trick is to recognize that the eye perceives sharpness primarily in the black-and-white image, not in colors. So, if instead of transmitting three complete, full bandwidth images, we make up a black-and-white picture from the color pictures, and transmit it at full resolution (bandwidth), we can transmit color information at lower bandwidth. The eye won't know we robbed it of sharpness.

So how do you make a black-and-white picture out of three pictures in the primary colors? You do it the way the HVS (human visual system) does it. Add each primary color in the same proportion that the eye perceives it. If you look at a chart of the sensitivity of the HVS to the three primary colors, you see that we are most sensitive to green, as it is in the middle of the eye's optical passband (which isn't very flat, by the way). So you mix in mostly green, with smaller proportions of red and blue. The proportions used in NTSC are 58.7 percent green, 29.9 percent red and 11.4 percent blue.

We call the resulting black-and-white picture the "luminance," or "luma" for short. Sometimes you hear it referred to as the "luminance channel" (not a new programming service). It is designated with the letter Y. (Why Y? I have no idea.) We treat the luma signal to a lot of bandwidth, theoretically giving it the full 4.2 MHz of the NTSC system. This signal can be fed to a black-and-white TV, so we are backwards compatible.

Recall from high school algebra, that if there are three unknowns to be solved, there'd better be three independent equations. The receiver needs three signals for the red, green and blue guns in the picture tube, so it had better get three signals from which to derive the gun drives. One signal is the luma signal, so we are down to needing two others. These two signals are called the color difference signals, because they are developed by taking the difference between the luma signal and the red and green signals. We write these signals as R-Y and B-Y, and we call them "RY" and "BY." These two signals can be filtered to a lower bandwidth than can the luma signal, because the eye is not as sensitive to sharpness of color information. For simplicity, I'll leave out one step in the process at this point, during which the axes of these signals are rotated.

We are left with the problem of cramming these two signals into the same spectrum occupied by the luma signal. This can be done by taking advantage of the fact that the luma signal has little energy in the upper portion of its spectrum–we can sneak another signal in that portion of the spectrum. We do so by modulating the two color difference signals onto two carriers, each at about 3.58 MHz.

How can we modulate two different signals onto carriers at the same frequency, and keep them separate? It is beyond what we can go into here, but one can show that two signals can be modulated onto two carriers at the same frequency, then demodulated independently, *IF* the two carriers are 90 degrees out of phase with each other. A 90-degree relationship is called a "quadrature" relationship, so we call the two signals "in-phase" and "quadrature" components (usually called "i" and "q"). The i channel is filtered to 1300 KHz, and the q to 600.

Smart reduction

Thus, we have succeeded in taking a black-and-white television system, and adding color in a way that maintains compatibility with older black-and-white sets, and doesn't take any more spectrum than the black-and-white signal. We did it by being smart about removing unneeded information from the signal. Talk about skill in bandwidth reduction! And it was done without computer simulation. We'll talk more about the color subcarrier in the future.

In the October column, I promised a very valuable attaboy (or attagirl) to anyone who e-mailed the correct answer to the question of why the field rate of NTSC video was shifted from 60 Hz to 59.94 Hz. The answer is tied in with the color signal. Congratulations to Brian McFadyen of Time Warner and Randy Midkiff of Continental, who have received their attaboys as of this writing. CED

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The Internet and the telephone network

By Jeffrey Krauss, surfing the telephone net and President of Telecommunications and Technology Policy

Earlier this year, I wrote about the telephone industry's complaints that the Internet is unfair competition with the telephone network because Internet telephony is "free." (See "Access charges for the Internet," in the February 1996 issue of *CED.*) Internet Service Providers (ISPs) are not paying access charges the way long distance companies pay access charges.

Now the telephone industry has raised a new complaint—Internet subscribers are screwing up telephone networks because the networks weren't designed for Internet connections. Phone companies just can't get it through their monopoly mindset that when customer demand patterns change, the service has to change. They don't understand that in the new world of competition, the ability to offer the service that customers want will be the difference between success and failure.

The access charge issue

An ISP is something like a long distance phone company, in that it gives subscribers access to a long distance communications network. Both the ISP and the long distance carrier incorporate local phone connections in their overall network. Both pay the local phone company for, in effect, reselling the capacity of the local phone network. But they pay different rates. The ISP pays the same rate as any business that uses the phone network to make local calls. The long distance carrier pays "access charges." Access charges are much higher than local phone rates, as high as five cents per minute.

Access charges originated in the early 1980s as an FCC-sanctioned way for long distance service to subsidize local phone service. In 1987, well before the Internet became popular, the phone companies wanted the FCC to apply access charges to enhanced service packet data networks like Telenet and Tymnet, but Congress objected, and everyone lost interest in the issue. Now, with the rise of Internet telephony, the phone companies are at it again. They want their subsidies.

The current expectation is that the FCC will overhaul access charges in the 1997-'98 time frame. ISPs will have to pay access charges. But the rates will be knocked down from five cents per minute to a few tenths of a cent.

The network design issue

The new argument from the phone companies is that Internet traffic is different from voice traffic, so different that it could crash the phone network.

Wait a minute. Let's take a closer look at this argument. Sure, phone call durations might be longer when I surf the 'Net than when I talk to my mother in Florida, but what are the cost and engineering implications?

By the way, even the phone industry agrees that voice call durations have increased over the years. It used to be that an average phone call would last four minutes; now, the phone industry uses nine minutes as the average holding time.

My local loop and the connection to the local phone switch are dedicated to my phone number, whether I use it or not. The cost is independent of the duration of my calls.

The local switch gives me dialtone, interprets my dial pulses and arranges for a path through the network to be established. But that happens only when the call is dialed. After that, the switch circuitry goes on to set up the next call. Most of the usage of the telephone switch circuitry is independent of call duration.

But the phone industry is right about one element. There is a part of the network that is affected by call duration, the trunking between local switches. This is because the phone network assigns a circuit full time to a connection between switches, even though you might be sending and receiving data packets only sporadically.

But rather than figuring out how these trunks can be shared among multiple Internet connections so they can be used more efficiently, the phone companies are now spreading scare stories about the Internet causing a possible "meltdown" of the phone network.

The monopoly mindset

It's the same old story, but now with the local phone monopolies instead of a single nationwide Ma Bell. "Here's our network and our service; you must tailor your demand so it fits what we have."

Let's look at another part of the Internet, the intercity high-speed data circuits between ISPs. One of the leading suppliers of this service is MCI. MCI took its intercity fiber network, which was installed for voice telephone traffic, and figured out how to use it efficiently for high-speed data.

MCI saw the Internet as an opportunity, not a threat, and modified its network design to satisfy user needs. And the company earned a profit while doing it.

The phone company engineering philosophy has been stability, not agility. But the world is changing. Stability fits quite nicely with a monopoly environment. But "brand loyalty" is on its way out. Have you noticed that in the cable industry? It applies to the phone industry as well.

In the world of competition, companies must change, or die. CED

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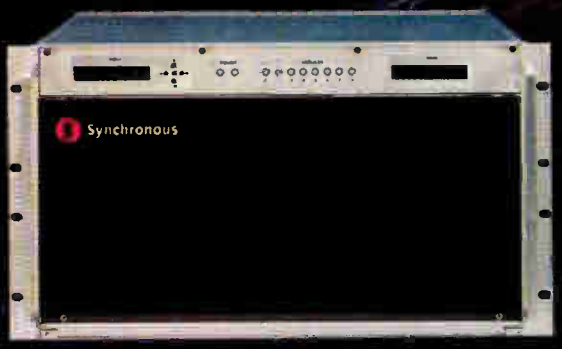

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directional trunk and feeder built about 15 years ago.

Using a network analyzer on the in-house system, it was determined that open low-value taps created unacceptable downstream group delay, varying from about 60 nanoseconds at the high end of the spectrum to 100 ns at the low end. These delays could indeed have a detrimental effect on 64 QAM bit error rates, making termination of taps a necessity.

Real tools being developed

One testing tool that has been developed by CableLabs and could be going commercial soon is the "Carrier Wave (CW) Tester," the brainchild of CableLabs Chief Technical Officer Dr. Richard Prodan.

The filtering approach, though it puts off the inevitable "clean-up," is gaining favor

The device helps operators determine the causes and characteristics of transmission interference by trapping and storing impairments in either the forward or reverse paths.

Prodan presented information gathered by the tester in several real, live cable systems and presented some general conclusions. For example, he has determined that upstream ingress is frequency localized, of long duration and primarily comes from interfering transmitters. On the other hand, downstream burst noise happens infrequently, has a short duration, is stronger than thermal noise, is constant over a 24-hour period and is primarily caused by intermodulation.

Pros and cons of filters

OK, so now that impairments can be found and understood, what's a cable operator to do to minimize their effects or eliminate them altogether? There are several answers, and some will work better than others, depending on system size, type and location, among other factors.

One of the most popular choices is to install a high-pass filter adjacent to customers' homes to eliminate the unwanted noise and signals emanating from the home by blocking the return spectrum. Other choices are bandstop filters, which pass the lower portion of the return band (where set-top boxes typically transmit information to the headend) while "cleaning up" the upper portion, where advanced services are likely to be placed, according to Antec's Farmer.

The filtering approach, though considered nothing more than a method to make the return band work while putting off the inevitable "clean-up" to a later date, is nevertheless gaining favor. One engineer who reluctantly allowed his systems to use the approach is Cox Cable's Alex Best.

"All it does is delay the time when we have to go out and clean up those homes," Best admitted, but they do allow an operator to get started sooner and probably at less up-front cost.

Cox is presently upgrading many of its systems to 750 MHz capacity, full two-way capability and with fiber nodes typically serving about 1,000 homes. The company planned to have completed the upgrade on plant passing about 500,000 homes by the end of 1996, Best said.

Farmer's own personal favorite approach is the network interface module located on the side of the house through which all services pass. In this scenario, the full NTSC spectrum is passed through the NIM, while the return spectrum is blocked, except perhaps for a narrow slice of RF spectrum that is used for pay-per-view return signals.

This could allow operators to shift the return to the high end of the spectrum, which avoids the messy and crowded 5 MHz to 40 MHz area, Farmer said.

Digital signals could be demodulated at the NIM and either remodulated in a lower-order scheme for robust delivery throughout the home, or converted to NTSC. Either approach would allow signals to be displayed on all TVs without a set-top (as long as the TV could tune all available channels). A simple RF remote could be used to control the received digital channels. Data services can easily be supported with a telephone cable that runs from the PC's 10BaseT port to the NIM.

All in all, "the return isn't a slam dunk, but it can be made to work," Farmer told the gathered audience.

Modulation selection can make a difference

Sometimes, even the choice of modulation methods can improve network performance, according to Dennis Picker, VP of engineering at Terayon Corp. The Silicon-Valley-based company is touting its Synchronous Code Division Multiple Access (S-CDMA) as a way to combat many problems cable operators often encounter in the return band.

Specifically, Picker said S-CDMA is superior to other modulation formats for the following reasons:

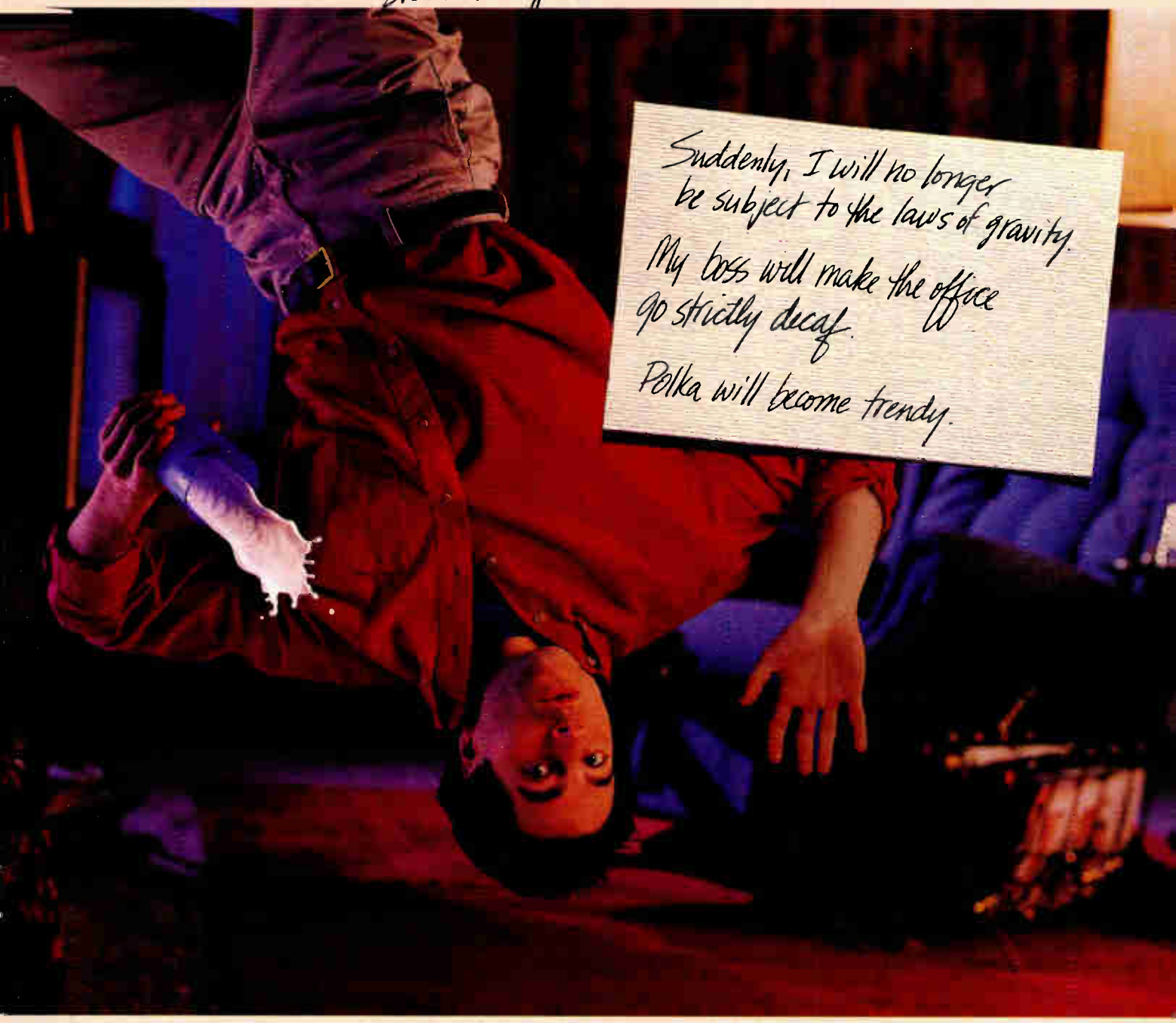
✔ Frequency division multiple access (FDMA) approaches are highly susceptible to non-linear distortions and offer no special defense against white noise or impulse noise;

✔ Time division multiple access (TDMA) schemes, both the asynchronous and synchronous variety, offer no special defenses against white or impulse noise, or narrowband interference. They also suffer from access and equalization problems because the burst mode and contention access slots pose power saturation problems, which can cause nonlinear impairments from amplifier saturation. Also, the approach requires precise synchronization;

✔ TDMA/FDMA hybrids do offer "after the fact" recovery from narrowband interference and provide for more graceful degradation (dropping to a lower-order modulation or selective dropping of frequencies).

But S-CDMA beats all those by spreading the spectrum and adding synchronization to minimize intercode interference, Picker said. Further, it provides interference immunity by providing gain, a real-time defense against narrowband interference and impulses. CED

THE FEARS OF *Steve Kinger*, CATV NETWORK ENGINEER



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Wrapping up management solutions with OSS

Proprietary management solutions hinder cable's future success

By Michael Lafferty

Amidst all the hype and hoopla about new broadband services swirling around the industry these past few years, there's been a small, but vital, revolution taking place in the back rooms and back offices of the industry. It hasn't received as many headlines as cable modems, interactive TV or telephony. Yet the success of those services, no matter how dazzling the core technologies, rests in large part on what's going on behind the scenes in cable operations around the country.

Cable operators are now facing what may be the most crucial test of their ability to compete in the deregulated marketplace. Operational support systems have become a lighting rod topic for operators who are in the thick of battle with competing service providers. Having the fastest modem in the market or the most dynamic interactive graphics around isn't enough.

Operators have to be able to deliver those services to the customer in a seamless, effortless manner with nary a glitch, blip or delay. And the complexity of doing that, creating an open platform that ties such things as customer service, trouble ticketing and dispatch, access control, automated provisioning, inventory control and billing, will be the determining factor in cable's ultimate success or failure in the converging marketplace.

Bottomline reality

Simply put, today's largely proprietary management solutions won't work much longer. Jim Chiddix, senior vice president of engineering and technology for Time Warner Cable says the growing complexity of developing technology and the expanding number of services it supports demands a comprehensive operational support system (OSS) solution.

"We're getting into a lot of complex businesses,"

PHOTO BY MARK SIMS

says Chiddix. "And those complexities extend from simply provisioning them, getting them on the air, to doing diagnostics when things go wrong, to dealing with customer questions and turning customers off and on. That's what an OSS does, all of those things. And the systems are complex enough, that you have to do that in software with computer automation.

"Traditionally, we've done all those things in a very manual kind of way. That's because our services and networks right now are relatively simple. In terms of provisioning, we make sure all the channels are on the air leaving the headend and we hook up customers manually by hooking up the drop. We do diagnostics by seeing where the phone calls are coming from. We use fairly simple systems for customer billing and support. And, up to now, we've made all that work.

"But, when you've got cable modems, digital telephony and interactive TV, you've got a different world. If you get a call from a customer saying his modem isn't working, what do you? Is it an amplifier? Is it a problem with the customer's software? Is it a problem in the headend? Is it the database? Our traditional methods of approaching that just won't work.

We've got to have computers that look at all these elements of our systems and let us turn things off and on, let us do diagnostics, let us talk to the customers in a helpful way and let us get bills out."

Another fact that's coming home to roost in the industry is that proprietary solutions, in many instances, are quickly becoming a thing of the past. The drawn out, difficult effort to hammer out cable modem specifications is only the most obvious example. A similar change of heart is taking place in the OSS/network management arena as well. And that change is being

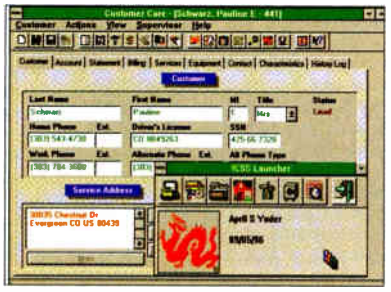
Simply put, today's largely proprietary management solutions won't work much longer

spearheaded, and in some cases forced, on vendors by operators who are struggling for their economic survival against deep-pocketed telcos and utilities.

Thinking smart

Competitive pressures on the cable industry have forced operators to get smart fast when it comes to developing integrated operations support systems. Computer technology has a number of advantages, not the least of which is consolidation. For example, while operators may have cable systems scattered around the map, computer management technology allows them the luxury of consolidating their management systems in centralized locations or network operation centers (NOCs).

Cox Communications Inc. is proceeding full speed on the construction of an operations center in Atlanta, spurred in large part, by the new competitive reality. "It's the new services that are driving it more than anything," says Mark Davis, director of engineering/telephony operations for Cox. "We've been able to get by without a whole lot of network management for cable TV in the past. But now, the times have changed where we'll no longer rely on the customer to tell us when we have a network problem. And with the telephony services and providing lifeline services, we know it's going to be crucial that we know the health of the network. It's the same with data services. It's a no-brainer that we have to have a network operations center in place."



Jones' Cyber Solutions put provisioning at CSR fingertips.

Davis reports the facility is under construction and is scheduled to be ready in January 1997. The company issued an RFP and has compiled a short list of vendors. The decision on the management system should be made by the first of December. While the Cox NOC may not initially be the most comprehensive management facility around, it does have a formidable task and a lot of potential.

"It'll be monitoring all the major network elements in Cox," says Davis. "Everything from HFC elements like the fiber nodes and power supplies, to things in the headend like lasers and receivers. (It will also monitor) the Sonet gear that will be hauling the telephony and the ATM gear that will be hauling most of the data. It will be looking at the data headend interface terminal and the telephony headend interface terminal. We will not necessarily be looking at the individual homes, even though we have the capability of doing that, we'll just be looking at major network elements.

"Obviously, we won't have all the bells and whistles on day one. We'll bring things on as they become available. But we're looking for a package that will be capable of looking at all those elements and giving us the management visibility we need."

Eventually, says Davis, the NOC will be tied to other management services in the Cox system. "We have a separate group in our MIS department that's working on the customer care and billing systems (with CBIS - Cincinnati Bell Information Systems) which the NOC will interface to. Also our engineering systems, as far as doing capacity management on the network, that's going to be hooked together as well. So, we will have dispatch capability as well."

The NOC's initial focus will be concentrated on major system clusters in San Diego and Orange County, Calif., Phoenix, Ariz., Omaha, Neb., Oklahoma City, Okla., New Orleans, La., Hampton Roads, Va., Providence, R.I., Hartford, Conn., and Pensacola and Ft. Walton Beach, Fla. These clusters represent 85 percent of Cox' 3.2 million subscribers.

Different approaches, same goal

Like Cox, a number of other operators have come to realize they have neither the time or money to totally start from scratch when it comes to developing OSS/network management systems. Three of the country's top MSOs — Tele-Communications Inc., Continental Cablevision and Jones Intercable — are the most rabid proponents of end-to-end management solutions. While they've each taken a slightly different approach, their commitment to modular, open interface management systems will probably make things a lot easier for smaller sized operators following in their wake.

TCI's SummiTrak system is currently in the process of being deployed. SummiTrak, like the company it serves, is a massive system that consists of 70 modules with more than 1 million lines of code. The system is made up of a number of task-specific systems including internal corporate voice and data communications, network management and monitoring, marketing and billing. Sadie Decker, TCI's vice president of advanced information technology, says SummiTrak's digital mission-critical network (for internal corporate communications) is complete and covers 12,000 nodes throughout the country.

The marketing system, says Decker, is being tested now and will go live by the end of the year. This system collects, stores and processes such information as take rates, subscriber counts and what various products are doing in specific markets. The billing system is being tested in Greeley, Colo. SummiTrak is also the billing engine for TCI's digital roll out (AllTV) in Hartford, Conn. And the SummiTrak pay-per-view module, reports Decker, supports 450,000 subscribers in Denver.

Network operating centers are being built to monitor TCI's headend-to-the-home cable plant. This will consist of three regional centers and a control center in Denver to be operational in 1997. "This is how we will monitor our telephony, our @Home and digital systems," says Decker. "What's going to happen, as we roll out digital, then SummiTrak goes right along and replaces the existing systems."

NOC on wood

Another aggressive operator in the OSS/network management field is Continental Cablevision Inc., under the direction of Rob Strickland, Cablevision's

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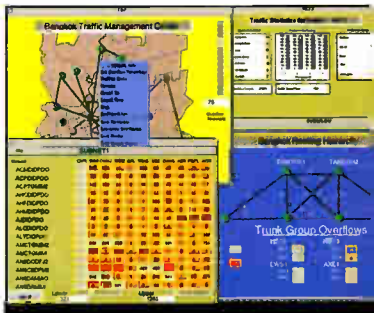

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Rob Strickland

senior vice president for information systems. Like other operators, Cablevision is in the process of finalizing the roll out of its NOC in Chelmsford, Mass. Strickland says that when he joined the company nearly three years ago, the NOC was a foreign concept in cable circles, but not in the information technology (IT) world he was familiar with.

"When I originally came to cable two-and-a-half years ago," states Strickland, "not surprisingly, network operation centers didn't really exist for cable. There really weren't many products that had the capability of looking out across the proprietary interface that existed in the RF world. Those proprietary interfaces don't exist in the world of IT. So, we knew very quickly when we built the enterprise wide area network for the company, we would have to build a network operations center."

As a result of that vision, the IT staff at Cablevision quickly formed a partnership with the engineering staff to get the NOC up and running. As far as the management systems that will run in the NOC, Strickland is a firm believer in not reinventing any wheel he doesn't have to. A slight literary analogy helps Strickland explain his philosophy on developing management systems for Continental.

"Let's say there's two sides to a bookshelf,' explains Strickland. "On the left-hand side you've got 'Build it'; on the right-hand side you've got 'Buy it.' We try to work from right to left. So if it exists and we can go buy it, we'd rather buy it. We'd rather not go and try and build it because that's very expensive and you have to acquire a core competency that you probably don't need.

"What we're trying to do if we can't buy it, is perhaps we can direct it. That means if somebody out there is trying to build it, we tell them we want to help them build it. We don't have developers or armies of people that do all that. In fact, what we have are the vendors doing it for us. But, what we're giving them is the first opportunity and the first customer, and quite a big one at that."

Coming from the IT world, Strickland is also a firm believer in standard protocols and open interfaces. The proprietary mindset of the cable industry was something he was determined to change not only to assist his company's future growth and development, but that of the vendors as well.

"That was the biggest hurdle we faced," says Strickland. "There are certain technologies, interfaces and management protocols that have existed for a long, long time that are just finding their way into the cable

environment. We tried to find vendor partners that wanted to help us to solve the problem first at Continental and then roll it out across the industry."

Strickland says the company is working with a number of vendors to develop an OSS system where all the subsystems communicate and share information on a common platform. CSG Systems Inc. is working with Continental on its customer care and billing system (C2IT). They're adapting a product called Spectrum from Cabletron for network management and working with Cheetah/Superior Electronics on equipment monitoring. They are also testing Arrowsmith for fleet and workforce management solutions.

Strickland believes his company's efforts in getting these diverse vendors to work together will have a beneficial impact on the industry as a whole in reducing the proprietary nature of the cable beast. In addition, the vendors will then have the opportunity to tout their enhanced capability to communicate to other systems or applications.

Jones Intercable, on the other hand, has developed its own integrated management system through a wholly-owned subsidiary, Jones Cyber Solutions Ltd.(JSC). It is now in the process of rolling out the system in Buffalo, Minn. and then in Alexandria, Va. At the same time, it's taking it on the road for sale to other similarly challenged clientele. JSC's Intelligent Customer Support Systems encompasses customer care, intelligent device control, inventory management, work management & data collection products. The ICSS product line has been designed for convergence and has a residential telephony functionality as well.

Meanwhile, in the marketplace

Operators aren't the only ones trying to fill in the OSS/network management gap. A growing number of telecommunication vendors are getting involved as well. GTE's Network Management Organization has recently released its WorldWin family of software products for communication management. The WorldWin product line includes InView for network operations, InService and InForm for automated services fulfillment and integrated customer contact, and InExchange, a mediation gateway for network message management.

One feature of the WorldWin product line is a set of published application programming interfaces (APIs). These APIs let communication providers' existing management systems or applications communicate and exchange information with WorldWin.

The company, says Randy Boroughs, director of marketing for GTE NMO, has designed the system to

Randy Boroughs

provide what he calls "one-touch service," a crucial selling point in the competitive marketplace. "There's going to be a big push for what we call 'one-touch service'," says Boroughs. "You touch the corporation once to get all your issues dealt with. That means you call into a company's customer service center and you can order new service, you can have your problems addressed, you can have your billing inquiries handled, all with that one telephone call. The set of tools that allows a company to do that is very, very important."

Boroughs believes that while some people may be taken by the individual management systems, they tend to overlook the importance of their integration with the other systems an operator has running. "You've got the one-touch customer care," says Boroughs. "How can you truly be one-touch customer care and turn on that new service if you're not tightly integrated in an automated fashion to a provisioning system? The customer care person has to be able to turn on the provisioning system, which has to be able to touch the network without additional human intervention. The instantaneous turn-on of services is a result of the fact that all these things are integrated.

"Right now, in most of these companies, there is a big wall between the customer care people and the provisioning people. Usually it's faxes going back and forth, or some e-mail system. It's not an integrated system."

Another recent entrant into the market is Integration Technologies. It has introduced "model.it," a fully-integrated network design, engineering and management tool that documents the physical layout of the communications infrastructure in an industry-standard database management technology. The company has also introduced "field.it," a Windows-based, portable software tool that allows technicians to gather accurate field data about rack-mounted equipment in headends, central offices, equipment enclosures or remote enclosures.

The key, says Terry Poindexter, vice president of IT's OSS Group, is an accurate, up-to-date topology of the plant, down to the last amplifier or tap. Out of this, he says — network management and monitoring, customer care, provisioning, trouble ticketing and dispatch, access control, etc. — all else flows.

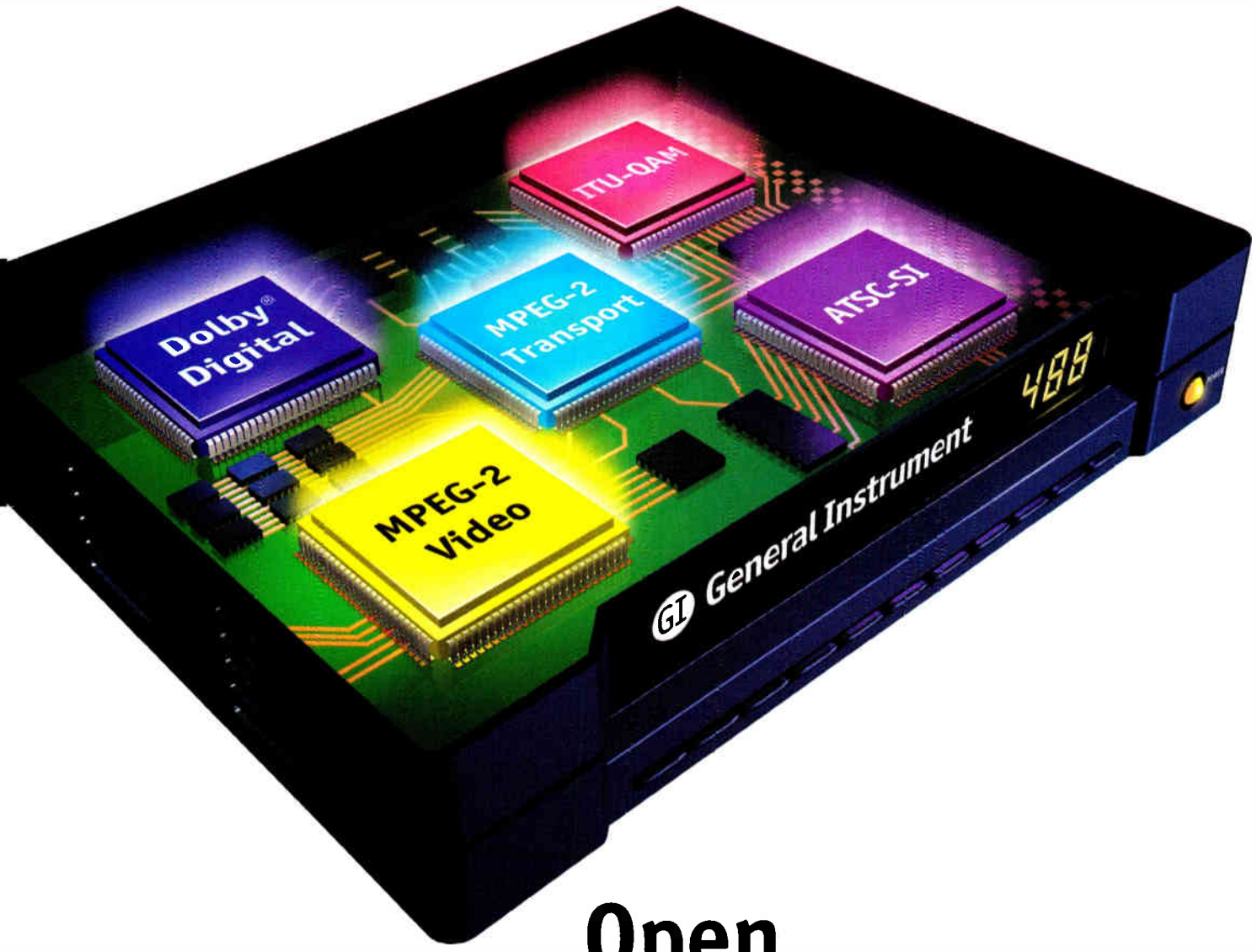
"Our goal," says Poindexter, "is to look at what's the right technology to model the key pieces of information you need for the business. The key pieces you need in this business come down to three things. You need to know your plant or network. You need to know customers. And you need to know services. With those three things, you can run your business.

"The challenge is getting those things modeled in the right information, coordinated successfully in your organization and being able to correlate information from one to the other."

Sink or swim

This ability to communicate between individual management modules or systems is the recurring theme in all these systems. The days of 'I'll do my job. You do yours.' are over in the cable industry. It's all interrelated. And because it is, everyone in a cable network will either sink or swim together in the rapidly converging, increasingly competitive marketplace.

For those who would prefer to float rather than flounder, CableNET '96 (see page 76) is a great place to learn how to go with the flow in OSS/network management. CED



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Implementing a workforce management tool

An operational assessment

By Jan Lubin, Senior Consultant; and Leigh Haney, Communications Manager, Arrowsmith Technologies Inc.
Special to CED *magazine*

When choosing and implementing a workforce management system, cable operators often wonder about the actual pay-back of the product and its effect on their operations. How will this product really affect the bottom line?

An analytical evaluation of a product offered by the authors' company was undertaken by a leading cable TV company to help determine the impact such a product has on operations. The Unix-based system facilitates routing and dispatching. Dispatchers route jobs to field technicians using a map-based graphical interface that shows pending work orders, and the technicians have hand-held computers in their trucks. Technicians are routed using a just-in-time method in this case study, and only their next one or two jobs are visible to them on their computers. Dispatchers and technicians rarely speak over the radio; instead, they use the handheld unit to open and close work orders, perform addressable convertor transactions, and message between base and other technicians.

This study was done quantitatively, utilizing a specific baseline period and testing that against a similar time period after implementation and training were complete. It is important to note that any and all variables used in this study will directly affect the outcome of the post-implementation study. Every site is different, and each will achieve disparate results after implementation. Variances in actual payback periods and returns on investment are a function of the type of communication system used, pre-implementation productivity levels and number of vehicles the company actually deploys.

The cable site studied and represented here consists of approximately 140,000 subscribers and roughly 2,400 miles of plant, 85 percent of which is aerial construction. Technicians perform a combination of trouble calls and installation-related work. Baseline performance was measured during the course of operations in the fourth quarter of 1995.

The baseline period

During the baseline period, technicians were asked to complete daily logs of their activities. These logs were used to develop baseline measures for current performance. Additional data was collected from billing system reports. The field data was not taken in a vacuum. Additional baselines were gathered for production volumes, staffing, shifts, time windows, scheduling and quotas to allow for an "apples-to-apples" comparison later. The baseline period included 53 work days of data from 20 technicians who were described as being representative of the workforce.

Quantitative measures were taken, and interviews were conducted to create process flows.

Figure 1: *Technician log data.*

Period	Minutes on job	Job count	Average minutes per job	Minutes in-transit*	Average drive	Minutes on break	Average job cycle (job+drive)	Adj. total minutes	Hours logged	Jobs per hour	Adj. jobs per hour
Baseline	301.0	9.8	31	2,231	26	52	57	576	9.60	1.1	**1.0**
Mar-96 average	239.3	9.8	31	1,861	24	47	55	473	7.88	1.1	**1.2**
Apr-96 average	280.4	10.7	33	1,911	21	41	54	512	8.54	1.2	**1.3**
May-96 average	258.1	11.7	281	193	20	42	49	493	8.22	1.3	**1.4**
Average test period	**259.2**	**10.7**	**31**	**190**	**22**	**44**	**52**	**493**	**8.21**	**1.2**	**1.3**

Figure 2: *Technician log performance changes.*

Period	Minutes on job	Job count	Average minutes on job	Minutes in-transit*	Average drive	Minutes on break	Average job cycle (job+drive)	Adj. total minutes	Hours logged	Jobs per hour	Adj. jobs per hour
Avg. test period vs. baseline	**-13.9%**	**9.3%**	**-0.3%**	**-14.8%**	**-16.2%**	**-16.4%**	**-7.6%**	**-14.5%**	**-14.5%**	**12.6%**	**27.7%**
Mar-96 vs. baseline	-20.5%	-0.3%	0.2%	-16.6%	-7.2%	-8.8%	-3.2%	-17.9%	-17.9%	6.6%	21.4%
Apr-96 vs. Mar-96	17.2%	9.4%	6.3%	2.7%	-13.4%	-14.2%	-2.3%	8.3%	8.3%	1.5%	0.9%
May-96 vs. Apr-96	-7.9%	9.3%	-13.3%	0.9%	-3.0%	3.9%	-9.3%	-3.7%	-3.7%	13.7%	13.5%
Avg. test period change	**-3.8%**	**6.1%**	**-2.3%**	**-4.3%**	**-7.8%**	**-6.4%**	**-4.9%**	**-4.4%**	**-4.4%**	**7.3%**	**12.0%**
May-96 vs. baseline (cumulative change)	**-14.3%**	**19.1%**	**-7.7%**	**-13.5%**	**-22.0%**	**-18.7%**	**-14.2%**	**-14.4%**	**-14.4%**	**23.1%**	**39.1%**

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Figure 3: Repeat trouble calls.

Trouble calls followed by a trouble call		
Period	**% of total**	**Change from prior period**
Jan-96	26.3%	
Feb-96	24.0%	-8.8%
Mar-96	21.9%	-8.6%
Apr-96	16.7%	-25.9%
May-96	13.9%	-14.62%
Avg. test period	17.4%	-16.4%
May-96 vs. Jan-96 (cumulative change)		-47.2%

This allows for a conclusive simulated model, capable of estimating results from re-engineering scenarios presented with site-specific data.

The overall pre-implementation assessment showed the following:

✔ Technicians averaged 1.02 jobs per hour.
✔ Technicians averaged 9.8 jobs per day.
✔ Job assignments without routing kept technicians in the office and out of the field.
✔ Job duration plus drive-to-job times did not equate to quota estimates.
✔ First and last drive times were nearly double that of job-to-job drive times.
✔ Tightly overlapped time windows made accuracy of quota estimates and job assignments more critical.
✔ Inefficient routing added to drive times and took away from on-job time.
✔ Twenty-eight percent missed time windows at $20 per subscriber credit for service guarantee–ouch!

A detailed analysis revealed the following statistics on how the technicians' time was spent. These percentages were based on an average work day of 9 hours, 37 minutes.
✔ Job time: 50 percent of total time.
✔ Drive times: 25 percent of total time, broken out as follows: Average drive time to first job: 26 minutes; average drive time to return to base: 27 minutes; average interim drive time between jobs: 14 minutes.
✔ Technicians were routed to "cluster" areas. This was re-engineered at implementation so that technicians work their way out of areas and then back to base, in a "loop."
✔ Break time: 9 percent of total time. Average break time was 51 minutes. (Technicians are given 60 minutes of break time per day.)
✔ Check-out time: 7 percent of total time. Check-out from base had numerous inefficiencies; however, inventory was handled very efficiently. The average time spent in check-out was 40 minutes. During this time, technicians reviewed their work, determined the job sequence and informed dispatch of job sequencing before leaving base. After reviewing job locations, they also determined if lock box keys were required and obtained them before leaving for the field.
✔ Check-in time: 4 percent of total time.
✔ Other time: 4 percent of total time. This primarily consisted of a technician assisting another technician who was running behind or who didn't have the skills needed for a particular job.
✔ Vehicle time: 1 percent of total time. Average time at the gas pump was six minutes.

Routing techniques during the baseline peri-

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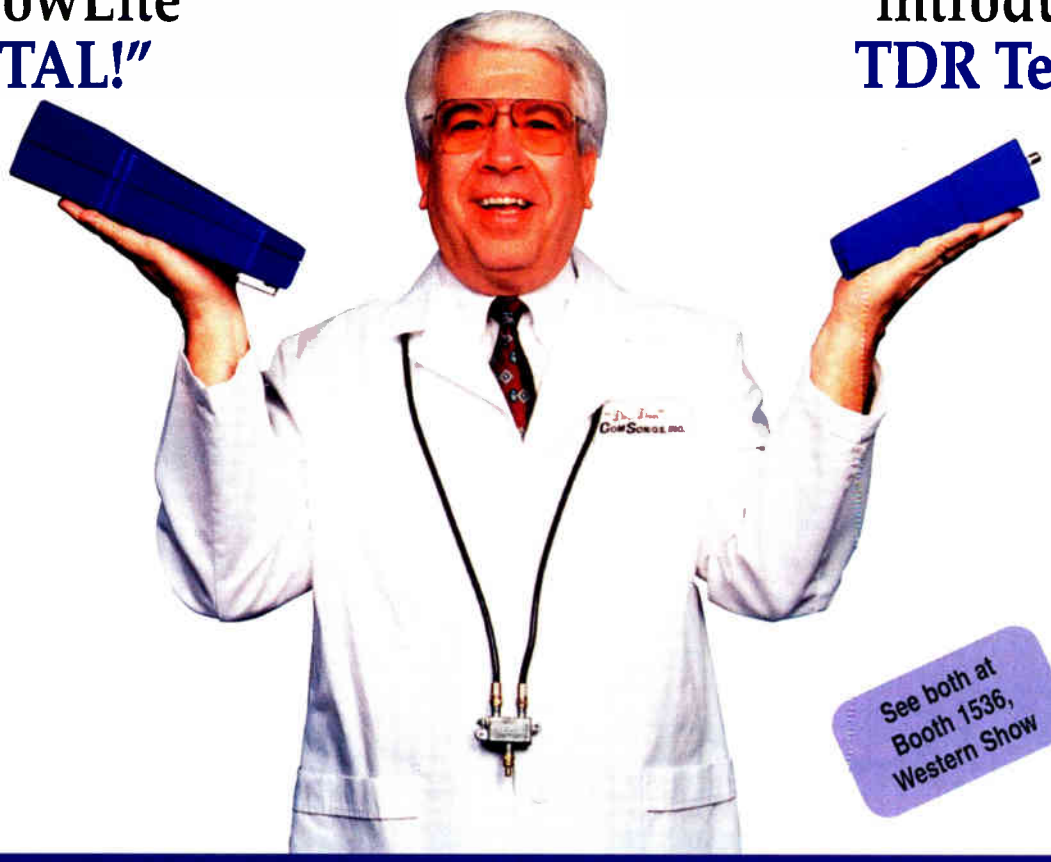

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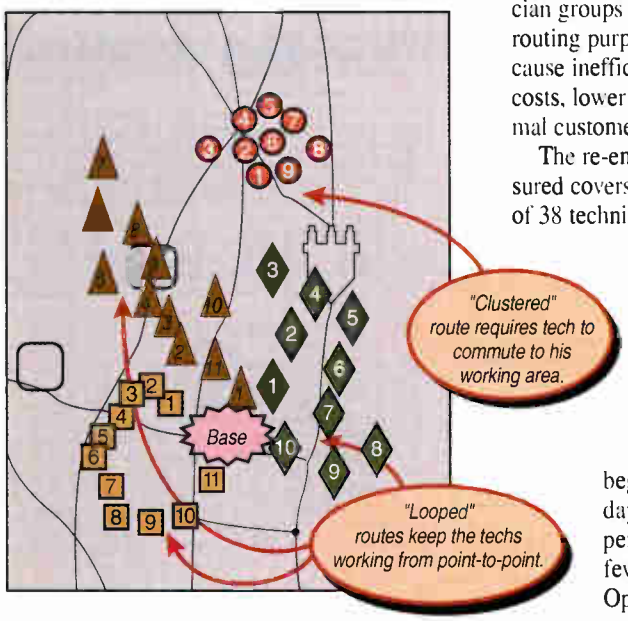
Figure 4: Looped vs. clustered routes.



od were significantly re-engineered as part of the implementation process. Many sites, including this one, use ZIP code or town boundaries for defining service areas, technician groups and other types of "zones" for routing purposes. Artificial boundaries can cause inefficiencies which result in added costs, lower productivity and less than optimal customer service.

The re-engineered operations period measured covers three months with an average of 38 technicians using the system. All results described in this analysis are the result of using the interactive routing and interactive dispatch functions.

Productivity can be measured both by quantity and efficiency. As shown in Figures 1 and 2, technicians began completing more jobs per day, with steady gains averaging 6 percent per month, while working fewer hours in the field. Operations have yielded an average reduction of 1.4 hours per day in the field. Technicians average 10.7 jobs per day, a 19.1 percent increase in the number of jobs completed.

These statistics are largely attributable to reductions in both drive time and on-job time, and less time required for pre-shift check-out of work. More effective routing, coupled with reduced radio time to support on-job transactions (updates, convertor transactions, etc.) account for these improvements.

Average drive times decreased 22 percent because of more efficient routing.

Increases in trouble call job lengths allow technicians to troubleshoot and perform customer education, resulting in fewer *repeat* trouble calls. As seen in Figure 3, a significant downward trend in repeat trouble calls has been seen during the operating period.

Technicians using the system complete 98 percent to 99 percent of the jobs assigned. Overall company-wide completion rates are in the 81 percent to 84 percent range.

Routing techniques

Technicians, when routed in a loop, working away from the base and then back, minimize unproductive drive times. Before, technicians were generally routed to a specific area in a "cluster," and remained there for the better

part of the day. This created excessive first and last drive times.

With the artificial boundaries previously created for routing, using ZIP codes or town boundaries, technicians were confined to specific areas. As a result, customers located on the fringes pose a complicated routing problem, add to the burden of time window compliance and lower field productivity. Under the new system, these area boundaries are softened whenever possible. Routing is based on technician/customer proximity (Figure 4). This reduces drive time and increases productivity. An understanding must be reached that technician cross-over takes place on an as-needed basis only.

When high frequency of tech cross-over is experienced, it is likely that staffing adjustments have been necessary but were never addressed.

During the pre-implementation assessment, drive time was identified as an area requiring improvement. Job-to-job drive times averaged 14 minutes, with first and last drive times averaging 26 and 27 minutes, respectively. Significant deviations in the first and last drive times existed, with maximums reported in excess of one hour.

Routing was the main culprit. Technicians were dispatched from a single location that is located in the southeastern one-third of the service area. As a result, many technicians had to virtually commute to jobs scheduled in the first time windows of their shifts.

Figures 5 and 6 compare drive time results. Baseline overall drive times were at 26 minutes. Operating with new software, this average was reduced to slightly more than 20 minutes in May 1996. The average drive time has shown monthly reductions of more than four minutes per job. This translates to an average reduction of two minutes per tech on both the first and last drive times and about 1.5 minutes for each of their intermediate drive times (job-to-job drive time).

Overall efficiencies of almost 22 percent have been gained through drive time reductions since the baseline period measurements. More than a 7 percent reduction in first and last drive times and a 12 percent reduction in job-to-job drive times have resulted.

As dispatchers become more adept at using the system's maps and work order search filters to distribute jobs to field techs, these results will show additional improvements. It's also important to consider that included in the drive time

Figure 5: *Average drive times.*

Period	Average drive (includes first/last)	First drive	Last drive	Interpolated avg. intermediate drive time
Baseline	**26**	**26**	**27**	**14.0**
Mar-96	24	24	25	13.9
Apr-96	21	24	25	13.3
May-96	20	24	25	12.3
Avg. test period	**22**	**24**	**25**	**13.2**

Figure 6: Drive time changes from prior periods.

Change from prior period	Average drive (includes first/last)	First drive	Last drive	Interpolated avg. intermediate drive time
Mar-96 vs. baseline	-7.2%			6.4%
Apr-96 vs. Mar-96	-13.4%			-10.7%
May-96 vs. Apr-96	-3.0%			-7.5%
Avg. test period	-7.8%	-2.6%	-2.5%	-4.2%
May-96 vs. baseline (cumulative change)	-22.0%	-7.7%	-7.4%	-12.1%

Figure 7: Sameday response on trouble calls–test period.

Work order volumes								
Period	Sameday	+1 Day	+2 Days	+3 Days	+4 Days	+5 Days	>=6 Days	Total
Mar-94	929	1,749	456	175	70	32	43	3,454
Apr-94	1,508	2,015	489	176	59	33	51	4,331
May-94	929	1,813	365	147	49	37	29	3,369
Percent of total work orders								
Period	Sameday	+1 Day	+2 Days	+3 Days	+4 Days	+5 Days	>=6 Days	Total within 24 hrs.
Mar-94	26.9%	50.6%	13.2%	5.1%	2.0%	0.9%	1.2%	77.5%
Apr-94	34.8%	46.5%	11.3%	4.1%	1.4%	0.8%	1.2%	81.3%
May-94	27.6%	53.8%	10.8%	4.4%	1.5%	1.1%	0.9%	81.4%

Figure 8: Billing system trouble call response.

Trouble call problem/fix report									
Period	Avg. elapsed fixed time	Change from prior period	First day	Second day	3+ days	Total	First day	Second day	3+ days
Jan-96	51:12:00		1,390	2,232	34	3,656	38.0%	61.1%	0.9%
Feb-96	39:53:00	-22.1%	2,554	491	24	3,069	83.2%	16.0%	0.8%
Mar-96	29:18:00	-26.5%	3,479	59	7	3,545	98.1%	1.7%	0.2%
Apr-96	25:56:00	-11.5%	4,235	12	7	4,254	99.6%	0.3%	0.2%
May-96	27:14:00	5.0%	3,482	13	1	3,496	99.6%	0.4%	0.03%
Avg. test period	27:29:20	-11.0%	3,732	28	5	3,765	99.1%	0.8%	0.1%
May-96 vs. Jan-96 (cumulative change)		-53.2%	150.5%						

are periods when techs are "available" (not assigned or working).

The system also records specific job start and completion times, allowing for greater time window compliance reporting accuracy. The billing system uses a dispatch-entered completion time, which is less accurate. Instead, this software uses actual date/time stamps to calculate response time totals. Total volumes vary between the billing system and workforce management system due to differences in the way dates are viewed.

The site measures its performance in "trouble call response" by two standards. Corporate standards interpret same day response as within a 24-hour period. The site has the goal of using calendar day as the measure of response.

Trouble call volumes also saw an increase as a result of the absorption of another site in April 1996. Techs covering this area implemented the system in June 1996, after the study.

Data supporting sameday trouble call response was not available during the baseline period. Therefore, January/ February 1996 was used to establish trends, although the software system was partially rolled-out during that time. With the new system, the site had seen average improvements of 11 percent per month in trouble call response. Prior to full roll-out, response averaged 45 hours, as compared to an average of 27.5 hours for the period when the new software was brought on-line. Cumulative reduction of response time from January to May 1996 is 53.23 percent, with 150.5 percent more trouble calls being done within 24 hours.

Figure 8 is an extract from the billing system reports supporting these statistics. Differences in the calculations from the billing system to the workforce software are the result of methods used to calculate "same day" response. This is due in part to techs entering a completion code to indicate response periods for the volumes indicated. (Clock times shown by the billing system are generated via the billing system.)

This system advocates more of a just-in-time routing system. The role of the dispatcher, therefore, changes from one of clerical support to managing the workforce. Techs become more self-sufficient by having the ability to perform convertor transactions and close work orders without dispatcher intervention.

When choosing and implementing a workforce management system, analysis can be done to benchmark changes in productivity. The key is to understand where productivity gains can be made, lay out clear objectives or measures of success and track these quantitatively to determine the return on investment. CED

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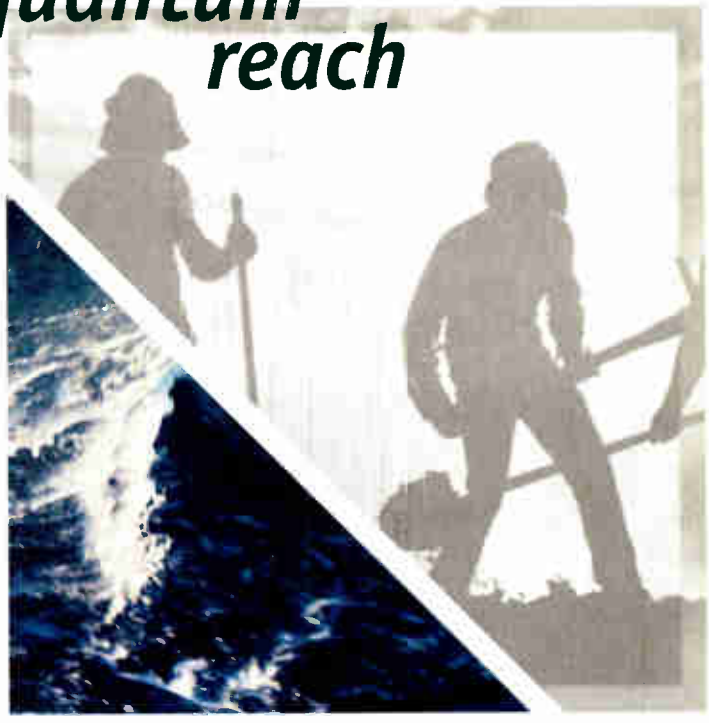

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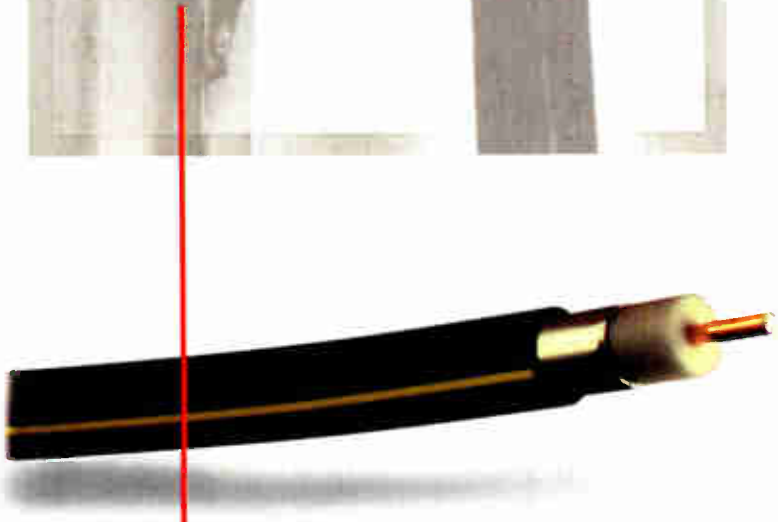

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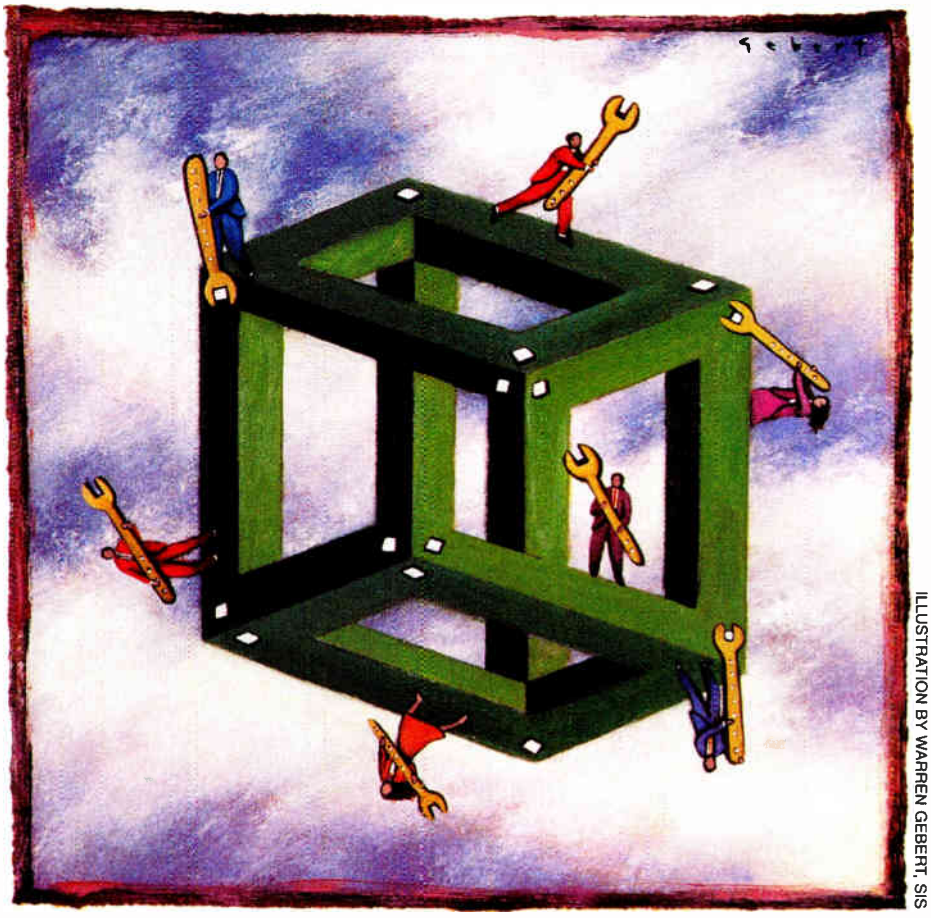
Operational issues transformed by perspective shift

A phased approach to automation, integration



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By Andy Paff, President and Chief Executive Officer, Integration Technologies, Englewood, Colo.

Voice. Data. Enhanced video. Operators contemplating entry into the brave new world of transactional telecommunications services also face new and critical operational and management issues. Fully automated and integrated service ordering and provisioning, billing, work order flow, trouble ticketing and network management will all be key elements in building and retaining a reputation for high-quality services at competitive prices.

New automated systems will be required to give customer service representatives the tools they need to effectively communicate with the customer–to outline new service offerings and place automated service orders. Work order managers need the tools to alert technicians in the field of the new order and to prioritize those incoming orders with maintenance tasks or network trouble tickets.

Network planners, designers and operations personnel need the tools to more effectively design, engineer and manage the now two-way analog/digital telecommunications network–one that requires a greater ability to analyze capacity use and traffic patterns. Operations managers need the tools to monitor the status of the network in real-time with the capability to initiate corrective steps toward resolving network problems or to plan needed enhancements to the network. Marketing personnel need tools to evaluate their initiatives and target new markets or submarkets; executives and financial personnel need their own set of analytical tools to manage and grow the business.

There are solutions

Today's operational support system (OSS) solutions provide significant advantages over their status monitoring predecessors. "Best-of-class" systems provide the standards-based, state-of-the-art computing technology platforms that can be integrated with other systems. Easy-to-use graphical user interfaces (GUIs) with hands-on training in new ways to do business means everyone from customer service representatives and technicians to executives and business planners can use the new tools to establish positive customer relations and improve network performance–while lowering operating costs and increasing revenues.

To initiate an OSS development program, operators must first understand where they are today, and where they want to be in the long run. What new services are planned? What type of functions will the operator keep in house; what may be outsourced? Which entity owns what type of telephony gear (specifically, the switch)? Who's handling the onerous task of transactional billing? How are technicians alerted that new work exists, and how is that work prioritized?

By analyzing the business processes that are used today and evaluating new systems that can automate and streamline these activities, a staged and practical approach to OSS deployment can be put into place that transitions the organization–and its people–to new automation tools without significant headaches or up-front costs.

How do we get there?

The broadband network itself is the largest single physical asset most cable operators have. And yet, significant gaps exist in what the current documentation indicates about the network, and what the actual reality of the network configuration and status truly is.

When the network was originally put into place–and through several upgrades–most of the information regarding the physical infrastructure (roads, bridges, manholes, poles, etc.) was documented in order to design, engineer and construct the network. Using computer aided design (CAD) tools, the physical

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infrastructure was divided into a series of artificially separated "drawings" that displayed a picture of the information. Once the network was engineered and constructed, CAD drawings typically made their way into a filing cabinet where they stayed until the next upgrade. By then, nobody's sure if the information is correct. The entire documentation process starts anew–likely at the same or greater cost than the documentation process ran the last time.

Accurate information about the network–its connectivity, its capacity, its layout and its elements–is critical to the successful deployment of two-way, interactive services. Without an accurate representation of the network's devices, its fiber and coaxial runs, its nodes and subscriber addresses (among other elements), operators attempting to deliver quality service rapidly and at low cost face an incredible hurdle.

The solution lies in gathering accurate data about the network. By verifying the existing network documentation, converting over information which is correct, and collecting new information about rack-mounted inside plant equipment and fiber and coaxial outside plant, operators can begin to build a complete, end-to-end and highly accurate "data model" that will be crucial to real-time broadband network management.

This data model, stored in an industry-standard relational database, builds an end-to-end view of the network that is accurately located to its geocoded positioning on the local land base. The operator, in essence, sees a map of the network; the data itself is organized by "objects" that are reused throughout the database. These objects link data about a particular device to the object. For example, amplifiers all have the same object, but individual amplifiers have their own information–manufacturer, installation date, last service call, etc.

Labor- and processing-intensive activities can be outsourced

These objects can then be linked to a higher-level network management system that will integrate the data about the device with its element management systems (EMSs)–a system within the device that reports its condition to the network management system. Integrating the data model with the NMS means operations personnel can monitor the real-time status of the network in a manner superior to other providers. Further integration with systems such as work order management provide supervisors with the means to geographically locate a specific piece of equipment or a subscriber's address. Integration with a dispatch management system means the technician can be directed to that site far more quickly than via a manual system.

A phased approach to OSS deployment

The first phase of development relies on putting in place the systems and procedures required to document the physical network. Once accurate information is obtained, it will be critical to have the procedures in place that

keep the data model completely accurate.

Secondly, implementing an integrated NMS will blend the data model with existing EMSs to perform alarm correlation across multiple vendor systems. Integrating this with the data model will facilitate rapid trouble resolution.

It's important to note that during Phase 1, many tasks remain manual. The main thrust of the phase is to establish the initial systems needed for operators to deploy a limited set of voice and data services. Labor- and processing-intensive activities can be outsourced to allow a low-cost entry into the market and minimize initial capital outlay; personnel are offered a manageable learning curve by keeping the focus on learning to manage network elements and gain experience and control over the network. High-visibility systems, such as automated service ordering and high-quality trouble ticket systems, could be initiated simultaneously to establish a customer perception of quality and responsiveness in the early deployment of telephony and data services.

Phase 2 extends the control over the business and network management processes as the network and customer base grows. Service delivery mechanisms are critical at this stage.

Additions at this stage would include: introduction of a modular customer management system that would initially provide GUI-based CSR screens to coincide with the first high-volume sign-up of telephony and data subscribers; and introduction of work force and dispatch management systems and integration of them with the network data model and trouble ticket system. These implementations would be timed to support the increased installation, repair and other service management activities associated with customer base growth.

The data model would be extended to be the "source of record" for network assets and would include increased functionality for inventory management, connectivity management and engineering management. The integrated NMS would be expanded to provide real-time monitoring and management of the network elements and automated reconfiguration of the network to maintain high service levels. Previous manual systems for provisioning/order management would be automated to improve service activation, manage labor costs and minimize errors.

At this point, a level of stability and experience in the deployment, operation and management of the voice and data access network will be achieved. Hence, the focus will move toward control and automation of end-to-end business functions, and expansion of the service catalog. Operators seeing significant growth in the telephony/data business could begin deploying and operating their own digital switches; however, some level of automation would be needed between the customer management/service ordering and switch/network element provisioning systems to bring network equipment on-line faster and with high-service availability at lower labor costs.

During Phase 3, the focus is on achieving a fully-integrated service management/network management solution capable of supporting rapid growth of the customer base, network and service catalog, while providing

exceptional customer service and "best-in-class" cost structure.

This phase involves full integration of the system solutions and achieving greater productivity by the people using them. For example, cutting 30 seconds from the time a CSR spends accessing and retrieving data in the course of signing up a single new subscriber can–with high volume penetration–cut CSR staff hours by thousands per year. Providing more immediate accessibility to relevant data by operations staff results in faster customer problem resolution as well as reducing outages that result in lost revenue when providing a usage-sensitive service such as telephony.

Expansion of the integrated NMS and maintenance of the highly accurate data model result in better monitoring, management and control of the network. Real-time network performance improves, intermediate and long-term planning are enhanced. Greater network capacity and service expansion can now be staged in the most cost-effective manner possible to the operator.

In the end, a robust base OSS architecture has been established. At this point, the operator would be able to incorporate new systems, add new features to existing systems or new network elements within the infrastructure without disrupting or reworking existing systems and suffering the corresponding inefficiency and expense that entails.

Finally . . .

Taking a phased approached to OSS deployment similar to that outlined above provides significant advantages. During Phase 1, operators can learn the true behavior of the HFC network in providing telephony and data services before a major roll-out of services occurs. Personnel training is minimized; data integration begins before widescale customer demand commences. Procedures can be put into place based on the actual systems deployed without causing the operation to come to a halt to train people or formulate new internal procedures.

By Phase 2, the baseline automation will have been established, and the first major roll-out of services occurs. This phase will see enormous growth; however, analyzing the performance of personnel and systems throughout this phase will help to identify problem areas and fine-tune the systems, processes and integration solutions needed to assure maximum effectiveness at minimal cost.

In Phase 3, manual operations will be all but eliminated; keystrokes needed for use of the various systems will be reduced. Costs are cut; margins improve.

The final result of this type of OSS deployment will be a comprehensive, enterprise-wide integration of a common database management system that supports established service and network management systems that may be spread throughout the cable organization. CED

About the author

Andy Paff is the president and CEO of Integration Technologies, a Denver-based network engineering, systems integration and software development firm.

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Return systems 102: What goes around. . .

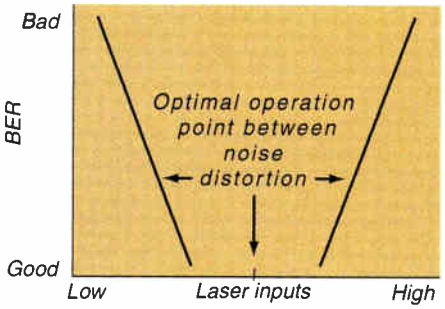
Setup, troubleshooting and test systems

By Thomas J. Staniec, VP–Network Engineering, The Excalibur Group, A Time Warner Company

"Return Systems 101" (see *CED*, August 1995, p.66) opened with the theme, "Everything Old is New Again." This article could be paraphrased as "what goes around, comes around." As more networks are being activated with operational two-way signal flow, more questions and ideas surface. Some questions are new and need answers. Others relate to issues and need refinement of past solutions.

While Return Systems 101 focused on basic operation of two-way networks, this article will cover more complex issues relating to setup, troubleshooting, equipment and test systems. The information presented comes from experiences in actual deployments of telecommunications services. Some testing is designed to understand how a problem impacts the network, why it happens and how it is introduced to the network. The great news is return networks work very well in supporting telecommunications. The difficulty lies in understanding how to set a network up for best operation. Information presented here will help with network operation decisions.

Figure 1: *Laser input should be centered between noise on the low level side, and clipping on the high side.*



The network

As previously indicated in Return Systems 101, the return laser is the weakest link in the return path from the subscriber to the receiver in the headend. Guess what? That is still true. The main source of the problem is how the laser responds from desired and undesired signals at its input. The **peak** level of all signals presented to the laser input must be below the maximum peak power for which the laser is rated. The question is, what is maximum peak level for a given laser? No one really knows. Today, manufacturers do not specify their equipment in this manner. Sometimes, the manufacturer can provide that information, but more often, information is not easily available. Manufacturers are in the process of clarifying how the specifications are written to be more helpful to the operator.

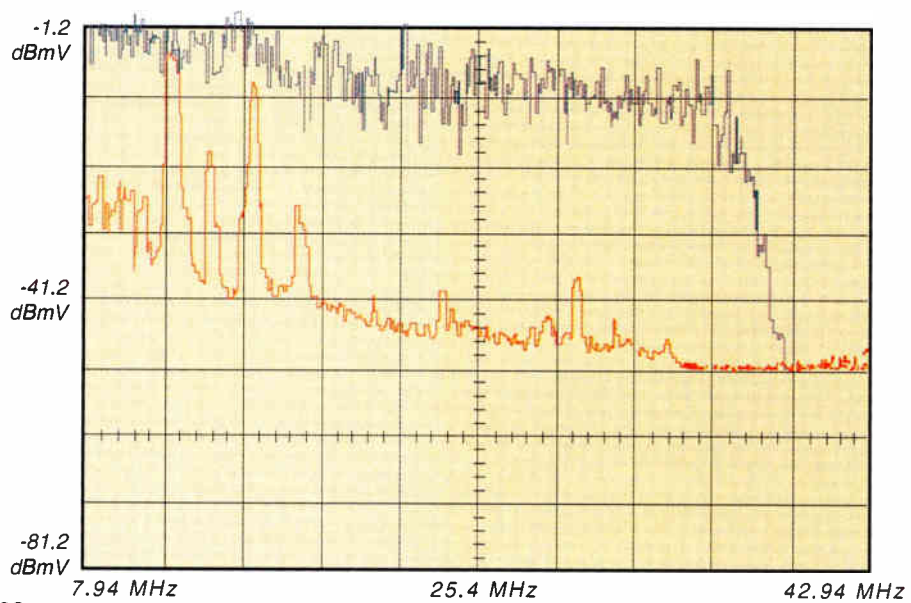
The previous article also recommended using the input to the laser as the network reference level. The idea has proven sound. At the output of the return receiver, it was suggested that the level be set to a convenient point slightly lower than the output from the return receiver on the longest return fiber optic path. All other return receiver outputs would be referenced to the same point. The goal is to preserve as much level at the output of the return receiver as possible to overcome losses in the coupling network behind the receiver.

Recently, with the deployment of cable modems, the thought has changed somewhat. The level at the return receiver output should reflect **the input to the laser**. For those who have already figured this out, congratulations (sometimes the old brain gets in the way of common sense). The reason centers around knowing how the network is operating. Any signal hitting the input of the laser will be directly related to the established reference. If the network starts to deviate, it will be detected quickly because the level at the output of the return receiver directly corresponds to the return laser input.

That's a nice starting point, but not the complete story. We need to understand where the point of clipping is relative to the lasers used. Currently, most manufacturers provide a specification which does not provide adequate information on how their return lasers operate. This makes aligning the laser and, subsequently, the network, much more difficult. The major concerns relate to the point at which the laser clips and where low inputs become overwhelmed with noise.

Working to deploy fully operational networks, I have seen several instances where high numbers of impulsive hits have been recorded. This led me to take a harder look at what causes problems in networks. What was found was a little surprising. To that end, with the help of CableLabs and Motorola, an operational two-way network was used to test the return of the HFC net-

Figure 2: *The effects of corrosion. The figure shows the superimposed spectrum analyzer image of water in a fitting.*



work. One of the first areas needing attention were return lasers. Below is a discussion of three ways to determine the maximum peak input level to a laser. They differ in the signals used to determine how the laser functions and, interestingly, present non-correlating information. The first attempt at laser correlation was done in conjunction with CableLabs and is discussed below.

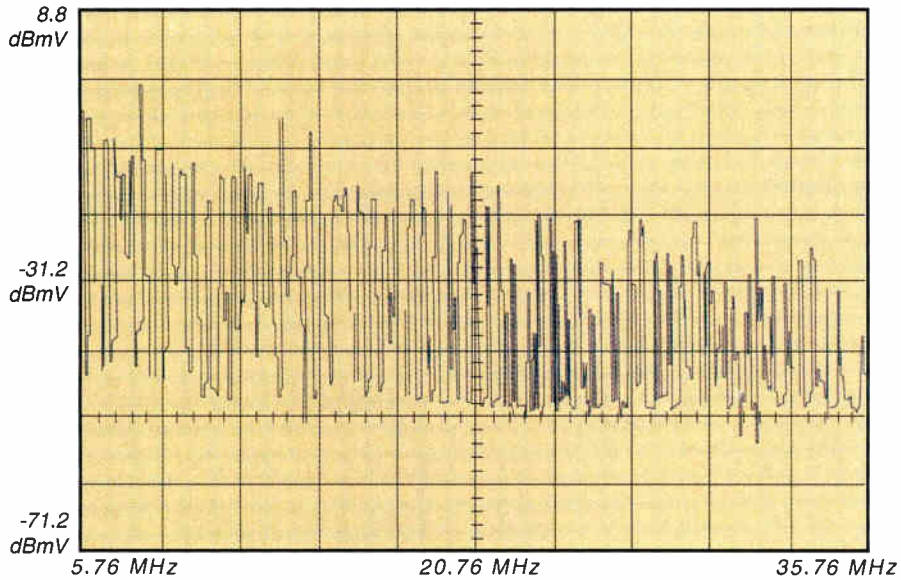
The laser

In the September 1996 issue of CableLabs' *SPECS Technology* newsletter, an article on "Testing cable return plant for clipping" appears. The article, by Tom Williams of CableLabs, is clear and will not be related in this article. The premise of the test involves a primary carrier at 8 MHz which is increased in level by 2 dB steps at the input to the return laser until the second (16 MHz) and third (24 MHz) harmonics appear, indicating clipping in the laser. The viewed harmonics could come from single-ended return amplifiers. However, the amplifier input range is generally greater than the laser and not the source of the harmonics. In short, the laser will most likely be the source of the problem.

A simplistic view of this test shows the difference between the manufacturer's rated level specification from the data sheet vs. what level causes clipping at the laser input. That difference is headroom. This test was run in conjunction with CableLabs in a two-way network this past summer. The results proved the tested network operated fine but could be driven into clipping. Further work showed the network was aligned toward the clipping side of the laser. The input to the laser should have been centered between noise on the low level side and clipping on the high level side. **Figure 1 presents the idea.**

The second method to test a laser involves the use of QPSK data modems and a data test set. The procedure is similar to the one above. Place the modems in the return at a frequency point that allows you to see the second and third harmonic in the return band. Keep increasing the input level until the bit error rate (BER) reaches $1x10^{-6}$. The difference between the manufacturer's specification and the level attained in the test suggest the peak input level the laser can tolerate.

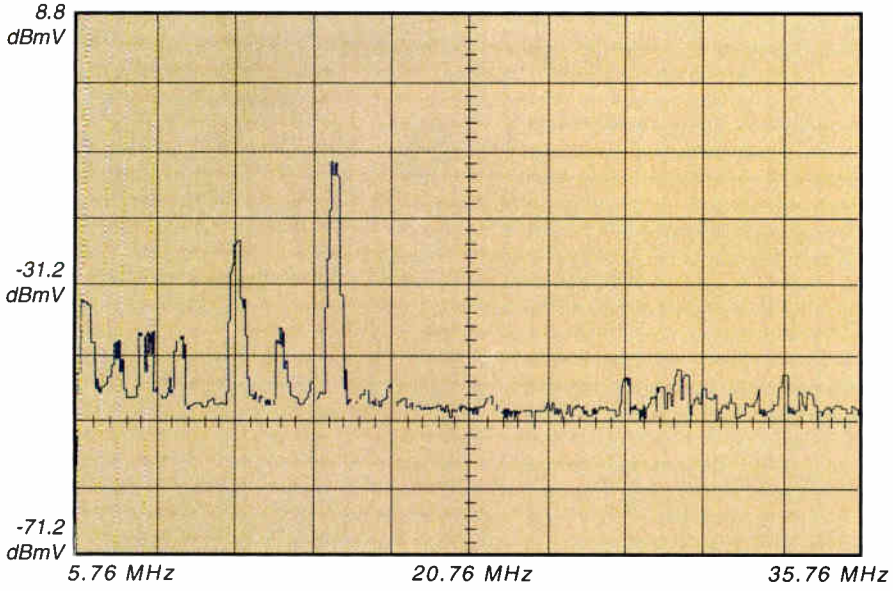
Figure 3: *The response of the wrong type of connector used on the wrong type of cable, with a little moisture thrown in.*



Working with that information will allow for the establishment of a power-per-hertz level allocation in the 5 to 40 MHz band. The description presented here is skeletal in nature. For a more in-depth discussion on this topic, read the paper, "Lessons for the interactive return system," presented by Dr. Kerry LaViolette of Philips Broadband Networks in the 1996 NCTA transcripts. Dr. LaViolette's testing differs from the above in that he had data carriers fully loaded in the 5 to 40 MHz return. One aspect of his testing showed that lasers, while performing to comparable curves could vary widely, which further enforces the idea of characterizing all lasers.

The test sequence actually used was designed by Motorola and involves the use of an arbitrary waveform generator (ARB). The designed waveform programmed into the ARB

Figure 4: What the network looked like after the problem in Figure 3 was found.



is a tone sequence equally divided on each side of a center frequency and appearing as though it represented the peak power level of a form of QPSK modulation. The testing was run on an active network, and the results proved to be interesting.

First, the standard CW tone test showed the laser under test could operate at a peak input level well above the manufacturer's published specification. However, the engineered test signal from the ARB put the maximum input level to the laser at, or slightly below, the manufacturer's specification. An interesting side result of this testing was directly visible on a spectrum analyzer. **Every time** a high-level impulsive strike entered the network, it caused CTB to show up around the ARB signal on the spectrum analyzer in the headend. The level of the intermodulation varied with the amplitude of the strike. This proved to be a solid verification of the type of problem prevalent in this **specific network**. The conclusions taken away from this test are:

✔ C/N, while needing to be held high, may not be a good predictor of network operation in a data system.

✔ Return lasers need to be characterized in a number of ways to determine the best median operating point once the peak operating point is established.

✔ C/CTB may become a more important predictor of network operation than C/N.

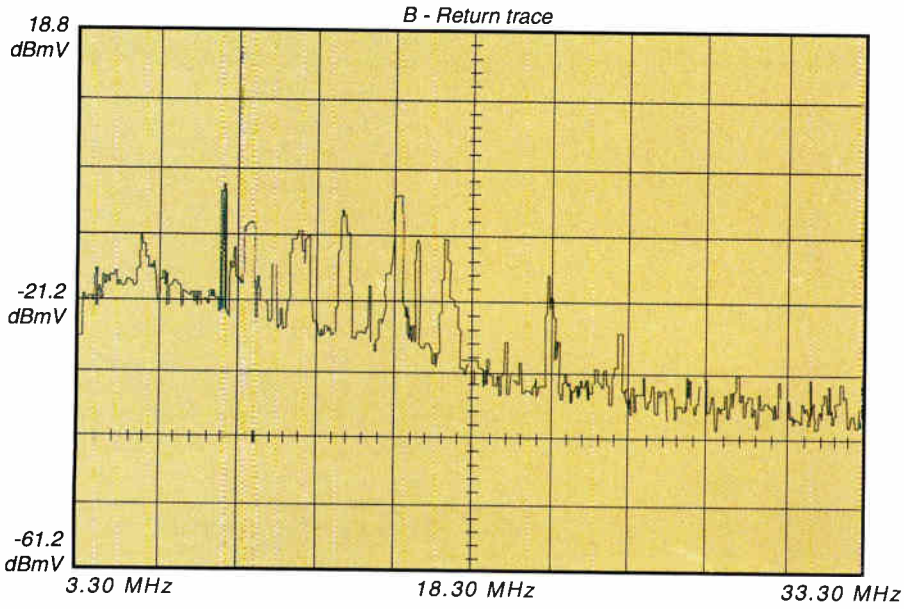
✔ Increasing signal levels into the return on "the more the better" mentality might be self-defeating.

The testing done with Motorola on a specific type of return laser shows this laser can only tolerate six narrow-band frequencies at individual channel levels about +12 dBmV, significantly lower than previously assumed. It needs to be stated that the specifications on this laser are for one video channel with some data carriers running 10 dB below the video. In this case, there are no video channels in this return. The six frequencies combined are smaller than the one video channel. It needs to be stated that other return lasers already perform better, but points up why network laser characterization should be done in every network.

The simple response is to lower all carrier levels to a point that doesn't affect the laser

Why is this information important? It sets the stage for a well-operating network. These concepts show how to operate the network as more digital carriers are added to it. As more channels of the same level are added to the return network, the laser begins to see higher cumulative power at its input. As the input power increases, the maximum power input

Figure 5: The node prior to filtering.



to the laser will be reached or exceeded, which affects the network.

The simple response to this problem is to lower all carrier levels to a point that does not affect the laser. Unfortunately, the simple answer is a little too simple. The digital modulation schemes used for modem, telephone or high-speed transmitters in the return need to deal with **peak** signals, not **root mean square (rms)**. Digital signals have peak power points much like the peak power point of a television signal. In the case of the television signal, the peak is the sync tip. A 64 QAM digital signal has a peak signal 9 to 10 dB higher than the RMS value. That peak point is represented in a 64 QAM signal at the point farthest away from the origin in the signal constellation.

For a QPSK modulated signal, the peak can be 3 to 5 dB higher than the RMS value

For a QPSK modulated signal, the peak can be 3 to 5 dB higher than the RMS value. The concern about peak power into the laser might not be a problem with one or two digital return carriers. As more carriers are added, the total power level increases just because more carriers are present. However, the power can increase **much** higher than the power you see as the carriers are added. In fact, as the modulation schemes come in and out of phase, the peak power can dramatically change. The total power can be pushed to levels well above what the laser can tolerate. This not only raises the specter of clipping and possible laser destruction but can show deficiencies in how the laser handles multiple high-level carriers. The resulting intermodulation problems, which can be caused by desired and undesired signals, will definitely affect any type of communications. The recommendations are:

✔ Characterize return lasers to understand how they operate.

✔ Depending how the return looks, run the levels at a point that increases the margin to interference by subtracting out headroom for ingress/impulse problems.

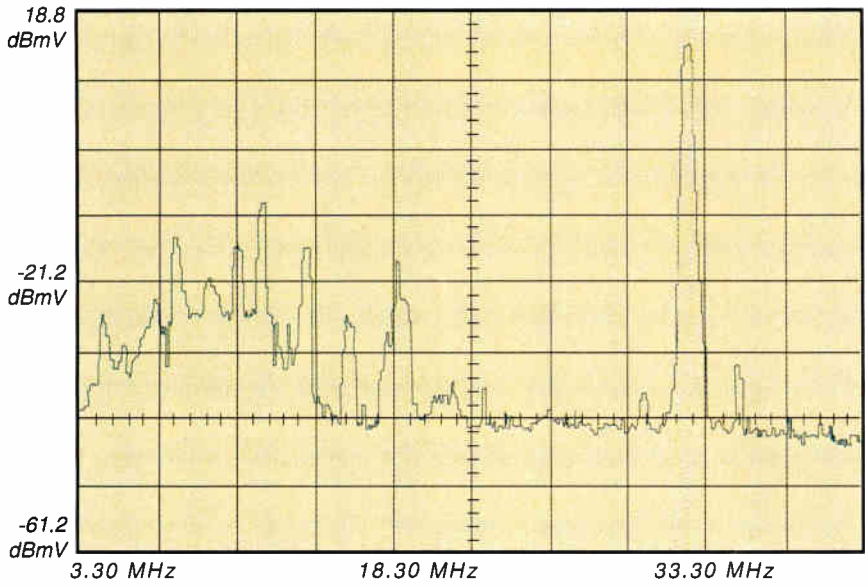
✔ Determine levels into the laser based on a **loaded** network bandwidth. As more carriers are added to the network, correcting the whole mess could be difficult as penetration levels climb.

The amplifier network

The manufacturers are getting better at helping the industry get the most out of their return networks. An excellent example of this is shown in Figure 8. This chart, reprinted with the permission of C-Cor Electronics, provides the operator with all the information needed to align a return network properly. While it is based on video channel measurements for carrier level and C/N, it provides a great tool for network setup. The chart makes it easy to determine how the network should perform.

In this case, from the bill of materials

Figure 6: *The node after filtering (so we thought).*



(BOM) or directly from the design maps, count up the total number of system and line extender style amplifiers. Enter the chart on the proper axis for each to the point where the columns intersect. The C/N listed is what you should expect for the RF plant C/N based on the 17 dBmV flat input levels into the return amplifiers. The reference return optics path loss budget for most manufacturers is in the 5 to 8 dB range. The C/N from the optical path is typically listed as 51+ dB for those budget losses. In a typical 500-home node with somewhere between 32 to 64 actives, the RF C/N will be in the range of 48 dB. The **combined** network C/N will be in the range of 46 + dB, well above the typical low- to mid-thirties C/N often seen in operating systems. Keep in mind that a 46 dB or better C/N number is based on a **4 MHz video bandwidth**. The C/N for a much narrower digital signal will be significantly better. Keep in mind C/N may not, by itself, determine total headroom and operating range for the network.

For all intents and purposes, the majority of problems in the return come from the drop systems attached to the hard coaxial networks. This has been verified by various groups working with the return network. I have stated on a number of occasions that 70 percent of the problems come from the subscribers' homes, 25 percent from the tap to the ground block and 5 percent from the hard coax plant. Generally, the 5 percent in the hard coax came from critters, craft and catastrophe. **Figures 2 and 3** add another word: corrosion. Both figures are from areas in a system where dynafoam cable is still in the network. Figure 2 shows the superimposed spectrum analyzer image of water in a fitting. This was an intermittent problem, causing the rise in the noise floor by over 30 dB.

The majority of problems in the return come from the drop systems

Figure 3 shows the response of a wrong type of connector used on the wrong type of cable with a little moisture thrown in for good measure. **Figure 4** is what the network looked like after the problem was found and repaired. It does not take a rocket scientist to figure out communications can operate well in **Figure 4** and not at all in **Figure 3. Return systems can, and do, operate very well.** The key to how they operate is practices, procedures and personnel.

The drop system

I have long held the belief that it is better to understand how something works badly than to understand how it works well. If you understand the "lemon" aspects of operation, you can learn how to make lemonade. With that in

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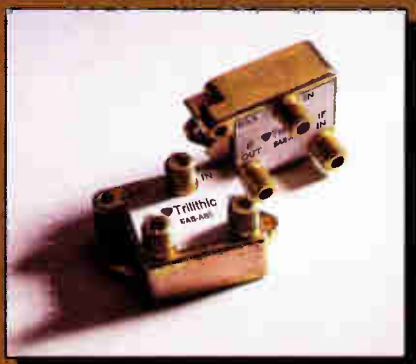

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mind, one system I worked with proved to be more than a little confounding with a smattering of confusion thrown in for good measure. The network typically operated well, but there were times when trial users reported less-than-optimum performance.

Viewing the nodes in question on a spectrum analyzer, at times they looked fine, and sometimes problems were apparent. The confusion came when the nodes looked fine but the trial users reported degraded operation. A clue to the probable cause came while collecting data on the modems. By varying the length of the packets sent, either 64-byte or 1518-byte, a consistent picture started to emerge.

The 64-byte packets would pass through the network with relative ease and high reliability. The story was quite different for the 1518 byte packets. They would be "hit" frequently and in some cases multiple times. These "impulsive" problem(s) are difficult to find via standard CATV spectrum analyzers because of their sweep speeds. It is highly probable that the problem is not caught because the sweep is at a different point than where the problem takes place. The test equipment needed to find these types of problems must log the occurrence as soon as it happens. Further, if the problem reoccurs, it may leave a signature trace. Realizing the trace has a signature can aid troubleshooting.

Realizing the trace has a signature can aid troubleshooting

Detective work

A plan was devised to help narrow down what, how and where these problems were coming from. The plan involved taking baseline information on nodes. The nodes had been balanced, and work was done to clean up ingress sources to a reasonable level. Further, the plan involved purchasing two types of windowed (to pass the return carrier from home convertors) high-pass filters.

One group of filters had an attenuation of 40 dB outside the window, while the other had a 60 dB attenuation. The window is centered at 8.9 MHz for the General Instrument convertors being used. CableLabs was solicited for the test equipment used to log events (hits) as

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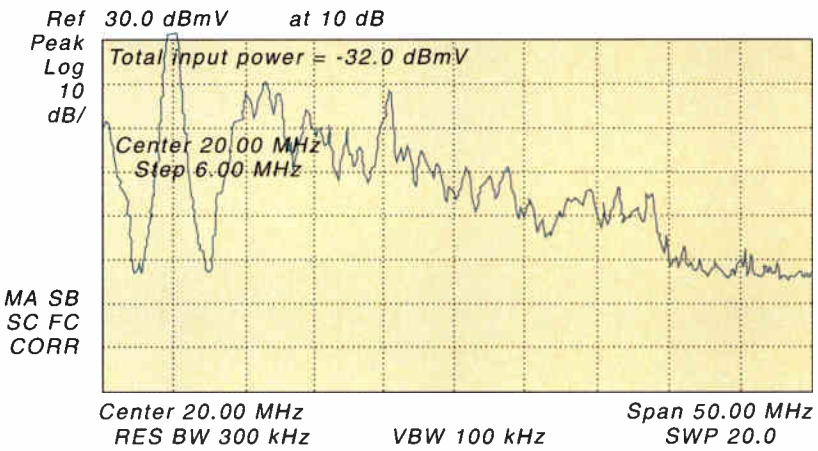
they happened. Four nodes were tested and provided some interesting results. Of the four, one node, far and away, was plagued by random events.

On a per-day basis, the node sustained thousands of hits which could effect BER. **Figure 5** is the node prior to filtering. **Figure 6** is the node after filtering (so we thought). Note the low frequency end of the spectrum and the drop in the noise floor on the high end. The carrier in the middle of the right-hand side of the screen is used in this testing. The actual data carrier occupies the first gradicule to the left of center screen.

Figure 7: The problem was tracked down to a battery charger for an electric wheelchair.



The highest daily rate in a 24-hour period of time was 6,940 events. The estimated BER in the period was in the 10^{-3} error rate before the network was filtered. The availability of the network, at times, was about 70 percent. No wonder the trial users would see slow operation! Once the network was filtered with the windowed 40 dB high-pass filters, the hit rate dropped to a maximum of 1,572 events in 24 hours–a sizable reduction. But the story does not end here. The BER **with the filters** only edged into the 10^{-4} range. The estimated network availability in this node improved to an average 99.4 percent over the 24 hours assuming a threshold of operation of $1x10^{-5}$. That number may or may not be reasonable, but it is the point where most forward error correction (FEC) starts to operate.

This node is hardly a sterling endorsement for filtering. I had difficulty accepting those numbers and decided a more thorough investigation was needed.

Discussions with CableLabs and summary information provided the answers. There are, in fact, signatures left by the offending problems. Armed with the new information, a closer evaluation of the node was made. That evaluation led to the following discoveries:

The availability of the network, at times, was about 70 percent

✔ Short-term, high level CB radio ingress is clipping the laser.

✔ The RF output from the convertors is clipping the laser.

✔ Very high level impulsive problems coming **through the window** are driving the laser into clipping.

In fact, the first visual sighting on a spectrum analyzer came while running the multiple tone test with Motorola. The problems appeared as beats clustered around the tone test. So, where were the problems coming from in a fully filtered node?

Armed with the above information, two people were dispatched to find out. The problems were assumed to be in the hard coax plant after the filters. But those assumptions were **wrong**. After a full week of work, the findings were as follows:

✔ About 24 drops were missed. That is, filters were not installed.

✔ Another group of filters were **not** placed at the tap port but at the side of the house, leaving the drop from the tap to the house open.

✔ One radial-cracked cable in the hard coax was found.

None of these problems were found using signal leakage measurements in the forward system. They were all detected using a CB radio with a spectrum analyzer and an all-band receiver in the headend. In most cases, no signal leakage from the forward system was found at the problem sites. If leakage was noted, it was at levels well below where it would have been investigated.

Instead, the predominate source of the problems was the drop system. I have often stated that a single house or drop can mess up the whole network, and that's still true (except in this case it was a total of about 30 drops). The

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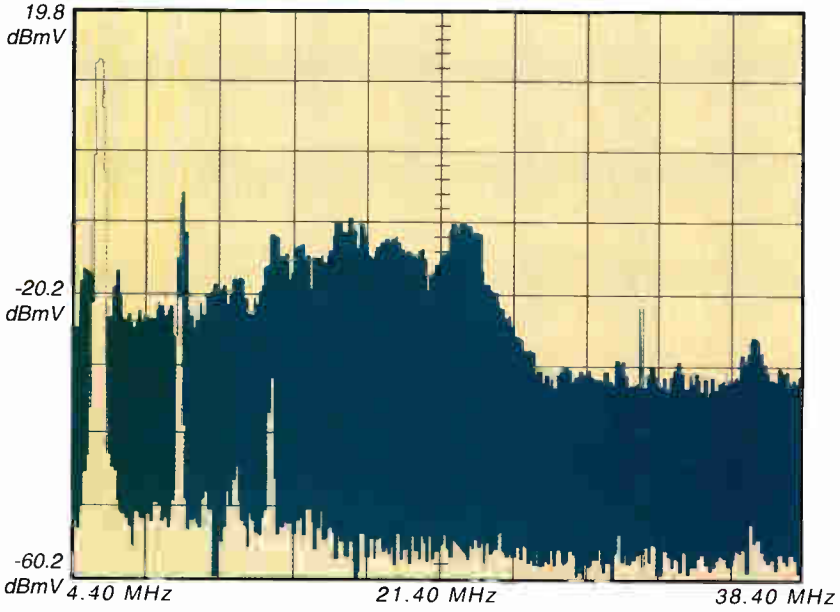
Figure 9: The problem proved to be the RG-59 cable from the ground block to the convertor input.



CableLabs monitoring equipment was moved back into this node and, while not complete, the total hits in a 12-hour period are now less than 360.

The above was not the only node tested in that manner. Another, cleaner, node was also tested. It had a worst-case estimated BER of about $1x10^{-4}$. The estimated availability at certain intervals was around 90 percent, with a 24-hour average of around 98 percent. After filtering with 60 dB window filters, the BER dropped into the 10^{-7} range. The estimated availability rose to 99.93 percent with a worst-case availability of 99.9 percent. These results are more in line with expectations.

The use of high-pass filters can be a volatile subject. The use of filters in these tests is to sort out what is happening in a network. They are used to find where problems come from, how problems get into the network and what it takes to correct them. The decision to use filters is not one to take lightly and should be weighted on a case-by-case basis. With filters, there are three simple options. They are:

✔ Do not use filters and keep the network clean. It can be done.

✔ Use filters for problems that cannot be resolved right away.

✔ Fully filter the network.

The choice of these options requires through analysis. If you do choose to use filters, here are some things to think about:

✔ Tests show that a 40 dB filter is more than adequate to get to the combined noise floor in a typical 500 HP node. The tests also show 60 dB filters brought the noise and impairments to the same point the 40 dB filter did. If your choice is to use filters, 40 dB filters appear more than adequate.

✔ If you are going to use or need a window for a convertor return carrier, make the window as narrow as possible **and** have insertion loss added at the window in the range of 6 to 10 dB. This will help with the convertor/laser clipping problem, not to mention impulse strikes that bleed through the window.

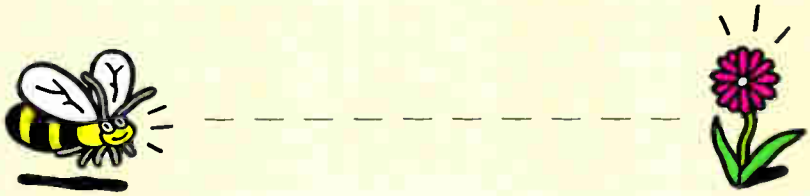
"Nobody knows the troubles I've seen"

In order to show and present material that is helpful and informative to technical personnel on how to solve problems, **Figures 7 and 9** are presented only to increase the readers' knowledge as they work on return systems. They do, however, represent real-life situations. **Figure 7** was tracked down to a battery charger for an electric wheelchair. The main feature of note in **Figure 9** is the big RF blob just to the left of center. When located, the problem proved to be the RG-59 cable from the ground block to the convertor input. Changing the cable fixed the problem. There was no noted damage to the cable.

The assortment of available test equipment is getting much better

Test equipment

What a difference a few months makes. The assortment of available test equipment is getting much better. The Trilithic unit operates well and is easy to use. Hewlett-



(bee) (flower)

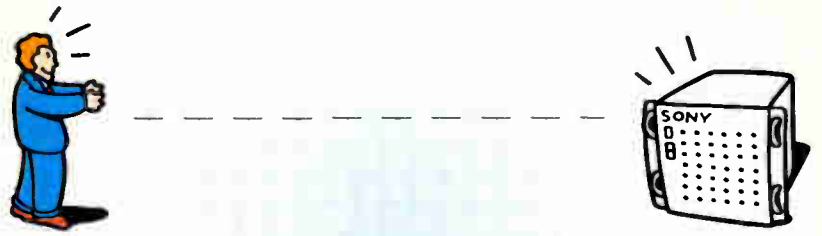


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Figure 8: *Return system C/N matrix (with high gain return)*

	Input levels	Noise figures	C/N
FlexNet amplifiers (bridger ports)	17 dBmV	11.5 dB	64.5 dB
Line extender (LEs)	17 dBmV	6.5 dB	69.5 dB

Line extenders	FlexNet amplifiers																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
10	59.50	58.31	57.37	56.60	55.95	55.38	54.88	54.43	54.02	53.65	53.31	52.99	52.69	52.41	52.15	51.91	51.68
11	59.09	57.99	57.11	56.39	55.76	55.22	54.73	54.30	53.90	53.54	53.20	52.89	52.60	52.33	52.07	51.83	51.60
12	58.71	57.69	56.87	56.18	55.58	55.06	54.59	54.17	53.78	53.43	53.10	52.80	52.51	52.25	52.00	51.76	51.53
13	58.36	57.41	56.64	55.98	55.41	54.90	54.45	54.04	53.67	53.32	53.00	52.71	52.43	52.17	51.92	51.69	51.47
14	58.04	57.15	56.42	55.79	55.24	54.76	54.32	53.92	53.56	53.22	52.91	52.62	52.34	52.09	51.85	51.62	51.40
15	57.74	56.91	56.21	55.61	55.08	54.61	54.19	53.80	53.45	53.12	52.81	52.53	52.26	52.01	51.77	51.55	51.33
16	57.46	56.68	56.01	55.44	54.93	54.47	54.06	53.69	53.34	53.02	52.72	52.44	52.18	51.93	51.70	51.48	51.27
17	57.20	56.45	55.82	55.27	54.78	54.34	53.94	53.57	53.24	52.92	52.63	52.36	52.10	51.86	51.63	51.41	51.20
18	56.95	56.24	55.64	55.11	54.64	54.21	53.82	53.46	53.14	52.83	52.54	52.27	52.02	51.78	51.56	51.34	51.14
19	56.71	56.04	55.46	54.95	54.50	54.08	53.71	53.36	53.04	52.74	52.46	52.19	51.95	51.71	51.49	51.28	51.07
20	56.49	55.85	55.30	54.80	54.36	53.96	53.59	53.25	52.94	52.65	52.37	52.11	51.87	51.64	51.42	51.21	51.01
21	56.28	55.67	55.13	54.66	54.23	53.84	53.48	53.15	52.84	52.56	52.29	52.03	51.80	51.57	51.35	51.15	50.95
22	56.08	55.49	54.98	54.52	54.10	53.72	53.37	53.05	52.75	52.47	52.21	51.96	51.72	51.50	51.29	51.08	50.89
23	55.88	55.32	54.83	54.38	53.98	53.61	53.27	52.95	52.66	52.39	52.13	51.88	51.65	51.43	51.22	51.02	50.83
24	55.70	55.16	54.68	54.25	53.86	53.50	53.17	52.86	52.57	52.30	52.05	51.81	51.58	51.36	51.16	50.96	50.77
25	55.52	55.00	54.54	54.12	53.74	53.39	53.07	52.77	52.48	52.22	51.97	51.73	51.51	51.30	51.09	50.90	50.71
26	55.35	54.85	54.40	54.00	53.63	53.29	52.97	52.68	52.40	52.14	51.89	51.66	51.44	51.23	51.03	50.84	50.66
27	55.19	54.71	54.27	53.88	53.52	53.18	52.87	52.59	52.32	52.06	51.82	51.59	51.37	51.17	50.97	50.78	50.60
28	55.03	54.56	54.14	53.76	53.41	53.08	52.78	52.50	52.23	51.98	51.75	51.52	51.31	51.10	50.91	50.72	50.55
29	54.88	54.43	54.02	53.65	53.30	52.99	52.69	52.41	52.15	51.91	51.67	51.45	51.24	51.04	50.85	50.67	50.49
30	54.73	54.29	53.90	53.54	53.20	52.89	52.60	52.33	52.07	51.83	51.60	51.39	51.18	50.98	50.79	50.61	50.44
31	54.59	54.16	53.78	53.43	53.10	52.80	52.51	52.25	52.00	51.76	51.53	51.32	51.11	50.92	50.73	50.55	50.38
32	54.45	54.04	53.67	53.32	53.00	52.70	52.43	52.17	51.92	51.69	51.46	51.25	51.05	50.86	50.68	50.50	50.33
33	54.31	53.92	53.55	53.22	52.91	52.61	52.34	52.09	51.84	51.61	51.40	51.19	50.99	50.80	50.62	50.45	50.28
34	54.19	53.80	53.44	53.12	52.81	52.53	52.26	52.01	51.77	51.54	51.35	51.13	50.93	50.74	50.56	50.39	50.23
35	54.06	53.68	53.34	53.02	52.72	52.44	52.18	51.93	51.70	51.47	51.26	51.06	50.87	50.69	50.51	50.34	50.18
36	53.94	53.57	53.23	52.92	52.63	52.36	52.10	51.86	51.63	51.41	51.20	51.00	50.81	50.63	50.45	50.29	50.12
37	53.82	53.46	53.13	52.83	52.54	52.27	52.02	51.78	51.56	51.34	51.14	50.94	50.75	50.57	50.40	50.23	50.08
38	53.70	53.36	53.03	52.73	52.45	52.19	51.94	51.71	51.49	51.27	51.07	50.88	50.69	50.52	50.35	50.18	50.03
39	53.59	53.25	52.94	52.64	52.37	52.11	51.87	51.64	51.42	51.21	51.01	50.82	50.64	50.46	50.30	50.13	49.98
40	53.48	53.15	52.84	52.56	52.29	52.03	51.79	51.57	51.35	51.15	50.95	50.76	50.58	50.41	50.24	50.08	49.93
41	53.37	53.05	52.75	52.47	52.20	51.96	51.72	51.50	51.28	51.08	50.89	50.70	50.53	50.36	50.19	50.03	49.88
42	53.27	52.95	52.66	52.38	52.12	51.88	51.65	51.43	51.22	51.02	50.83	50.65	50.47	50.30	50.14	49.98	49.83
43	53.17	52.86	52.57	52.30	52.05	51.81	51.58	51.36	51.16	50.96	50.77	50.59	50.42	50.25	50.09	49.94	49.79
44	53.07	52.76	52.48	52.22	51.97	51.73	51.51	51.30	51.09	50.90	50.71	50.54	50.36	50.20	50.04	49.89	49.74
45	52.97	52.67	52.40	52.14	51.89	51.66	51.44	51.23	51.03	50.84	50.66	50.48	50.31	50.15	49.99	49.84	49.70
46	52.87	52.58	52.31	52.06	51.82	51.59	51.37	51.17	50.97	50.78	50.60	50.43	50.26	50.10	49.94	49.79	49.65
47	52.78	52.50	52.23	51.98	51.74	51.52	51.31	51.10	50.91	50.72	50.54	50.37	50.21	50.05	49.90	49.75	49.61
48	52.69	52.41	52.15	51.90	51.67	51.45	51.24	51.04	50.85	50.67	50.49	50.32	50.16	50.00	49.85	49.70	49.56
49	52.60	52.33	52.07	51.83	51.60	51.38	51.18	50.98	50.79	50.61	50.44	50.27	50.11	49.95	49.80	49.66	49.52
50	52.51	52.24	51.99	51.76	51.53	51.32	51.11	50.92	50.73	50.55	50.38	50.22	50.06	49.90	49.76	49.61	49.47
51	52.42	52.16	51.92	51.68	51.46	51.25	51.05	50.86	50.67	50.50	50.33	50.17	50.01	49.86	49.71	49.57	49.43
52	52.34	52.08	51.84	51.61	51.39	51.19	50.99	50.80	50.62	50.44	50.28	50.12	49.96	49.81	49.67	49.52	49.39
53	52.26	52.01	51.77	51.54	51.33	51.12	50.93	50.74	50.56	50.39	50.23	50.07	49.91	49.76	49.62	49.48	49.35
54	52.18	51.95	51.70	51.47	51.26	51.06	50.87	50.68	50.51	50.34	50.17	50.02	49.86	49.72	49.58	49.44	49.30
55	52.10	51.85	51.62	51.41	51.20	51.00	50.81	50.63	50.45	50.29	50.12	49.97	49.82	49.67	49.53	49.40	49.26
56	52.02	51.78	51.55	51.34	51.15	50.94	50.75	50.57	50.40	50.23	50.07	49.92	49.77	49.63	49.49	49.35	49.22
57	51.94	51.71	51.48	51.27	51.07	50.88	50.69	50.52	50.35	50.18	50.02	49.87	49.73	49.58	49.45	49.31	49.18
58	51.87	51.64	51.42	51.21	51.01	50.82	50.64	50.46	50.29	50.13	49.98	49.83	49.68	49.54	49.40	49.27	49.14
59	51.79	51.56	51.35	51.14	50.95	50.76	50.58	50.41	50.24	50.08	49.93	49.78	49.63	49.50	49.36	49.23	49.10
60	51.72	51.50	51.28	51.08	50.89	50.70	50.53	50.35	50.19	50.03	49.88	49.73	49.59	49.45	49.32	49.19	49.06
61	51.65	51.43	51.22	51.02	50.83	50.65	50.47	50.30	50.14	49.98	49.83	49.69	49.55	49.41	49.28	49.15	49.02

Reprinted with permission of C-COR Electronics and based on their return equipment.

Packard/CaLan has a unit with excellent features for troubleshooting, alignment and network operation. Wavetek has come out with a higher power Stealth sweep which overcomes a deficiency in the original Stealth sweep system when used in the return network. Wavetek also has come out with an option on its new MicroStealth meters that allows you to look at the return spectrum in a spectrum analyzer mode. Investigation is being done on the unit to see if it can be used as a drop certification tool. TriSpec Communication out of Canada has a well-featured piece that provides a small, useful spectrum analyzer as a field receiver.

A short time ago, none of this test equipment existed. Test equipment will continue to evolve and so will the way we use it. As the network evolves, the test equipment has to follow. New tools are required to troubleshoot problems. Impulse problems demonstrate that premise exceptionally well. Wideband high frequency digital storage oscilloscopes can capture impulse events and will be needed. Arbitrary waveform generators to generate test signals and to reproduce the problems captured on the digital storage oscilloscope will help to "peel the layers of the onion back." That will allow for better understanding and control of these hybrid fiber/coaxial networks.

Further, we need to find a better way to handle level variations in the return path

While test equipment can help troubleshoot these kinds of problems, it is an "after the fact" solution. Network monitoring on a real-time, pro-active basis is needed. While system levels are important, the real problems that need attention are not being monitored or reported. It is not enough to capture an event at the output of a receiver in a headend. Impulse problems need to be reported from sensors **in the network at** the time the problem occurs. This will go a long way to fast identification and correction of the problem at its source. To date, no one has this type of monitoring or reporting capability.

In conclusion

This brings us to the end of Return Systems 102. It does not bring us to the end of the work that still needs to done.

We must find ways to troubleshoot and repair networks faster, preferably before the customer becomes aware a problem exists. To do this, we need pro-active monitoring on a real-time basis.

Further, we need to find a better way to handle level variations in the return path. Return amplifiers have always been treated as something of an after-thought. Now they formulate a position which can produce new revenue streams. On what, and where, you set your sights–along with how you control your network–will ultimately determine your success. Good luck! CED

CableNET '96 zeroes in on data, net management

A melting pot of vendors

By Dana Cervenka

While the purpose of the CableNET™ exhibit continues to be to show off the capabilities of the broadband cable network, the focus for this year's massive demo at the Western Cable Show zeroes in on data and network management applications.

Produced by Cable Television Laboratories Inc. (CableLabs), CableNET '96 will showcase multiple demonstrations from more than 35 high-tech companies, with another dozen or so firms providing raw infrastructure and components to make it all run smoothly.

The data focus is easy to understand, given cable operators' zeal to reap the bounty of providing high-speed connections to the Internet, and the focus on network management services is a logical follow-on. Responding to feedback from CableLabs' members like Continental Cablevision and Jones Intercable, who are themselves in the thick of implementing complex network and subscriber management systems, executives at the Louisville, Colorado-based consortium decided to incorporate network management demonstrations into the exhibit as well.

"We want to show that the cable industry is serious about the kinds of services it is going to be delivering, and there is an understanding that network management will play a key part in how it is able to handle the delivery of all these different services over the same pipeline," says Mike Schwartz, senior VP of communications for CableLabs.

This year, CableNET will feature three separate networks—RF, fiber and data—hauling information around the exhibit hall and out to Century Communications' local cable network, as well as to servers located as far away as that of Lucent Technologies in New Jersey. The data network, composed of two T-1 lines, will connect the exhibit directly to the Internet.

The exhibit itself is bigger than ever before, taking up a full 6,000 square feet of the Anaheim Convention Center, space which is donated by Western Show organizer CCTA (California Cable Television Association).

As for the fiber network, it's composed of more than 77 fiber miles, with 20 of those lit up and working. Of the 20, 15 fiber miles connect the exhibit to one of Century Communications' redundant fiber rings, while four miles will actually be in use inside the exhibition hall.

Configured to resemble a regional fiber ring, the network will pump two different channel lineups from Century to the show floor, and odds are good that the plant will approach 750 MHz in signal capacity.

Help for the modem-impaired

The main guideline CableLabs set up for the applications to be displayed is that they all either be already deployed in the real world, or be capable of being deployed within the next 12 months.

On the data side, Intel will be demonstrating an integrated diagnostic program it has written which is designed to help cable technicians complete the dreaded cable modem installation. In another portion of the exhibit, Lucent Technologies will be running packetized voice and music featuring a compression rate of 27:1 over the Internet, via LANcity cable modems.

LANcity, which is supporting a number of demos, has furnished modems to specific schools in the Anaheim area, which will send and receive high-speed data via Century's fiber network, as part of another demonstration. The data trial with the area schools will continue well after the show has drawn to a close.

The Lucent/LANcity teaming is a good example of what Frank Wimler, supervisor, technical services with CableLabs, calls the CableNET "melting pot."

"A lot of these companies get to meet other firms which are doing things that can enhance their own projects," notes Wimler. "It's a chance for them to work on applications that they wouldn't normally work on."

A number of vendors have stepped up to provide materials and equipment worth thousands of dollars to support the exhibit, including: Alpha, which is supplying power supplies; Amp, which is furnishing fiber optic equipment; Belden, which has given CableLabs coax and fiber; GI, which is furnishing modulators and lasers; Philips, which has provided taps and lasers; Bay Networks, which has ponied up for routers; and the aforementioned LANcity (see sidebar, "What vendors will be showcasing," on the next page).

While CableLabs has taken on the management role, as it did last year, the consortium has also hired a project manager from EDS to coordinate the whole tamale.

At the beginning of November, an engineering team from CableLabs was about halfway through with the integration of the various applications, all based out of a

What vendors will be showcasing at CableNET '96

@Home—A high-speed, end-to-end network solution for full Internet access.

ADC Telecommunications—Standard and enhanced telephony services, multiple levels of high-speed data delivery, tailored to varied market niches, and analog and digital video services. Services will be delivered over a single platform which allows for efficient management and use of the spectrum.

Bay Networks—Data routers and hardware to support a cable data business and necessary software to manage the cable data service.

CableData—A cable modem interface with a Java-developed graphical user interface Web page to perform business office transactions.

Com21/3COM—Interactive multimedia applications, Internet access of Web sites with audio and video dimensions. These rely on ATM (asynchronous transfer mode) technology.

Convergence Systems Inc.—Convergence Systems Inc. and Advanced Modular Solutions are presenting a headend computer solution designed specifically for the cable industry. The computer operates on all software platforms at high speeds, while taking up little headend space, and will run both Internet and Intranet with a firewall in between.

First Pacific Networks—Its system for delivering telephone service over the cable network.

General Instrument—The company is showing its 256/64 QAM digital video compression system.

Hayes Microcomputer Products—Fast Internet access using a one-way cable modem and telephony return.

Hewlett-Packard—High-speed Internet access services and a data network operations management system.

Harmonic Lightwaves—Complete network management from headend to line extender, and from the element manager to the network manager.

HITS (Headend In The Sky)–Digital video compression.

Integration Technologies, Objective Systems Integrators and AM Communications—An integrated, end-to-end network management system.

Intel—Installation and network management software utilities that may be used to install, connect and troubleshoot any brand of cable modem in less than 15 minutes.

Jones CyberSolutions—Network management, customer service system.

LANcity—Ethernet/ATM interoperability, network management and operations support services and a range of multimedia content delivered over its cable modems.

Lucent Technologies—A packet voice and music system that works over cable networks and a platform for delivering integrated voice, data and digital video.

Microsoft—A family of servers and client SW designed to provide cable operators with the technologies necessary to provide services to communities of users on both the Internet as well as Intranets. The software platform scales from hundreds of users to millions, enabling cable operators to cost-effectively address the Internet market systems wide.

Motorola—Cable-based telephony and high-speed data service over hybrid fiber/coax.

NEC America Inc.—Graphically rich data services and video with related data delivered via cable modem.

Network Computer Inc. (An Oracle Company)—Access to personalized information on the network computer using NC Smartcard.

Phasecom Inc.—Various broadband interactive applications like videoconferencing, high-speed Internet access and telephony, all over cable networks.

Racal Data Group—How traditional telephone and video may be integrated with networked interactive data services.

Superior Electronics Group Inc.—A broadband network monitoring and performance analysis system.

SkyConnect/Digital Equipment Corp.—A cable digital advertising insertion network management software product. Separately, SkyConnect will demo a streamlined way for buying, selling and fulfilling ads on local cable and the World Wide Web.

Terayon Corp.—A cable modem which uses code division multiple access (CDMA).

Thomson Sun Interactive, LLC —A Web browser application, running on a standard OpenTV set-top and TV, coupled with an Internet gateway suitable for deployment by network operators at their headends.

VideoActive Technologies Corp.—An Instant-Access NVOD system with an architecture that provides low-cost per thread movies-on-demand.

WorldGate Communications—Through its TV On-Line services, is offering universal consumer access to the Internet via television sets, using existing cable set-top convertors, without the need for a personal computer or high-speed modem.

Your Choice TV—Nationally delivered enhanced PPV service that gives consumers a second chance to watch some of America's most popular TV shows. Your Choice TV provides time-shifted programming from major broadcast and cable networks.

Zenith Electronics Corp.—Two-way cable data delivery and data delivery using cable in one direction, and telephone lines for the return. The display includes Web pages on television.

Supporting vendors providing enabling technology

Alpha Technologies Inc.—Power supplies, uninterruptible power and technical support.

AMP Inc.—Fiber optic equipment and telephony category 5 equipment.

Bay Networks—Internet routers, Ethernet switches and technical support.

Belden Wire & Cable—Fiber optic and coaxial cable, telephony cable.

Comm/Scope Inc.—Fiber optic cable, coaxial cable, telephony cable and shipping.

Gilbert Engineering Co. Inc.—Coaxial connectors.

Hewlett-Packard—Spectrum analyzer.

General Instrument—Modulators, fiber optic transmitter/receivers.

Philips Broadband Networks—Cable distribution equipment, fiber optic transmitter/receivers.

LANcity—10 Mbps cable modems and technical support.

"garage" on Century Communications' property in Anaheim, Calif.

"All of our headend racks, our taps, our networks—everything is strung out on the floor of the garage, and vendors come in and prove that their equipment will work on our internal network," notes Wimler. Once the actual exhibit setup begins, on the morning of December 7, CableLabs staff and personnel from participating vendors will have four days and a few sleepless nights to construct the entire exhibit and bring all of the applications on-line. Attendees can experience CableNET '96 in the arena of the Anaheim Convention Center. CED

Testing 256 QAM transmission of data over HFC

GI and Rogers report successful field tests

By Marc Ryba, Senior Project Engineer; and Paul Matuszak, Senior Project Engineer, GI Communications Division, Eastern Operations, General Instrument Corp.

Addressing industry demands for more efficient bandwidth utilization and building on its experience with 64 QAM transmission over cable, General Instrument has developed a 256 QAM transmission system that provides far more efficient use of cable system bandwidth and expands channel capacity. This expanded channel capacity results in a 44 percent increase in information rate and a 50 percent increase in video content as compared to 64 QAM. With it, broadband network operators will be able to carry two HDTV channels instead of just one in a 6-MHz space. The added capacity enables expanded video, modem, telephony and business data services. 256 QAM transmission also makes it possible to substantially increase the number of cable services on bandwidth-limited networks designed for analog video performance. This capability might allow deferral of costly upgrades/rebuilds.

GI successfully conducted the first extensive field tests of the 256 QAM system in an actual cable environment with Rogers Cablesystems Limited, Canada's largest cable operator. The field testing discussed was performed at 21 locations served by three different Rogers headend sites servicing parts of Toronto, Newmarket, St. Thomas and Woodstock in Ontario, Canada. New and older cable plants were chosen to test the performance of 256 QAM transmission in systems typical of deployment scenarios.

Background

As mentioned above, the 256 QAM system's increased information rate enables a larger number of services to be compressed in a 6 MHz bandwidth. This increased information rate, resulting from 256 QAM's added spectral efficiency, provides the opportunity for carrying additional services such as increased quantities of digitized cable channels, video-on-demand, near-video-on-demand, Internet access and interactivity–without compromising existing features and services–which results in additional revenues for broadband network operators. On average, for equivalent picture quality, nine NTSC signals can be placed in the same bandwidth, as compared with only six signals for 64 QAM. Table 1 provides a comparison of 64 QAM and 256 QAM efficiencies.

These values are based on an average bit stream for each video service. Assuming that film-based services are effectively digitized at a 3 Mbps (Megabits per second) rate, and live video at 4 Mbps, the 256 QAM transmission results in a 50 percent increase in both live video and movies per 6 MHz bandwidth. Also, with the HDTV bit rate specified by ATSC as 19.4 Mbps, 256 QAM is able to transport two HDTV signals in the same bandwidth, while 64 QAM can accommodate only one signal.

The larger constellation size and concomitant reduced Euclidean distance associated with 256 QAM transmission does compromise some of the signal robustness seen with the 64 QAM signal. The recommended carrier-to-noise ratio for operating 256 QAM and 64 QAM through the cable system is 37 dB and 32 dB, respectively. The theoretical BER curve showing carrier level vs. additive white Gaussian noise (AWGN) is shown in Figure 1.

The carrier-to-noise ratio for the theoretical coded 256 QAM signal has a 6 dB shift in noise performance as compared to 64 QAM and is therefore less tolerable to noise. The curve also shows the increase in performance obtained by the use of ITU J.83(B) FEC over the ITU J.83(A) with a 256 QAM constellation at 5.056 MSps (Mega Symbols

Figure 1: *64/256 Coded and uncoded theoretical BER.*

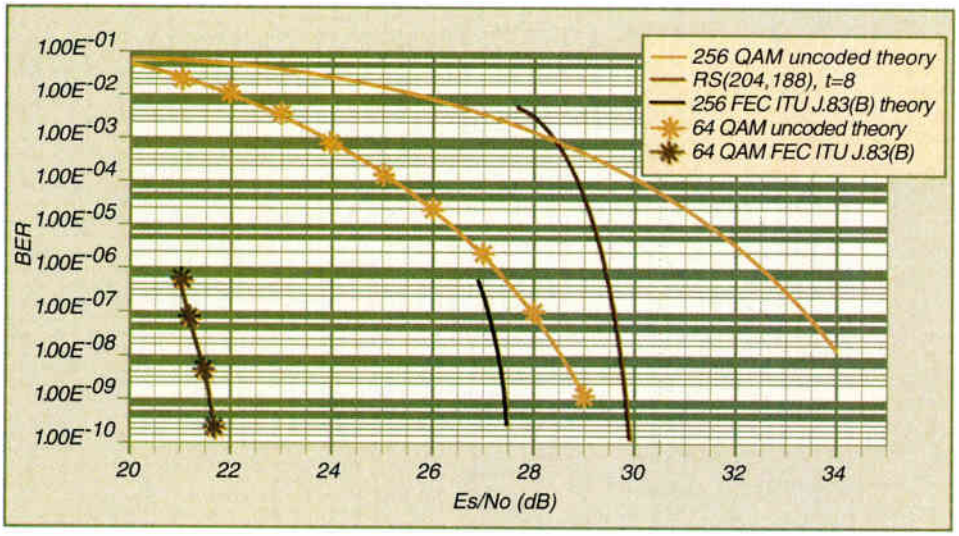

Table 1: *Comparison of 64 QAM and 256 QAM.*

	64 QAM	256 QAM
Information rate:	27.0 Mbps	38.8 Mbps
Total bit rate:	30.3 Mbps	42.9 Mbps
Symbol rate:	5.06 MSps	5.36 MSps
HDTV	1 service	2 services
Digital NTSC signals in 6 MHz*	6 services	9 services
Digitally compressed movies*	8 services	12 services

**Values based on average bit rates for different sources, not maximum.*

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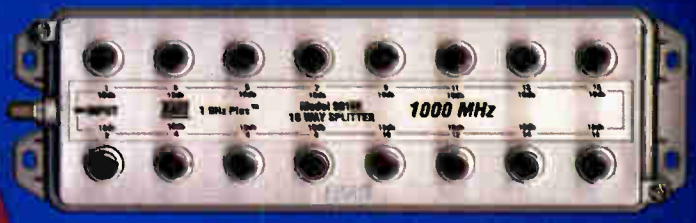

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per second). Parameters such as CNR, CSO and CTB should be well controlled for 256 QAM transmission. It has been observed that peaking in the distortion components is a primary cause of bit errors.

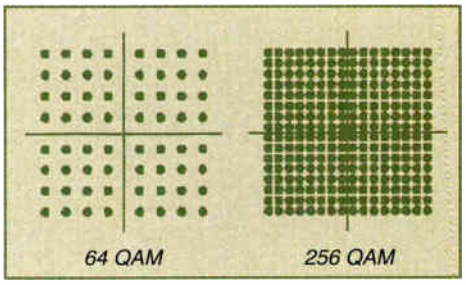
As Figure 2 illustrates, because of the denser 256 QAM constellation, it is less tolerant of these distortions. Therefore, for successful deployment of 256 QAM, cable plants should adhere to FCC technical standards as a minimum.

Test setup

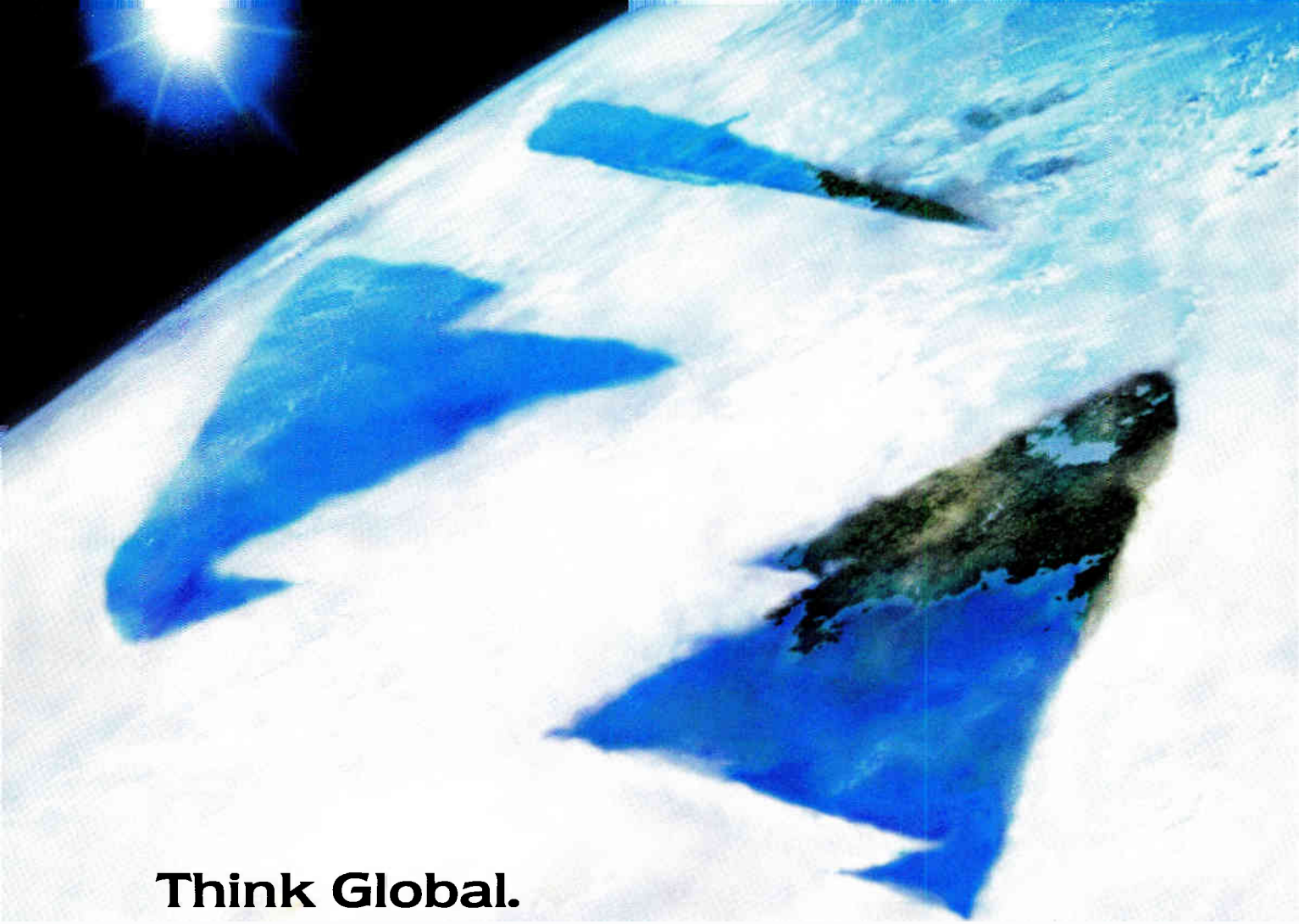
All tests were bit error rate tests and were conducted using Broadcom transmission hardware, ITU J.83(B) Forward Error Correction (FEC) and prototype demodulators. A block diagram of a typical receive site test setup is shown in Figure 3. A pseudorandom data generator and FEC encoder were used to produce the input to the Broadcom 256 QAM modulator. Channel up-conversion was performed using a General Instrument C6M for the 256 QAM signal and was then combined with Rogers headend analog channels for transmission. The QAM signal transmission channels were varied from area to area, with the test channels usually operating at the upper edge of the cable spectrum.

The 256 QAM average signal power level was adjusted at the headend for operation at 10 dB below the adjacent analog video's peak of sync power. The proof of concept receiving equipment which was used consisted of an 860 MHz bandwidth RF tuner and a 64/256 dual QAM demodulator incorporating an ITU J.83(B) FEC at an interleaver depth of 66us. Testing was performed in selected Rogers employee homes and at pedestal taps in residential neighborhoods through 100 feet of coax simulating the drop to other cable subscribers' homes. Extended duration testing was performed in the Rogers employees' homes to both assess longer term error performance as the cable system levels change with temperature and to determine the impact of in-home wiring on 256 QAM modulated signals.

Figure 2: Constellation diagrams.



Performance tests at the pedestals consisted of BER measurements and input power level variations of the QAM and analog signals. Two PCs were used for each demodulator/BERT pair during the course of the tests: one for logging errored seconds from the HP3784 BER tester and the other for tuning and controlling the demodulator. Recording of BER data was accomplished via an RS232 link between the BER tester's printer port and a PC. Short-term tests were performed using 15-minute gating periods. Extended duration testing consisted of one-second gating periods for the duration of the test. Each test had an associated error log that recorded the error count and the time duration of the test period. The file was stored in ASCII format for later off-line analysis.



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Reader Service 47

Table 2: Extended duration test results.

Site	Analog signal level (dBmv)	Digital signal level (dBmv)	Digital CNR (dB)	% EFS	Avg. BER	Elapsed time
1	-2.3	-11.4	32.3	99.97	$9.74E^{-9}$	37:02:59
2	11.2	0.6	36.2	99.93	$6.07E^{-7}$	5:36:55
3	-1.2	-11.5	38.1	99.99	$2.2E^{-9}$	13:16:26

Test results

Initial testing consisted of a lab trial of the 256 QAM signal over an ALS DV6000 (8-bit) digital fiber link. The fiber link consisted of a 1550 nm laser and 20 km of Corning SMF28 fiber optic cable. No problems arose with transmission of the 256 QAM signal through the link. A BER vs. broadband noise response curve was verified for the QAM signal by introducing AWGN into the system after the modulator. Little degradation in BER vs. noise performance was seen on the QAM signal. The link was found to be transparent to the 256 QAM signal and ran error-free. This BER curve is shown in Figure 4.

The IF-RF performance over cable vs. fiber link is virtually identical. System performance, shown in Figure 4, is degraded by approximately 0.6 dB for the following reasons:

✔ The 64/256 QAM dual-mode Broadcom demodulator chip, which interfaces directly to the ITU J.83(B) FEC, provides seven soft decision bits rather than the eight required by the FEC in 256 QAM mode. Since the LSB is not used, this results in 0.2 dB of performance loss;

This mismatch between the transmitter and receiver adds 0.4 dB degradation

✔ In order to transmit 5.356 MSps in a 6-MHz channel, a filter roll-off (a) of 12 percent is required. A filter with an alpha of 12 percent is used in the transmitter, but the Broadcom demodulator chip implements a receive filter with a roll off of 20 percent. This mismatch between the transmitter and the receiver adds 0.4 dB degradation.

The first set of system tests was conducted over a newly-upgraded HFC plant. Two fiber optic links were used and consisted of a 55 km fiber link using the ALS DV6000, and 10 km AM fiber links connecting the headend to several optical hubs, as shown in Figure 5. From the hubs, coaxial distribution was used with the longest runs tested being two equally long active runs. The first consisted of seven trunk amplifiers and two line extenders, and a second consisted of six trunk amplifiers and three line extenders.

The 256 QAM signal was placed on EIA Channel 80. The lower adjacent channel supported cable modem traffic operating at 500

Continued on page 88

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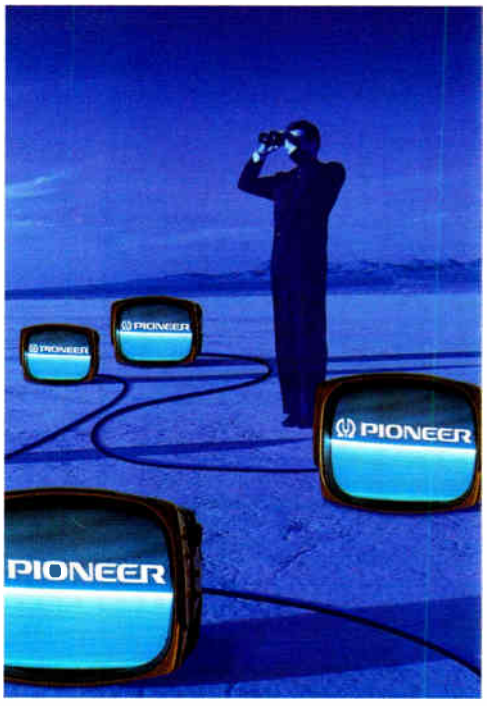

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Reader Service 49

New RF receiver chip set

By Rich Bay-Ramyon and Jim Wang, California Eastern Laboratories

A team of engineers from NEC and California Eastern Laboratories has developed a new miniature double conversion RF receiver for cable modems. Designed to be used as a chipset inserted on a motherboard, or as a miniature, standalone 1.5-inch x 3.0-inch board, the receiver reduces the size and complexity of the RF/analog section of cable modems. More importantly, it will enable OEMs to assemble the RF tuner portion of their high-speed (27 Mbps) digital cable modems for as little as $10, and in turn will enable MSOs to field smaller, lower-cost modems in their HFC networks. CEL and NEC plan to offer the design as a reference standard for all cable modem receivers.

The receiver combines off-the-shelf components with a silicon IC chipset developed at the joint NEC/CEL Product Design Center. This receiver chipset is a product of the partnership. The receiver is designed to process inputs from 250 to 860 MHz, so it can be used in both U.S. and European cable modems. The CEL receiver subsystem was designed to tune and process cable TV or video channels modulated at 64 QAM (a 256 QAM version is planned).

This chipset promises to play a key role in miniaturizing modems. It's designed to replace the "canned" discrete tuner modules now commonly used in cable data modem designs. By packaging the entire frequency conversion function into a small group of ICs, the chipset makes it possible to assemble the entire RF tuner/QAM demod subsystem on a card that measures just 4.5 square inches.

The card combines these functional blocks: High pass filter, designed to reject signals below 200 MHz; Pin attenuator, provides additional signal control ahead of the upconvertor; the upconvertor; an intermediate 915 MHz saw filter; a linear UHF downconvertor; dual low noise synthesizer; 36 or 44 MHz TV saw filter; QAM IF downconvertor; and LO crystal references and voltage regulators.

The first two frequency conversion ICs and the synthesizer make up the tuner section. The third frequency converter further processes the signal to feed the 64 QAM demodulator/forward error correction ICs in the digital section of the modem. The card itself is a four-layer glass epoxy board, with an interface bus for the synthesizer and AGC. The first IC in this line-up is the upconvertor, which combines a 15 dB AGC amplifier, a Gilbert-cell mixer, two stages of local oscillator (LO) buffering, a VCO, and temperature compensation circuitry. Available in a 20-pin SSOP package, the IC provides wide frequency bandwidth and high dynamic range performance, plus 5 dB to 20 dB of conversion gain with an 8 dB noise figure.

The second IC is the downconvertor, which is housed in a compact 8-pin SSOP package and contains a UHF mixer, a VCO and an IF amplifier. It dissipates just 40 mA from a 5V supply and features good linearity with low oscillator phase noise.

The QAM IF downconvertor provides an additional 25 dB of AGC control and performs the final downconversion to 5 MHz. A video amplifier further processes the signal in preparation for digitization and demodulation.

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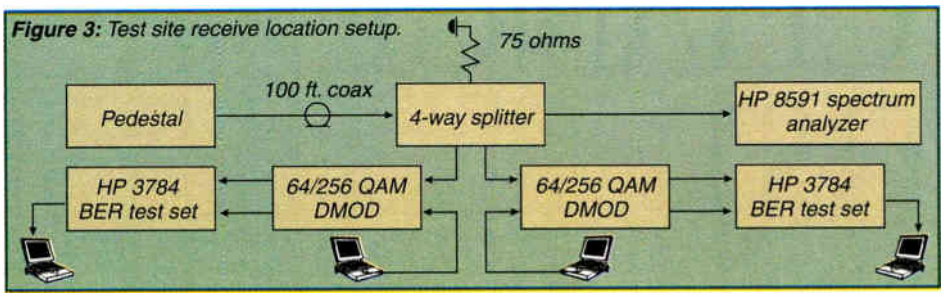

Figure 3: Test site receive location setup.

(Continued from page 84)

kbps QPSK. The upper adjacent channel was inactive. Five sites were tested under short-term conditions, and all ran error-free. One extended duration test was performed and resulted in 99.97 percent error free seconds (EFS). The test duration was 37 hours, 3 minutes. Table 2 provides a summary of the extended duration tests performed.

Threshold of visibility (TOV) also was performed at this location. TOV is defined by CableLabs as a BER less than or equal to 3^{E-6}, obtained in three consecutive 20-second gating periods. If a BER greater than 3^{E-6} occurs in one of the three 20-second gating periods, another period is allowed to be tested. The limitation in TOV testing was found to be the signal level at the front end of the tuner. TOV levels were within amplitude variations that are expected to be seen on a typical cable drop over time because of temperature. Digital carrier-to-noise ratios for all sites were found to be between 31 dB and 33 dB. Analog carrier-to-noise ratios up to 45 dB were measured. Carrier-to-noise and distortions did not present a problem at this location.

Subsequent system testing was performed at two different locations on older, non-rebuilt coaxial systems. The first system tested was specified as an "electronics drop-in upgrade" 450 MHz system. This location's longest active run that was tested consisted of a 30-trunk amplifier cascade. The 256-QAM signal was placed on EIA Channel 48. Both lower and upper adjacent channels were present and used sync-suppression for video scrambling. Five short-term tests were run at four locations. The tests ran error-free. One 256-QAM extended duration test was performed and resulted in 99.93 percent EFS. The test duration was 5 hours, 36 minutes. Considerable in-band tilt, (approximately 3 dB), was observed on the 256 QAM signal at this site. The tilt was because of excessive system frequency/amplitude roll-off and exceeded the specification for the demodulator. The tilt is the cause of the degraded BER performance.

TOV testing was performed on one site and found to be consistent with the previous measurement on the recently upgraded HFC system. Digital carrier-to-noise ratios for all sites were found to be between 30.5 and 36.2 dB. Analog carrier-to-noise ratios up to 46.6 dB were measured. The carrier-to-noise ratio did not present a problem at this location. Distortions did not appear to be problematic at this location and met FCC required specifications.

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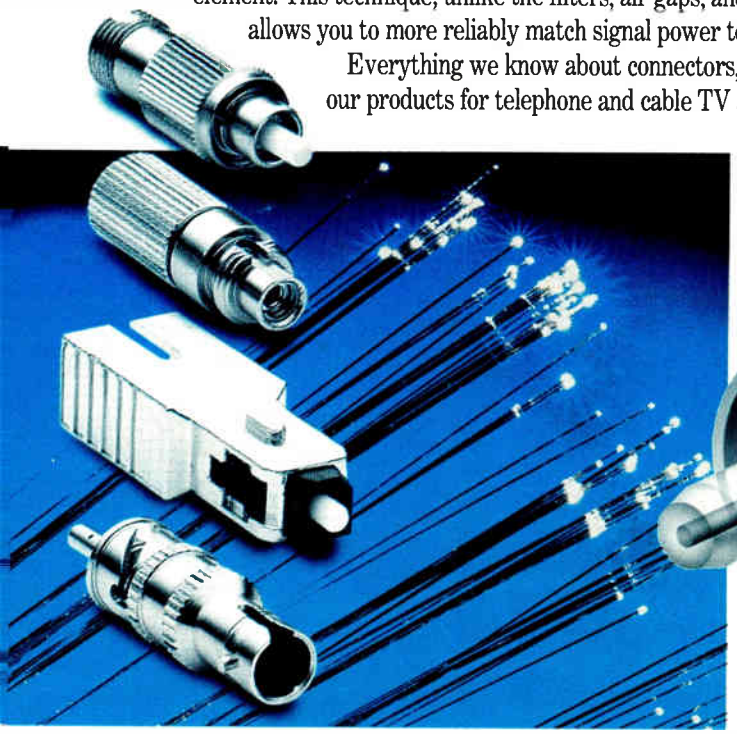

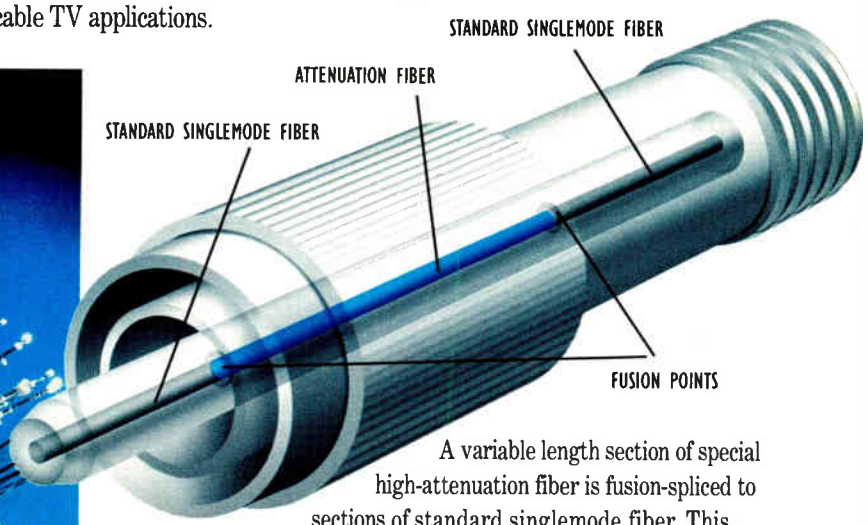

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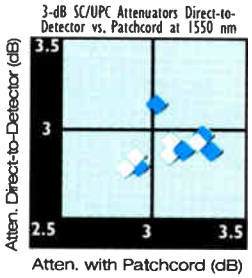

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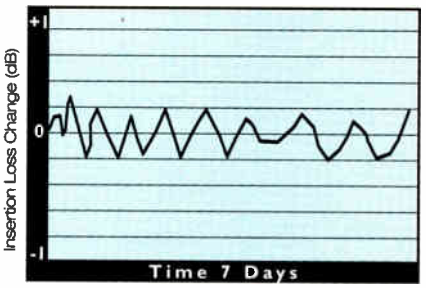

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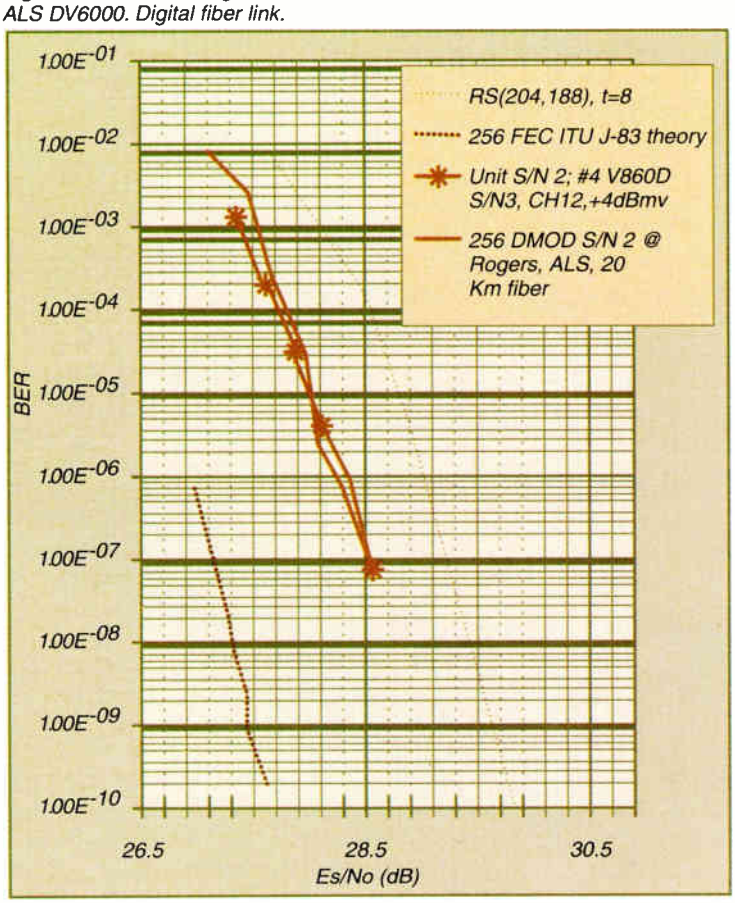
Reader Service 53

Figure 4: 256 QAM single channel with Gaussian noise. IF-RF coax link vs. ALS DV6000. Digital fiber link.



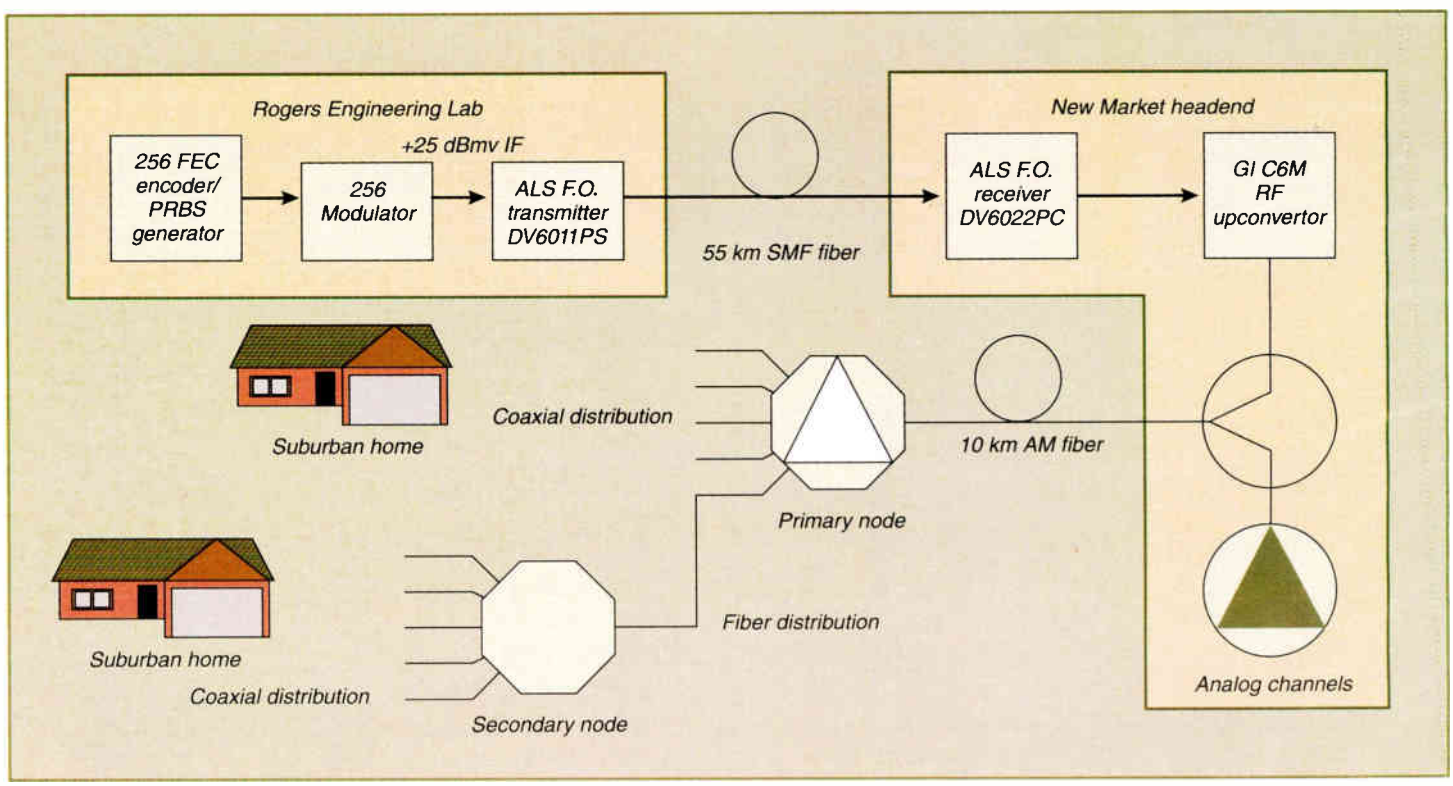
was also an older 450 MHz system. The longest active run tested consisted of a 31-trunk amplifier and one-line extender cascade. The 256 QAM signal was placed on EIA Channel 51. The lower adjacent channel was active, and the closest upper channel was EIA Channel 53. Three locations were tested under short-term conditions. All tests ran error-free. Two extended duration tests were performed simultaneously and resulted in 99.996 percent and 99.994 percent EFS. The time duration was 13 hours, 16 minutes. Digital carrier-to-noise ratios for all sites were found to be between 30.8 and 38.4 dB. Analog carrier-to-noise ratios up to 48.4 dB were measured. CNR, CTB, and CSO did not present a problem at this location.

Conclusions

Based on the test results obtained on the Rogers system, 256 QAM is a viable transmission format for properly maintained new and older cable plants and inside wiring. Short-term tests yielded error-free performance, and extended duration test results showed EFS performance of 99.93 percent or better. Test results indicate minimal degradation in performance when operating over a digital fiber link, such as the ALS DV6000. On the headend systems tested, for the most part, RMS distortions measured were below the levels that would induce bit errors.

Distortion levels (rms values) such as CTB and CSO were not the primary cause of errors, but the random peaking of these distortions was a cause for concern. In HFC plants, shorter runs and fewer active components minimize the potential for these effects. The FCC technical standard for cable is still a viable guideline for implementing both 64 and 256 digital transmission. At a minimum, operators should adhere to the FCC specification to ensure successful implementation of digital transmission. CED

Figure 5: HFC plant and DUT block diagrams.



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Reader Service 66

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ADSL technology: Dead in its tracks?

Technology's threat to coax diminishes

By Alan Stewart

Once viewed as the telephone industry's secret weapon in its war with cable TV providers, asymmetrical digital subscriber line (ADSL) seems to have been sidelined by the baby Bells as they scramble to maintain their local loop monopoly. In a blow to U.S. ADSL vendors who saw their stock value tumble, Ameritech, BellSouth, Pacific Bell and SBC Communications retained France's Alcatel Telecom as their future supplier of ADSL products. At the same time, they emphasized that the deal depends on the conclusion of successful contract negotiations.

Before discussing this in more detail, it would be useful to review the history of high bit rate subscriber line. First off the line during the late 1980s came HDSL (high bit rate subscriber line). This is based on bi-polar 2B1Q bit coding, which lowers the cost of deploying T-1 access lines. It enables the telcos to send high-speed digital signals over unrepeatered, unshielded twisted pair (UTP) wire to business users.

HDSL was followed a few years later by ADSL, which uses advanced multilevel modulation techniques to send compressed video and data signals to single line residential users. ADSL was followed by VDSL (very high bit rate digital subscriber line), designed for drop wire applications, and SDSL (symmetrical digital subscriber line). These technologies have been collectively dubbed xDSL.

Bell Atlantic used ADSL to enable its subscribers to order movies and other kinds of TV programming at 1.5 Mbps. The regional Bell's original intention was to provide libraries of MPEG (Motion Pictures Experts Group) compressed movies and other kinds of television programs at a server at the telephone exchange. Using a set-top box and a handheld controller, users could enjoy on-demand programming, and the company didn't have to sink capital into a complete network rebuild.

That relatively straightforward application is now history. The latest idea is a family of high bit rate solutions up to 50 Mbps which utilize cell-based solutions such as ATM (asynchronous transfer mode) to provide interactive broadband to the home and office. The trouble is that the standards for these are not in place, and many experts feel that such full service solutions are best done in other ways.

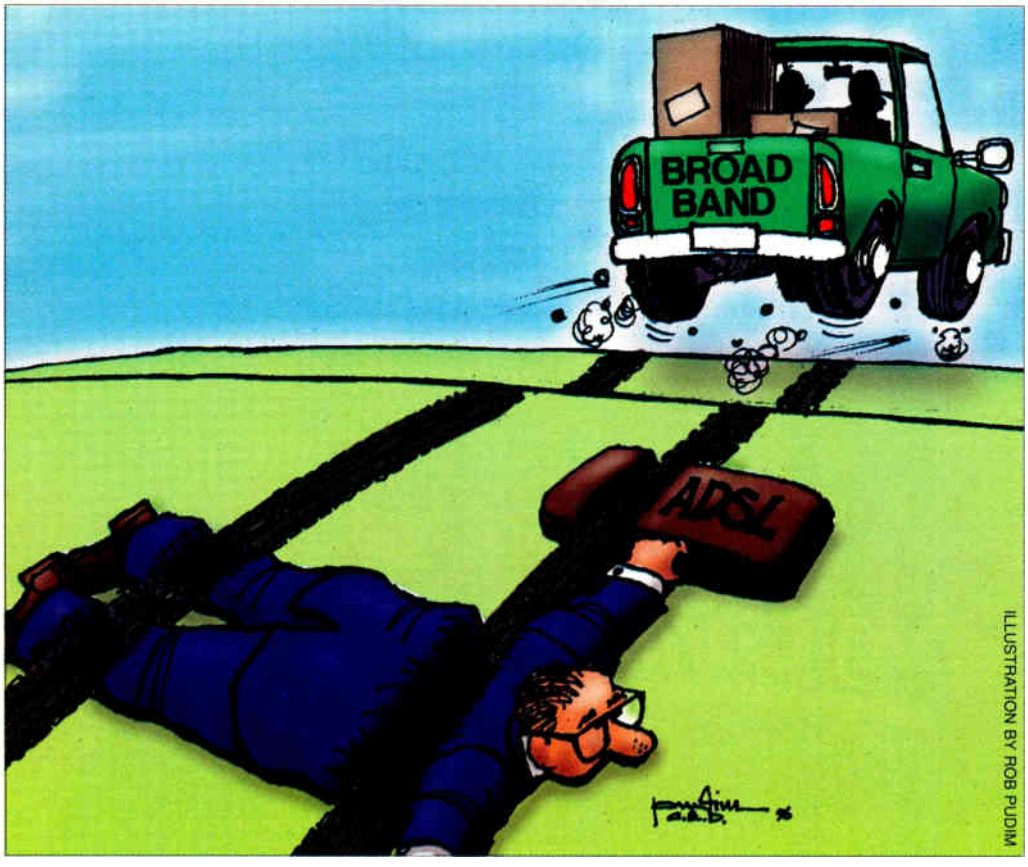
Residential ATM

Returning to the Alcatel announcement, on the surface the regional Bells appear to be supporting the introduction of end-to-end ADSL using a combination of ATM cells and modems. In fact, the news probably signals a delay in widespread ADSL deployment in the U.S. for at least 18 months. The French vendor will need at least that long to meet emerging standards for residential ATM.

"It may be technically possible to have a point-to-multipoint physical architecture [based on ATM] in the home," observes David Thorne, technical area leader, BT Labs, and chairman of the ATM Forum's Residential Broadband working group. "However, this would require a much more complex system and is not a scenario which the ADSL standard supports."

In a presentation during the Maximizing Copper conference held in London in September, Thorne noted: "Alternatively, the access network system could be terminated at a single point within the home and then fed into a separate in-home distribution system. These two scenarios have become known as passive and active network termination (NT), respectively."

Another problem is that it is not known whether unshielded twisted pair wiring (UTP) in most home and small business premises is capable of carrying 6.0 Mbps signals. Thorne believes the solution is to use an active NT. This presents difficulties in the U.S., where the telcos do not control inside wiring.



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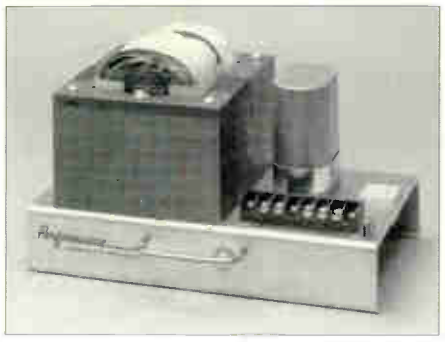

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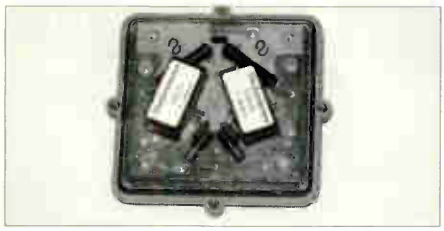

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Circle Reader Service # 81

"The ADSL system is terminated at the NT, which feeds into a general purpose, symmetric in-home distribution system," notes Thorne. "This capability needs to be maintained right up (to) the customer equipment, as multiple traffic types (e.g., video, voice and data) could be delivered to a single physical item of CPE (customer premises equipment), i.e., a PC." (See Figure 1.)

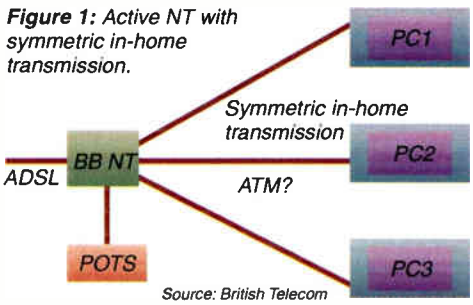


Figure 1: *Active NT with symmetric in-home transmission.*

Bells, whistles and delays

The reaction of U.S. vendors to the Alcatel announcement has been muted. "Today's ADSL vendors must formulate a strategy for incorporating ATM switching as soon as possible," notes Rob Faw, president of global operations for Westell Technologies. "The deployment of extensive services configuration and management capabilities across a wide range of access elements including ADSL will be part of this process."

Faw explains that a handful of telecom vendors and specialized software-centric companies can offer these capabilities, but the process will take time. "It is not clear that the telephone operators and service providers can wait for interoperable ADSL equipment to emerge on the market during the next several years, in an environment of increasing competition and deregulated access," he concludes.

The problem for ADSL is that it is rapidly taking on the garb of a fully fledged access infrastructure. As it acquires more and more complexity, the likelihood that it will be delayed by standards and interoperability concerns increases. Peter Krawarik, manager of business development and quality, local loop transmission, with Ericsson Austria, explains: "The impact of standards on new product emergence is complex. Bodies such as the ADSL and ATM Forums promote their respective solutions and try to influence larger standards bodies such as ANSI and ETSI. In Europe, where telecommunications are operator dominated, standards processes are frequently used for exclusion, while U.S. standards bodies are vendor dominated and tend to promote technology."

This holds important implications for U.S. consumers. The cable TV industry's 65 percent share of the television audience was gained using a straightforward point-to-multipoint network that provided 60-plus channels to all households and did not require complex standardization.

Could a combination of ATM and ADSL replace this infrastructure by providing broadband bidirectional multimedia to the home? Not if it gets bogged down in the standards process, implies Krawarik. "New applications develop consistently faster than the relevant standards, and standards become more of a hindrance as they are not creating, but only responding to market applications."

VOD stumbles

Globally, telcos have field trialed ADSL with varying degrees of success. Starting in the early 1990s with Bell Atlantic, British Telecom and Telstra (formerly Telecom Australia), GTE, other regional Bells, and many international PTTs have tested the new technology.

In April 1995, Bell Atlantic, long a fan of video-on-demand (VOD) over telephone lines, installed the first paying ADSL customer in Fairfax County, Va. Six months later, 1,000 customers were receiving on-demand video entertainment with VCR functionality, accessing over 600 titles including movies, sports, children's programs and special interest features. One year later, this well publicized service, called Stargazer, was abruptly cancelled.

"We found that only about half the copper loops were adequate to support 6.0 Mbps ADSL and discontinued the service," explains Larry Plumb, communications director at Bell Atlantic. "There were other problems, including set-top box design and inside wiring. In my opinion, there never will be a shrink-wrapped ADSL consumer product you can buy at your local store," says Plumb. This puts ADSL in a totally different class from dial-up modems.

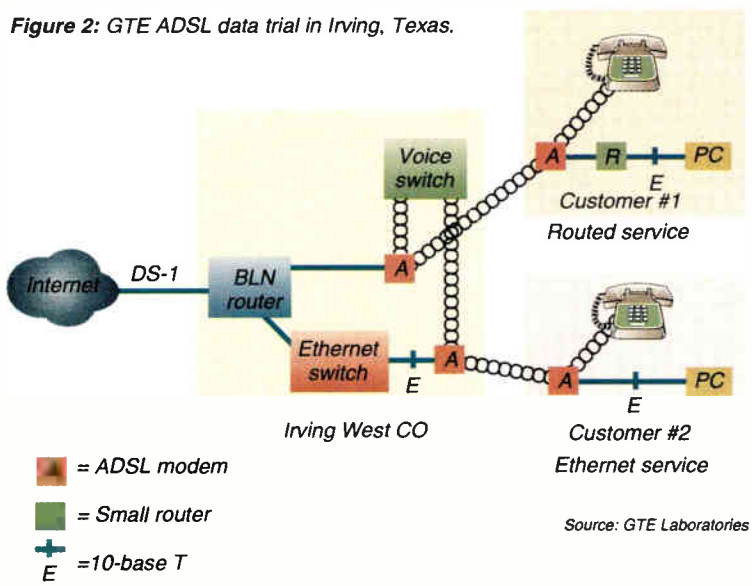
Enter Internet

General Telephone uses ADSL to connect small businesses, stores and libraries in Irving, Texas to a web site. "Web browsers and PCs have created demand for high-speed, low-cost Internet and LAN access," explains Bob Olshansky, manager, advanced service platforms for GTE Laboratories. Echoing the views of the ADSL Forum, Olshansky notes that 35 million U.S. homes will have PCs in 1996, and thus, UTP provides a key entry strategy for IP services.

"We implemented a 'proof-of-concept' trial involving three local exchanges and 20 ADSL lines to small businesses and GTE employees," he explains. "The objectives are to evaluate ADSL data modems, evaluate network architecture, identify deployment and operational issues, and evaluate customer response. We are testing IP (Internet protocol) dialtone router-based IP access to IP hosts, IP networks and value-added IP services."

These services require routers and Ethernet switching at the subtending exchange and small routers at the customers' premises (see Figure 2). "We use ADSL modems from Westell and Amati, Bay Networks and Cisco routers, and GTE-provided Ethernet interfaces and browsers. We also install special shielded twisted pair premises wiring," says

Figure 2: *GTE ADSL data trial in Irving, Texas.*



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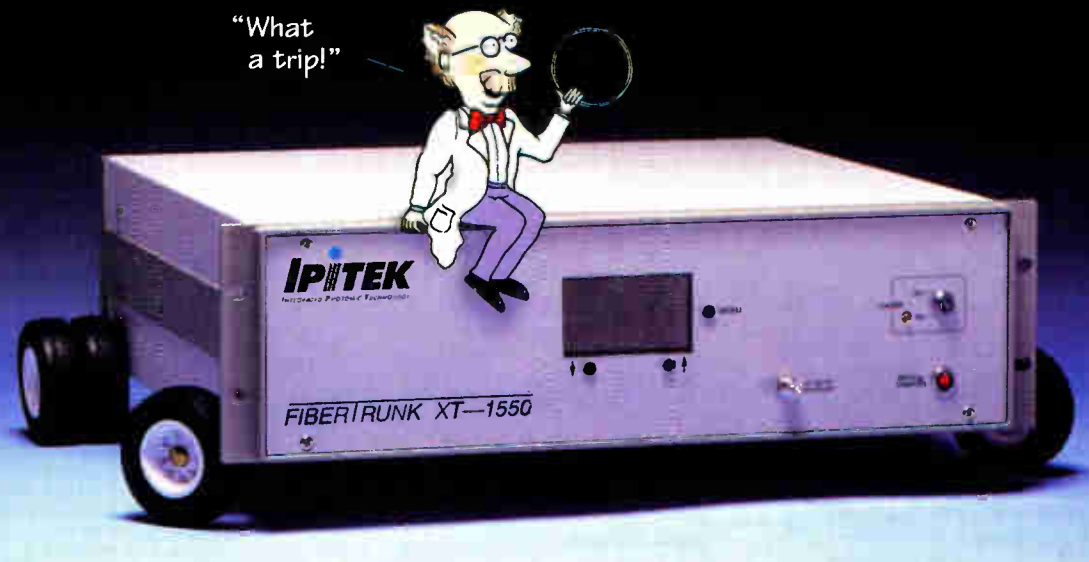

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Reader Service 62

Power distribution cables in HFC networks

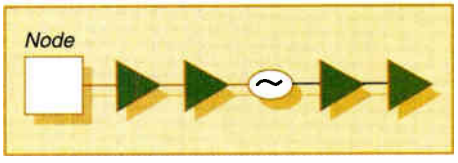
Centralized vs. distributed systems

By Dan Kerr, Engineering Design Manager, Continental Cablevision; and Mark Alrutz, Product Manager, Trunk and Distribution, CommScope Inc.

Broadband systems are evolving to provide myriad services beyond cable television. These services include high-speed data transfer, two-way interactive media and telephony. In support of these requirements, coaxial plant has moved from traditional tree-and-branch style architectures with long cascades of amplifiers to newer hybrid fiber/coax (HFC) architectures. These fiber-rich plants shorten amplifier cascades, improving signal quality and reliability.

Plant reliability is crucial to these new systems, particularly in the case of lifeline telephony service. Shortened amplifier cascades have improved the situation, but the entire system is still susceptible to power outages. Traditional telephony systems provide their own power, so telephone service is maintained through a power outage. Traditional cable television powering is provided by power supplies located throughout the plant, and each is susceptible to power utility failure.

Figure 1: *A simplified powering scenario.*



Uninterruptible power can be provided by batteries or generators at the power supply location. Unfortunately, these backup systems add cost and more maintenance and reliability issues to the plant. A more efficient solution is to concentrate all the plant power supplies and backups at one central location.

Centralized powering is the term used to describe the movement of power supplies to a central location, perhaps near a node. Placing all the power equipment at one location simplifies plant maintenance and allows more efficient backup systems to be used.

Centralized power concepts

The concept of centralized powering is inclusive to many different design techniques. For the purpose of this discussion, centralized powering will be loosely described as the relocation of power supplies from a distributed orientation to a single location. This may encompass a varying number of power supplies, and may take place to varying degrees throughout the network. For instance, a node with three or four distributed supplies may centralize all or some of the supplies. A system with hundreds of supplies may arrange those supplies into groups, or may only centralize a small area. The options are endless, and well beyond the scope of this discussion.

The benefits of centralized powering are also as varied as the system designs, but no less remarkable. In addition to the reduction in maintenance costs associated with distributed power supplies and their required batteries, reductions in the actual number of power supplies of a magnitude as high as 20 percent is achievable in some areas. Perhaps the most compelling argument for centralizing power–enhanced reliability–is unrelated to these savings. A central supply location can be built with generators and batteries to provide support previously unachievable in a distributed plant.

In order to take advantage of these cost and reliability benefits, centralizing power does require a review of the design concepts used for distributed power. Distributed power is traditionally achieved by placing a power supply in a plant location which balances the current

Figure 2: *Centralized power.*

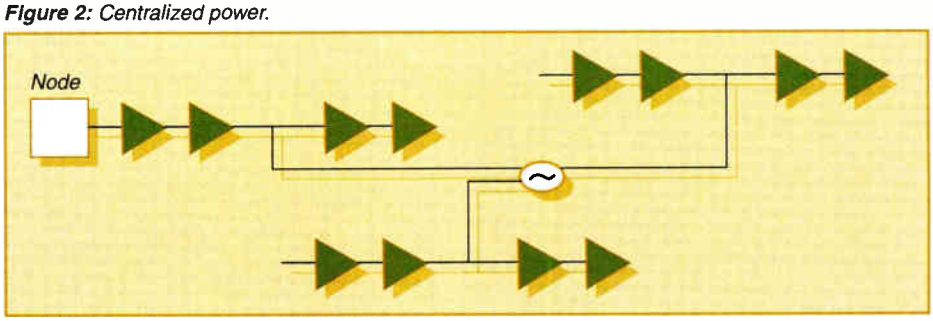
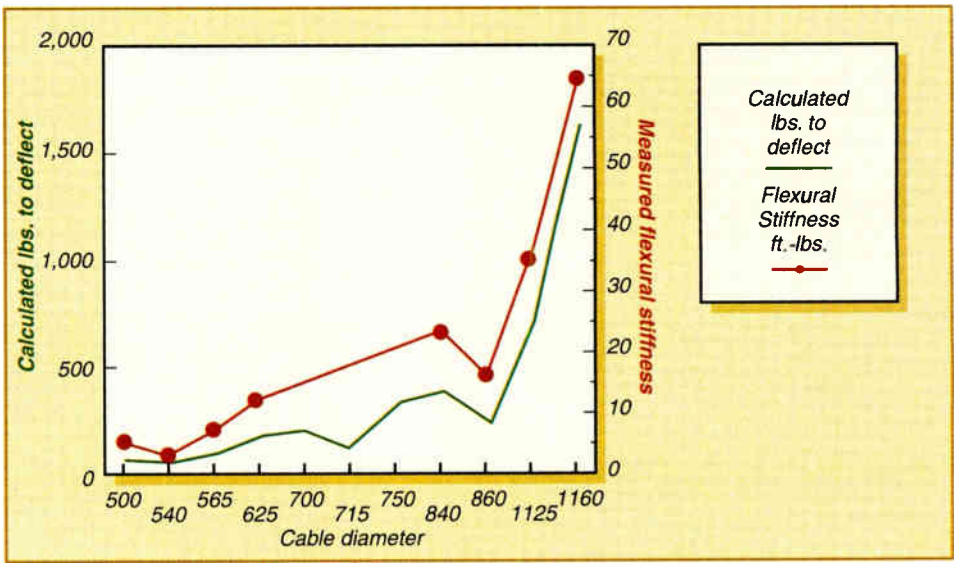


Figure 3: *Comparison of cable stiffness vs. diameter.*



against large monoliths that are very well-financed, and we are, as an industry, highly leveraged already," acknowledges Lind. "So if you're going into a contest with all this debt, what kind of a chance do you stand?"

Referring to the recent Videotron U.K. sell-off, Craig Gibson adds, "Chagnon's statement in the paper that he will be the least-leveraged company in Canada is absolutely accurate as far as cable is concerned, as far as the Big Ten (MSOs). And that's wonderful, because he'll need that breathing room to finish his fiber optic builds, to change out his amplifiers to go to two-way, to move up the reliability levels so that when (he) gets into the telephony-like products, whether it be data or voice, (there will be) the same level of reliability that Bell has."

Some constraints to restraint

Unfortunately for Canadian cable, there's a limit to how much debt reduction can be achieved. That's because although corporate takeovers have played a role in pushing it up, they're not the major driving force.

Instead, what's causing the debt is system upgrades, says Gibson, "the amount of capital being expended on new technologies and (the) extension of existing services."

"Did we end up incurring a lot of this debt because of the acquisition of Maclean Hunter?" asks Phil Lind. "No. The debt is primarily because we've been expanding the shape of the network within our cable systems. We have been pouring money into facilities for the last several years to try and upgrade them, to ensure that they're two-way interactive, WAVE-ready (WAVE is Roger's Internet service, which is already available in limited deployment) . . . so that they can compete with telephone companies and the satellite companies and wireless cable companies."

This is also the case with Shaw, says Jim Shaw Jr. "Right now, Shaw is getting ready for competition," he says. "We're spending all our money improving our HFC network, and designing competitive products for new entrants to compete with.

"There are customers to lose now, and we're getting ready so that we don't lose them."

In fact, upgrading is a way of life for the entire industry, Lind adds. "Over the last five years, cable companies generally have been spending a lot of cash trying to improve their systems," he says. "And now that competition is coming along, they're going to have to increase the rate of expenditures."

Hence, "When cable companies get the opportunity to reduce their debt level, they do."

Other challenges

Despite the debt implications, Canadian cable knows it has to spend its way to a viable competitive position. As Craig Gibson says, "Without the technology at the front end, we can't deliver, for instance, the high-speed Internet services that we want to deliver."

As well, top executives like Phil Lind also accept that they're going to lose customers when new offerings such as MMDS, LCMS, DBS and telephone-delivered video become available to their subscribers.

"Many of us think we're going to lose market share," he says. "But we also think that we can't just lose share; we have to have replacement revenue. We have to be out with a new array of products which we can sell to people and gain additional revenues."

However, getting those new products to market is also going to be costly.

It's not just the network rebuilds. It's also the cost of new technology like the digital set-top box, whose estimated pricetag has gone from C$300 to C$650.

Says Lind, "We always knew they were going to be a lot higher than that. We told the Commission at the first hearing that the price was going to go up dramatically."

Canadian cable has to balance its needs for expansion against its bottom line

Then there's the question of the so-called "level playing field" between cable and the telcos, or the potential lack of it, if cable's worst fears come true.

"I think we face some difficult times as an industry," Lind says. "That's why we're struggling so hard with the CRTC (the Canadian Radio-television and Telecommunications Commission, the Canadian regulator) and with the federal government to persuade them not to allow the telephone companies to enter cable TV on a cross-subsidized basis: i.e., letting the telephone ratepayer pay the freight into the video business. And not (to allow their entry) until they clear out all their self-imposed debris which stands in the way of us being able to compete with them in their market."

Faced with all of this, it's no surprise that Canadian cable is cleaning up its books, and looking for new money where it can.

Phil Lind, vice chairman, Rogers Communications Inc.

Jim Shaw Jr., president and COO, Shaw Communications

"They need cash," says Debbie Lawes, editor of the industry newsletter *Canadian Communications Reports*. "They can sell off as many systems as they want; it really doesn't matter. They have to raise money in the marketplace, and if you ask them, this is what they're saying is their biggest challenge right now."

She adds, "You can only raise so much money in Canada, and you tap out the markets here, so they're going for high-yield bonds in the United States."

Of course, the amount Canadian cable can raise is limited by Canada's foreign ownership laws. Currently standing at a maximum of 33 percent, the push is on to raise that limit to 49 percent for telecommunications companies, says Lawes. "If that happens, it's guaranteed the cable industry will be right there as well, saying, 'raise us to 49 percent.' And if that happens, you're going to see a lot of new money coming into this country from abroad, basically from the United States, and that might their saving grace."

The future

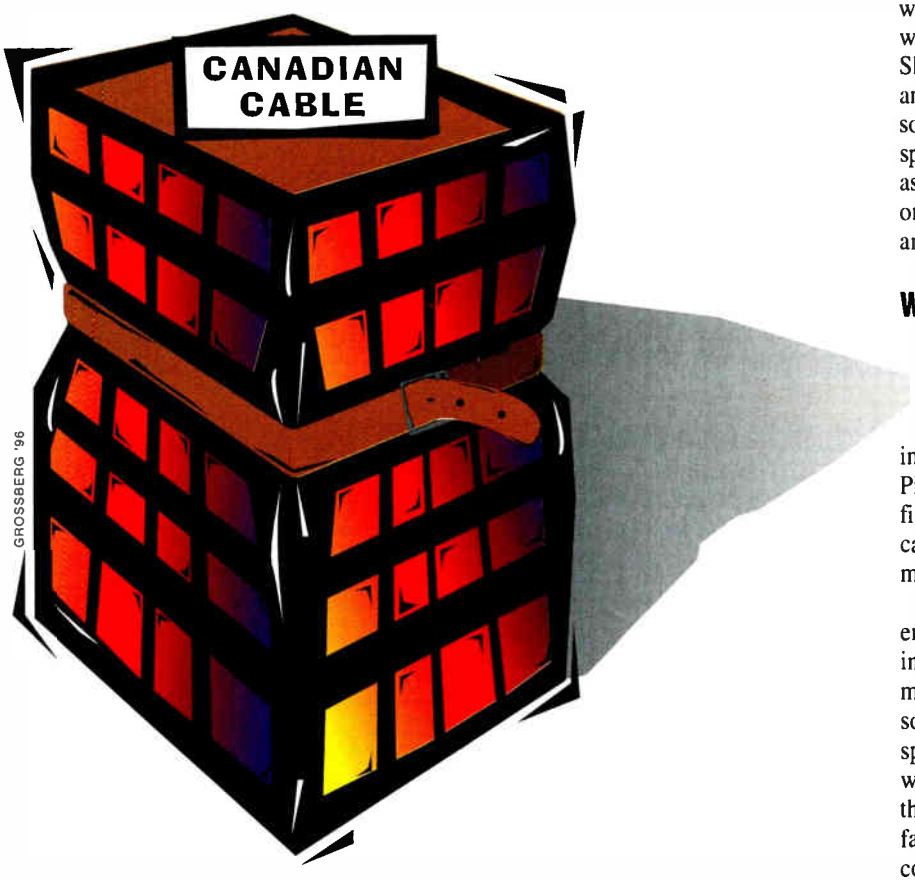
One thing is clear: to succeed in this brave new world of competition, Canadian cable has to balance off its needs for expansion and new services against its bottom line. As Phil Lind says, "The biggest challenge in the next five years, I think, is to be able to complete the transition into a competitive environment without being drowned in the process.

"Two things have to happen: we have to get our networks completed . . . and we have to get the government to recognize that, to have sustainable competition, we can't have that well-financed, privileged phone company apparatus being able to cross-subsidize its entry into cable."

"There's no way that there's a future guaranteed to us," Lind adds. "We've got to go out and earn it." CED

Canadian cable industry is tightening its belt

Operators put their financial houses in order



By James Careless

Note: All financial figures here are in Canadian funds; the conversion rate is U.S.$1.00 = C$1.32-1.35.

After years of digging itself deeper into debt, the Canadian cable TV industry is trying to get its financial house in order. Proof of this new frugality is everywhere.

For instance, consider Rogers Communications Inc., Canada's largest cable system owner. In recent months, it has sold off its Sun newspaper chain, its Davis + Henderson check-printing division, its U.S. business forms subsidiary, Transkrit Corporation, and–in a stunning reversal to RCI's history of relentless expansion–300,000 "non-core" cable subscribers to Cogeco Cable.

The reason? "Our debt is in excess of C$4 billion (to be exact, C$4.7 billion)," says RCI Vice Chairman Phil Lind, "and in the last several months, we reduced it by C$800 million."

Rogers isn't alone in cutting its debts. Recently, Le Groupe Videotron ltee–Canada's second-largest MSO–reclaimed C$825 million from its investments by selling off its 56 percent controlling interest in Videotron Holdings Plc (U.K.) to Bell Cablemedia Plc.

"This sale allows us to repatriate the funds needed to fuel our economic growth in North America, and to reduce our indebtedness in Canada," said Videotron Chairman and CEO André Chagnon in a news release.

Meanwhile, number three-ranked Shaw Communications Inc. has also moved to tidy up its books. Says Jim Shaw Jr., president and COO of Shaw Communications, "You've seen a whole bunch of announcements where we've rejigged all our debt, and redone our terms, and such." That debt currently stands at about C$1.2 billion.

"The first thing we've done is we went out and renegotiated our main banking facility, which is a billion-dollar facility that Shaw has with 26 banks around the world," explains Shaw. "So we went out and renegotiated that, and changed the terms on that, and in turn, got some increased flexibility on what we could spend our money on . . . For the first time, we asked for some flexibility to be able to spend on telephony from the banking community, and we received that."

Why the big debt payoff?

Across the industry, there's clear agreement as to why Canadian cable is getting its financial house in order after years of acquisition and growth. The industry's attitude is best summed up by Pierre Gagne, Cogeco Cable's vice president finance, who says, "Basically, people in the cable industry have sat down and said 'bigger may be better, but not necessarily so'."

The reason that "size at all costs" has fallen out of fashion is because big growth incurs big debts, and too much debt is a major drawback when facing bigger, more solvent competitors. In plain language, we're speaking of Canada's telephone companies, who coordinate their actions nationally through the "Stentor" group. (One crucial fact: In 1995, Canada's "larger telephone companies had total revenues of C$13.2 billion," says a recent Canadian Cable Television Association document entitled *Cable Competition: The Facts,* "six times the revenues of C$2.3 billion for the larger cable television companies.")

"The only problem the (cable) industry has, quite frankly, is that it's probably too highly leveraged," notes Craig Gibson, a partner in the Information, Communication and Entertainment Practice of the professional services firm KPMG. "When you compare telephony (to cable), any of the Stentor companies or anything of that nature, they are in much more solid financial shape as far as the balance sheets are concerned."

"The knock on the industry generally is that the cable industry has been facing competition

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CED: What's the number-one reason for going through such a process?

Green: One of CableLabs' major efforts is to get hardware as soon as possible because it's not sufficient to simply know how to do it. We're charged, as one of our missions, with tech transfer, and that means getting it in the field in a reasonable and useful time period. We look pretty carefully at how long it will take to get these things deployed–and suppliers are the best source of information on that. There are a lot of reasons for partnerships with vendors on these kinds of things, but that's one of the major ones.

CED: How would you describe your relationship with US West, which is about to be the third-largest cable operator?

Green: We've always had a friendly and cooperative association, because we're located in pretty close proximity to its laboratory. Over the years, we've had regular meetings with them to discuss technology and directions. We've talked about having joint projects, but have never really done it. We know the people, and we're expecting them to have a lot of interest in our activities. They have attended our conferences even though they're not members at this point.

CED: I imagine you're working to turn them into members.

Green: Yes. I think it's on track. We have continuing discussions and they've shown an interest, but we'll have to wait until the Continental deal is completed before there are any changes. But we'd welcome them.

CED: It seems that with their advanced technologies lab right down the street that there may be some interesting synergies.

Green: Right. We assume that if they're going to be a cable company, they'd be very interested in the very best in cable research, which is going on at CableLabs.

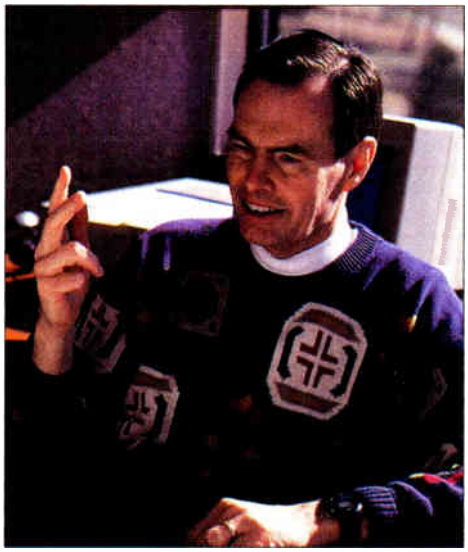
CED: What about 1997? What will be the big projects?

Green: There have been some interesting outgrowths of our work. One was a spin-off, which was MPEG LA. It's a licensing authority for MPEG that's under (former CableLabs COO) Baryn Futa. In the early days of MPEG work, we wanted to reduce any barriers to the implementation of MPEG, so Baryn formed a group of the intellectual property rights-holders and worked with them for a couple of years. Then those people wanted to form an organization to administer the rights, so we spun off this company to manage that. We share a small part of the revenues of that group.

CED: What exactly will it do?

Green: It will monitor the use of MPEG and collect revenues and look for infringements. It's a good job for a lawyer like Baryn. The other part is to take this group of manufacturers and melding them into a united whole, and that isn't easy, either.

We also have some work of our own. There's the CW Tester, which is a device used for measuring and monitoring the error statistics caused by random ingress. We've used it as a development tool for quite some time.



"One of the highlights of the year was the executive committee retreat"

This is a pretty comprehensive hardware and software package that collects data and tells you what your error statistics are, which is very important in operation as well as preparing the plant. We've been building these ourselves, but we going to try to go commercial with that.

We're also looking at some new areas, but it's a bit too premature to talk about them, but they're new initiatives and new directions.

CED: Looking back over the past year, is there anything that sticks out?

Green: One of the highlights of the year was the executive committee retreat in June. It was an exciting experience because we had all of the CEOs talking about what we ought to do next to expand our role. We've sorted through all that and have a plan to try to implement it. We'll meet with the committee again soon to go over that plan to make sure we're doing what they want us to do. It'll probably be mid-December before we can go public with that.

But I think we've been useful to the industry as a centralized forum for the specification issues on data modems, digital video compression and in the deployment (of those services). I think that our relationship with our members is as strong as it's ever been, and getting stronger all the time because of that role.

CED: We seem to be standing on the threshold of deployment of digital video and data, but what about telephony?

Green: We're testing telephony modems in the same way we're testing data modems. We have them in house. Telephony really consists of three things: wired telephony, wireless (PCS-type) and CAP services. We're doing work in all three, but primarily in wireline and wireless. We have a telephony switch and we're doing a lot of work on remote antenna drivers and doing some field testing in that area.

There's a certain amount of overlap with data when you're talking about the physical layer. They're not identical, however. Telephony requires very low latency from a network, whereas data can allow a little less, generally. So there are certain synergies, and we try to dwell in those areas. The high-speed data modem effort may have been more visible, but we're certainly committed to the telephony technology.

CED: It seems that now would be a good time to develop some type of network management standard. Would you agree?

Green: We're working on that, too, under Pam Anderson. That will probably be one of our major efforts next year, after having been in the background this year. Hardware deployment has taken precedence so we can get equipment working in the field, but we do have an effort on network management, network monitoring and network integration.

We also have two RFIs: one on status monitoring and one on the "Internet device" to explore and understand the next generation of home appliance that will be used on the cable system and the Internet. The intent is to create a dialog with industry to get a feel for what they see. There are several key players, including Oracle and others, who have different ideas on how the TV, the PC, compression and the digital connection to the Internet all interact. CED

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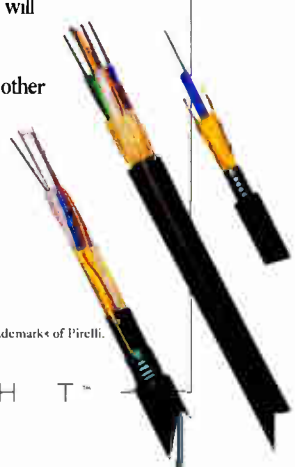

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to be an advantage to having a modulation scheme that addresses all services, not just video compression. It would be nice to have an integrated modulation approach for telephony, data and video. Rich Prodan (CableLabs senior VP and chief technical officer) has been very busy with that.

CED: Does it appear as though that will be possible?

Green: Oh yes, it's very possible, it's just a matter of figuring out exactly what spec you need. The spec has been developed and was approved by the SCTE (recently). What that does is to allow variable interleaving, so you can get the kind of protection you need for video images and adjust the interleaving to reduce latency that you need for data.

CED: Is this the spec that General Instrument and Scientific-Atlanta have pledged to work toward?

Green: Yes. In the SCTE meeting, there was agreement, and S-A and GI were there. The SCTE is in the process of approving that. So, finding the solution for integrated modulation, I think, is done.

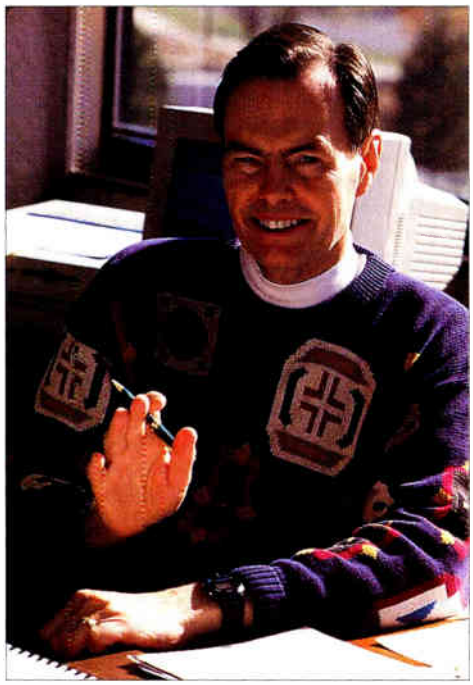
CED: What is the value of reaching such an agreement on interoperability?

Green: It's probably even more significant than even I realize because it's a definitive specification that's pretty much based on existing standards. There are some small exceptions to that, but it tells the manufacturing community that if it takes all these pieces and puts it all together, that will be our operating standard. That's significant in that it's all available and the intellectual property is available as well. So it eliminates most of the barriers to getting hardware and sends a clear signal that this is the way we're going to do it.

It also addresses, for the first time, the issues of encryption and access control and allows multiple types. It doesn't restrict it to just one system. It eliminates stumbling blocks to deployment because it permits scale economics, multiple suppliers and tells the financial community that this is real, this is going forward.

It's very important going forward because it allows any manufacturer to be compatible with cable. That has always been a concern, especially from the consumer electronics industry, which didn't know what a decoder for our signal would look like. I think you'll find many manufacturers that were not traditional suppliers interested in the set-top spec. It's also possible to begin thinking about building this directly into receivers.

I hope it sends a signal to the manufacturers that we in the cable industry really do have our act together vis a vis the technical specifications of equipment. We're able to speak as an industry–to me, that's the most significant element. That's been our goal at CableLabs since our inception.



"It's very important going forward because it allows any manufacturer to be compatible with cable"

CED: What about new initiatives?

Green: We have a new department, called strategic assessment, that's under David Reed. What his group is doing is looking at technology from our point-of-view to understand the economics of the cable industry's deployment of various services. And he also looks at competitive deployments. Most of that, of course, is not releasable, as you can imagine.

CED: What kinds of things does he look at?

Green: All the competitors. DBS, ADSL, MMDS and PCS. It helps us to understand our business as well as understand our competitors' business and what their technical and economic strengths and constraints are. We don't do business models; we do economic modeling and insight. Those things have been occupying our time up to now.

Our emphasis now, for the rest of the year and into next year, is on the TCI work and (supporting) other MSOs who are actually deploying the hardware. We have several efforts. One is a deployment subcommittee that Tony Werner is chairing. It has the CTOs working together to identify the technical and economic issues and to assist other operators who haven't begun deploying yet to give them a heads-up. They're developing a handbook that will be available to our members.

CED: So, this is a "how-to" handbook?

Green: Yes. (It covers) how to get prepared for it, what you need for test gear, all that kind of thing. Doug Semon is the guy to talk to on that. It's pretty important for all members, but especially those who are just getting started. But even the leaders can transfer what they learn in one place and apply it somewhere else later.

The other very important thing is the modem standard, which has been worked on all year with the MCNS group to bring that to fruition. That seems to be well on track. Part of our September board meeting was dedicated to a review of the standards process and all of the modem data we had.

Data modems have been a very high priority all year, and that's been an extensive test program. The results were presented during the Summer Conference on how the modems we've tested performed. And that process continues.

There are two parts to that testing: the physical layer, which is the modulation up- and downstream and error correction; and then the other part is the Mac layer, which is more or less the software and how it interfaces with the application. That's the computer data side–how many bitstreams can you get and what's the traffic loading and those sorts of issues. Bob Cruickshank has been working on that.

CED: CableLabs has issued a couple of press releases, one saying that the spec is on track and a more recent one regarding cable modem manufacturers and their intellectual property.

Green: When you're developing a purchase specification, you need to work closely with suppliers to do that, because what you're doing is taking the requirements of the industry and matching it with what can be built. So, the Hell Week we had was that kind of interchange with suppliers. The suppliers who were there (Com21, Motorola, General Instrument, Hewlett-Packard and LANcity) were willing to agree to a process of working together with us, which includes making available their best thinking on the subject. We've done the same thing with digital video compression because it's important to have (input from) suppliers like GI and S-A and others.

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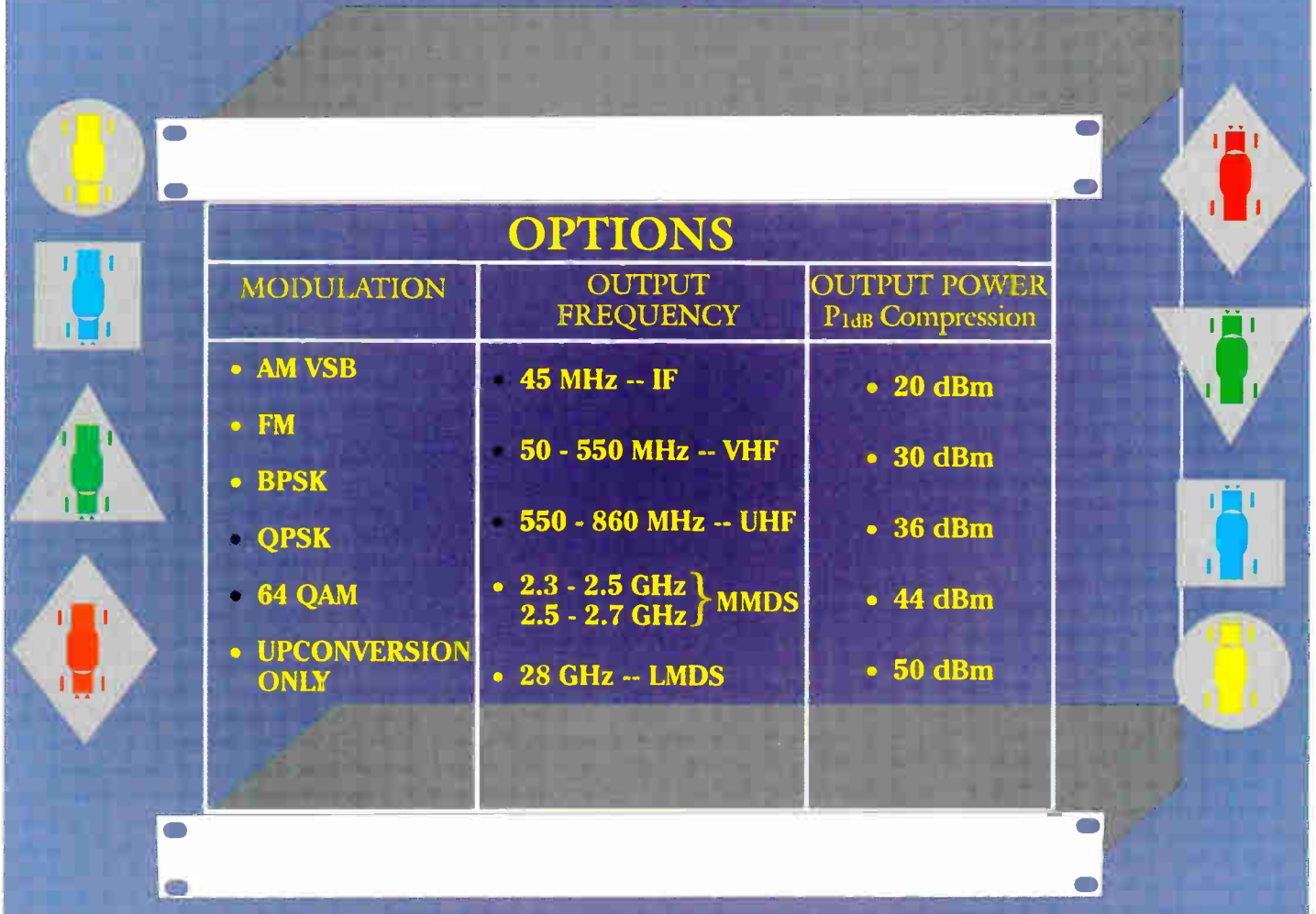

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Mapping the cable industry's future

CableLabs supports digital deployment

Over the past several years, the work undertaken by Cable Television Laboratories has often defined the future directions of the cable TV industry in general. From digital video compression to high-speed data, the industry's key services have first been explored and defined by work done at CableLabs. To get some idea of where the industry might be headed, CED Editor Roger Brown interviewed CableLabs President and CEO Dr. Richard Green. What follows is an edited transcript of that conversation.

PHOTOGRAPHY BY BOB SULLIVAN

CableLabs President and CEO Dr. Richard Green.

CED: What are CableLabs' current key initiatives?

Green: Our primary initiatives for this year are to assist the deployment of digital services in three basic categories: digital video compression, digital data modems and digital telephony. Earlier in the year, we focused on the return path–making it work, determining what the problems were and helping to find solutions to that. Our winter conference was the culmination of a series of events all focused on trying to determine the best solutions to the return path. We had a very good presentation by our key members outlining what the best approach is. The bottom line is that it can be made to work, but the issue is doing it at a reasonable cost. I think everyone came away feeling, "OK, well, that one's in the bag. We've crossed that hurdle, we know how to make it work and have a good handle on the economics."

From the first quarter (of 1996) on, we've been focused on the hardware that is going to be deployed. We've focused on the encoders and decoders for video compression. I think we have one of the best facilities in the world for checking bitstreams for MPEG compliance. We've tested a large number of encoders, almost any encoder that exists, that we can have access to.

CED: Do you contact the manufacturers to request tests, or do they contact you?

Green: It works both ways. The manufacturers know we're doing it, and many of them get a hold of us and want to be tested. In some cases we go out and request to test. We can take all the data and compare it. But the real issue is how to make compression work for the cable systems and with the best possible economics.

We've tested the decoders as well and the modulation schemes for digital video compression. We've been very active in the standards process. One of the issues we've been trying to address is the modulation scheme in the downstream. We have selected a modulation scheme (two years ago), but there appears

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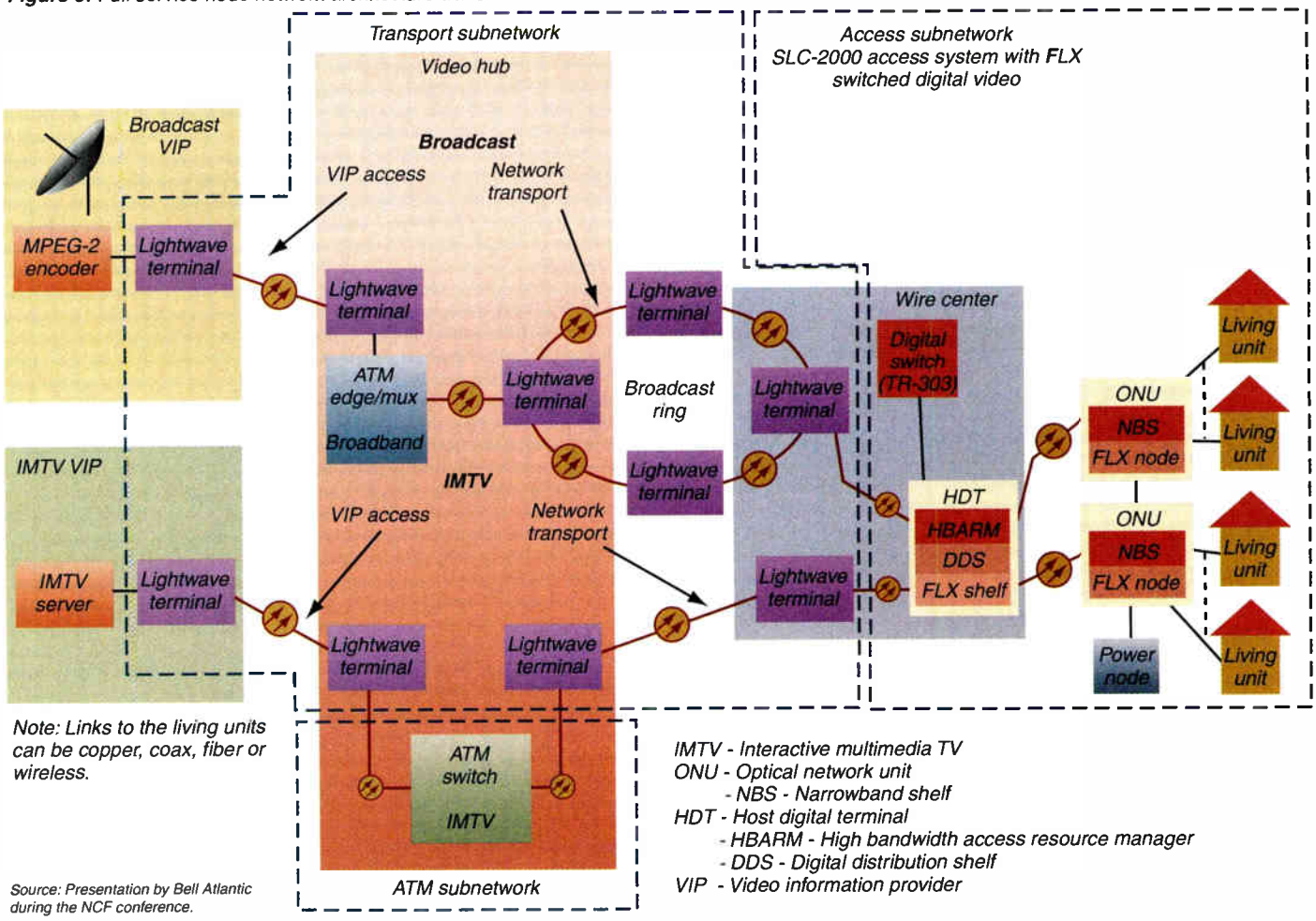
Figure 5: *Full service node network architecture-transmission.*



Source: Presentation by Bell Atlantic during the NCF conference.

speeds of 6.0 Mbps for loops less than three miles in length, or should it move to higher speeds (up to 50 Mbps) on shorter loops that access fiber nodes? The author believes that the VDSL approach makes more sense when viewed in the context of an evolving access network (see below).

This network will use many different technologies, notes Ray Albers, vice president of technology planning for Bell Atlantic, who spoke at NCF/InfoVision in October. Albers proposes a full-service digital video dialtone platform that consists of a combined central office and host digital terminal supplying customers over HFC, fiber and copper, and copper only. Multipoint microwave distribution is also used (see Figure 5).

What is ADSL's role in a distributed architecture such as this? Probably, it would become one option among the several that make up the xDSL family listed earlier. Over the next few years it is likely that the access network will accommodate:

✔ Medium-sized business users connected using HDSL data pipes

✔ Smaller businesses and work-at-home customers connected over coax or copper drop wires using VDSL

✔ Residential customers supplied with cable TV over HFC

✔ Internet connectivity at higher speeds over cable modems, ADSL or MMDS.

In the October 31 edition of *USA Today*, Kevin Maney reported that ADSL could play a major role in speeding access to the Internet once problems of distance, radio interference and PC compatibility are solved. High-speed access consists of many related parts, and what happens in one part can adversely impact other parts of the network. PacTel says it plans to provide ADSL service to its Silicon Valley customers late next year, but by that time, customers will have other choices, including cable modems and broadband wireless. CED

Figure 6: *Dataquest market projections (U.S.). Annual sales in thousands of units*

Modem	1995	1996	1997	1998	1999	2000
ISDN	130	220	344	481	636	805
Cable	13	25	80	210	540	900
xDSL*	0	50	350	1,000	1,700	3,700

*ADSL, HDSL, SDSL

6.8 Million xDSL unit sales projected by year-end 2000
1.8 Million cable modems
2.6 Million ISDN lines

References

Some of the information in this article was obtained from the Maximizing Copper in the Access Network, IIR conference held in London on September 16-17, 1996.

About the author

Alan Stewart is a freelance writer who specializes in telecom issues.

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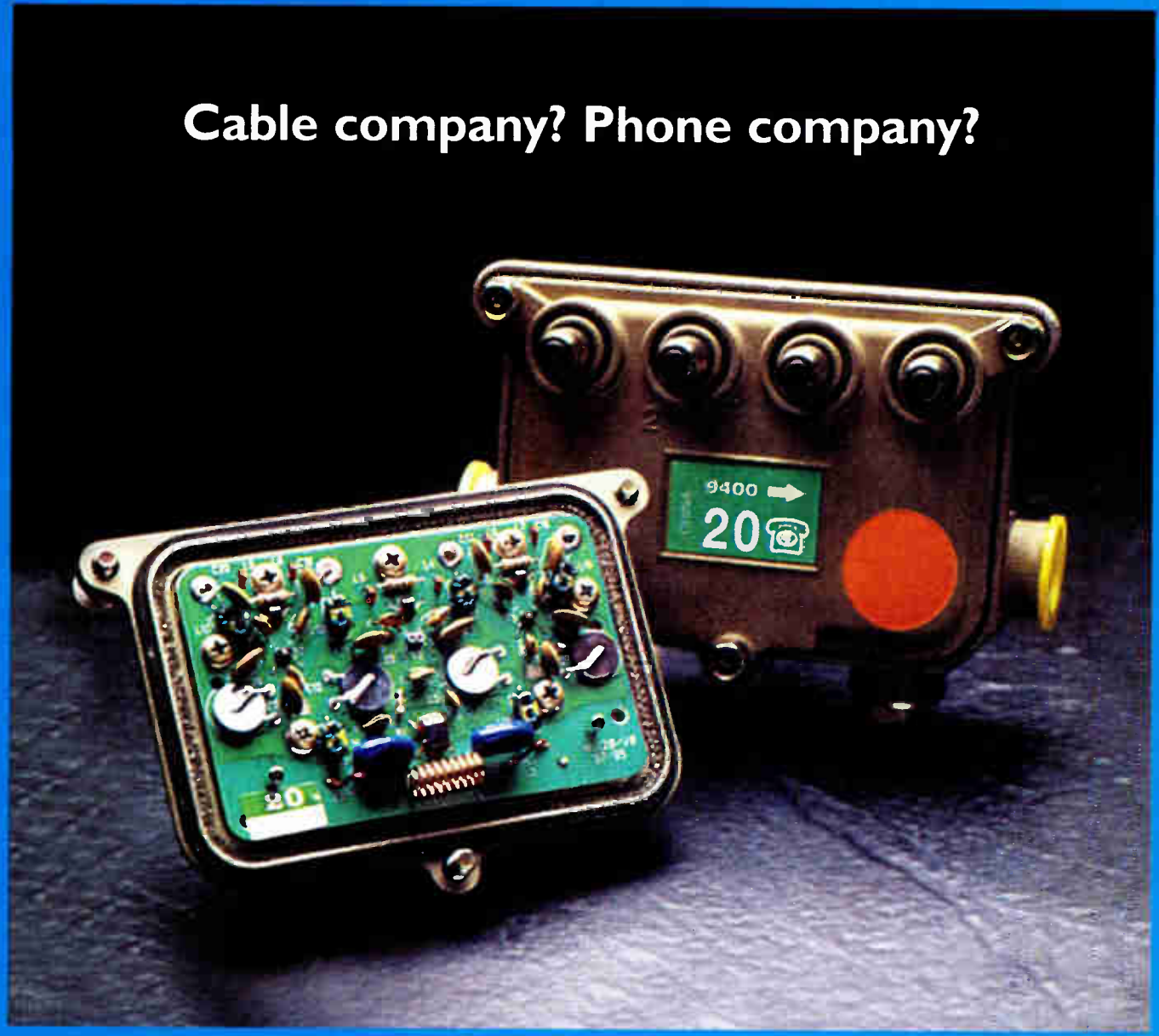

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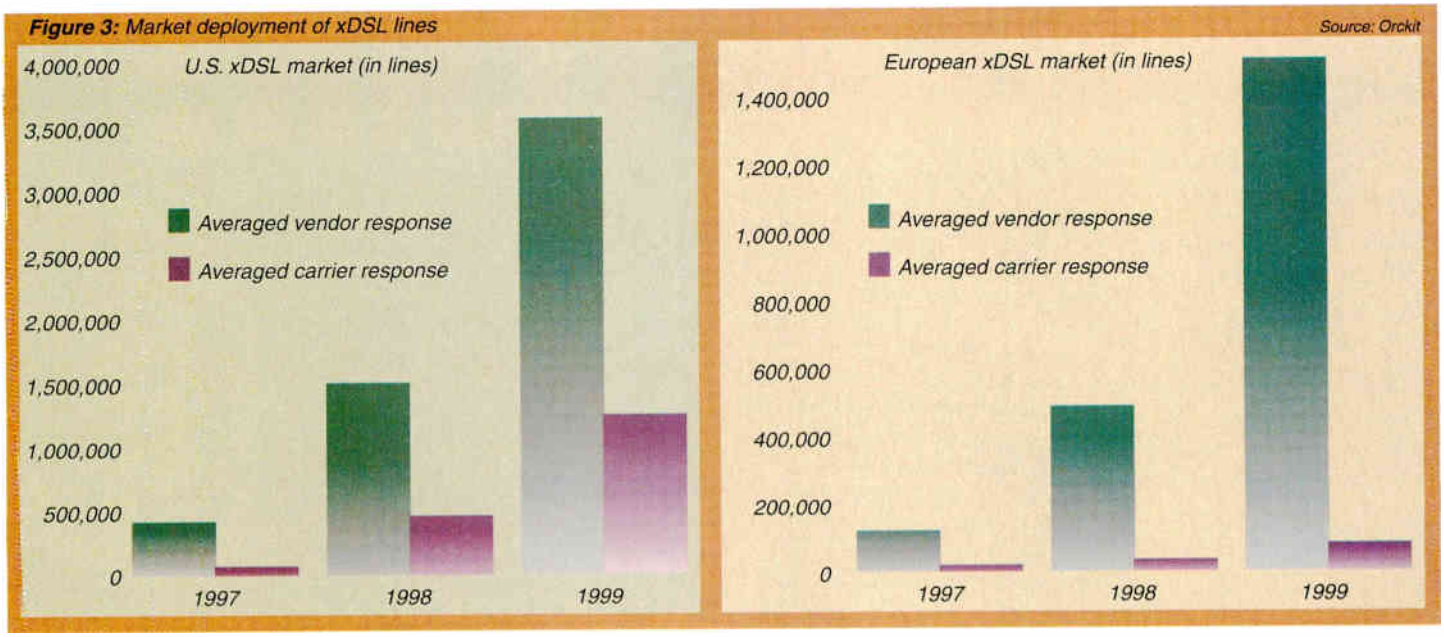
Figure 3: Market deployment of xDSL lines



Olshansky. The latest rumor heard on the street is that GTE is re-evaluating ADSL for this application.

Australia's regulatory framework allows Telstra the freedom to build and operate both a telecommunications and subscription broadcast pay TV network. The company has chosen to deploy a hybrid fiber/coax (HFC) network plus explore the video and data delivery capabilities of ADSL using NEC Australia as its vendor.

A decision on ADSL is not expected until next year at the earliest and is dependent on favorable cost comparisons with other architectures. "The greatest cost reduction impact is expected to come from lower equipment prices due to the development of a global ADSL market," explains Symon Rozenthal, ADSL manager for Telstra. "Current models indicate that costs for ADSL deployment are similar to HFC deployment for the penetration levels expected in Australia."

Market miscues

Unrealistic marketplace expectations have dogged ADSL since its inception. Unlike HDSL, which provides telcos with immediate cost savings, ADSL offers only vague expectations of future revenue streams. Westell's Faw admits that most ADSL forecasts are based on RFPs (requests for proposal) by the telcos. Data presented in London indicates a wide discrepancy between vendor expectations and carrier forecasts for xDSL systems (see Figure 3).

"The supplier industry, in an environment of low ADSL sales, has invested an estimated $150 million in the development of signal processing technology, access and network management systems for ADSL," says Faw. "At the present moment, no one is making any money in this industry, yet huge investments will continue to be made."

The danger here is that new technology can become self-sustaining, irrespective of its potential for meeting the real needs of users. "Strong vested interests can become proprietary in nature, and we should insure that we see interoperable network managed systems at the user and network interface level if we are to succeed," Faw concludes.

Dan Arazi, vice president, marketing at Orckit Communications, believes that the best application for ADSL is VOD integrated with Internet, as this will provide benefits to both business and residential users. Internet service providers want faster access over copper, but before this can be done, some key data access questions must be answered:

✔ Will IP be the only common protocol for the Internet?

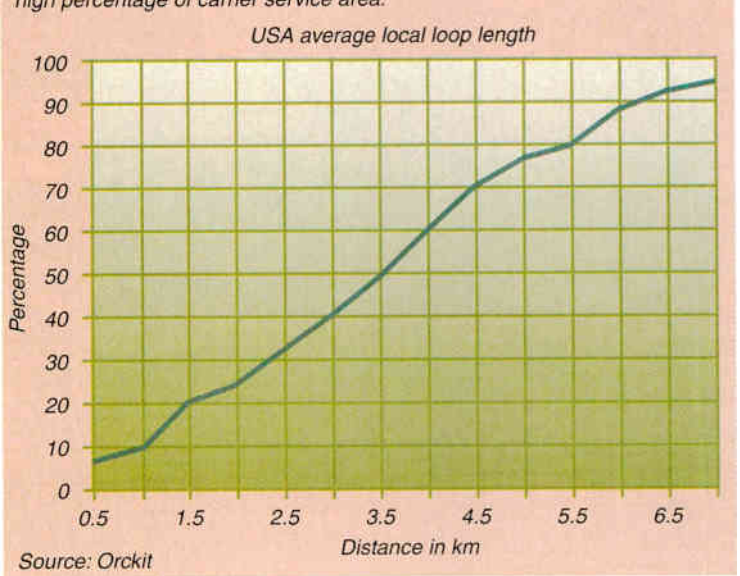
✔ Will IP be sufficient for a network running at 50-times a regular dial-up modem speed?

✔ Is ATM ready to replace IP?

Because of differences in local loop quality, achievable bit rates will vary widely across the access network. To accommodate this, the data rate must be able to drop back to a default speed just as it does in high-speed dial-up modems today. "Rate adaptive ADSL is probably the only way to cover a high percentage of CSA (carrier serving area) loops today, notes Arazi (see Figure 4).

Changes in the access network and the emergence of xDSL presents the industry with a dilemma. Should it promote asymmetrical solutions at

Figure 4: Rate adaptive ADSL, DMT. Probably the only way to cover a high percentage of carrier service area.



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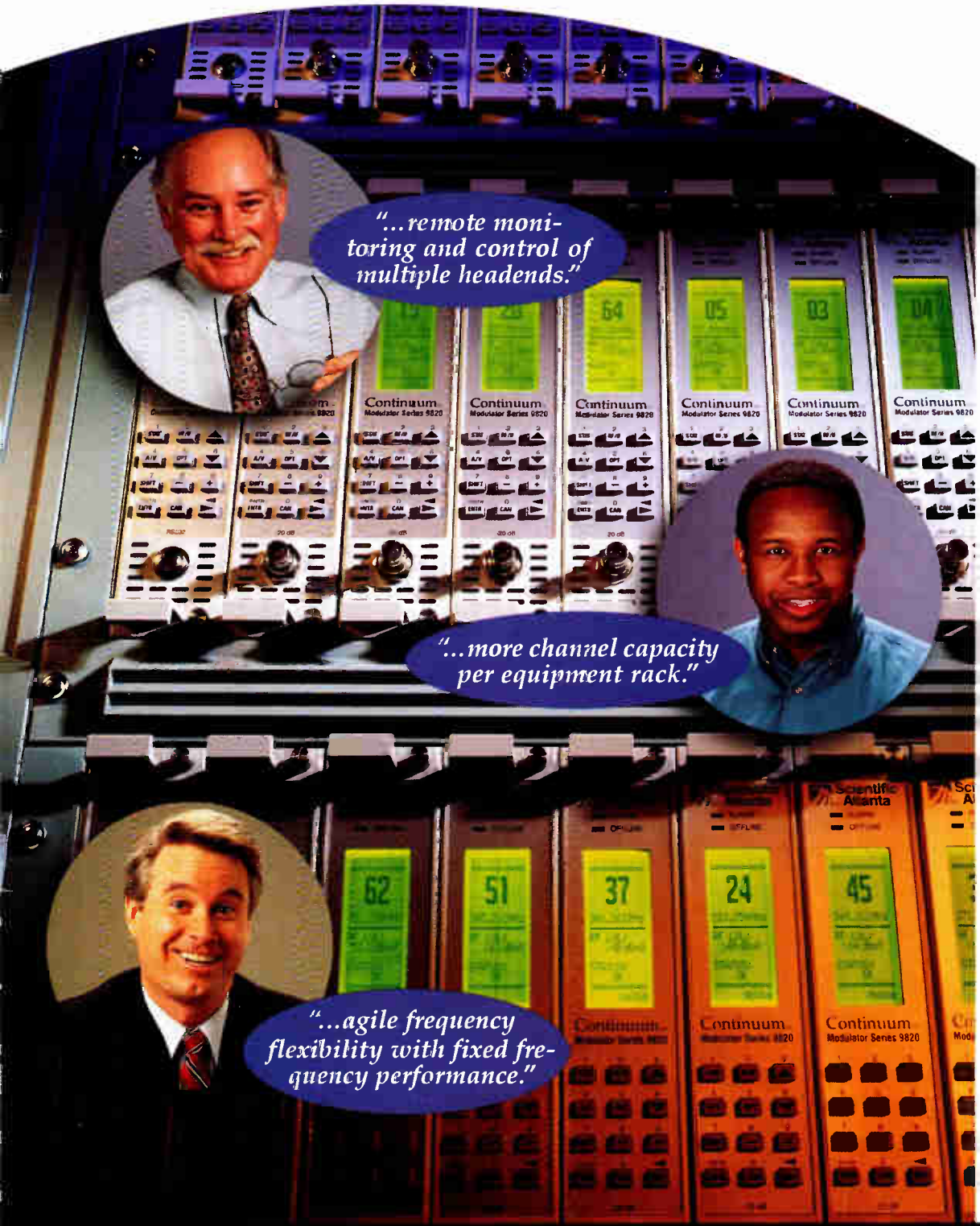

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flow and voltage drop in two directions. In a simplified scenario, a power supply might be placed halfway between the node and the last active, with current being inserted and directed toward and away from the node. This positioning "balances" the system–providing roughly equivalent voltage levels at the first and last actives in the RF plant (see Figure 1).

Centralized powering removes the distributed supply from this balanced location, and places it at a spot central to the area served and in common with other relocated supplies. This may be at the node, but can be anywhere appropriate for a large power supply, such as an industrial or secluded area. Once moved, the system design must be reviewed to determine how appropriate voltage and current levels can be maintained (see Figure 2).

Moving the system power supplies to a central location does not necessarily change the point at which power must be inserted into the network. Should power be inserted at the node, for example, additional current must be delivered on the first trunk cable to deliver adequate power to the feeder legs. This high current will have a high voltage drop associated with it, so care must be taken to ensure that adequate input voltage is used to withstand a large drop and still provide adequate voltage at the last actives without overloading any devices in the current path.

This large voltage drop can be dealt with in several ways. The input voltage can be raised, to 90 volts, for example, so there is more voltage available to work with. A system with a 90 volt input voltage can better manage an early 20 or 30 volt drop than can a system with a 60 volt input. The voltage drop can also be negated by reducing the resistance of the cable carrying the high current. This has traditionally been done by using a larger cable than is necessary for the RF design, such as a one-inch trunk cable.

Even if power is inserted apart from the node, and while 90 volt operation and greater current handling capacities of electronics help, some simple tenets remain:

✔ When powering coaxial networks, the load needs to be balanced in the circuit, particularly if there are line-powered devices at the home;

✔ The current generating capacity of an efficient powering system can exceed the current carrying capacity of a cost-effective coaxial plant design; and

✔ In an HFC network with short cascades, the fiber cable effectively isolates portions of the plant from a more centralized power generating source.

In short, there is a best location for the power inserter and a best location for the power source, and they are not on the same pole. This implies that some type of cable is required to put power where it is needed.

Table 1: *A comparison of weight, size and loading.*

Cable configuration	Pair of #1 Cu	Pair of 2/0 Al	1160 coax	Pair of 750 coax	PF 625 coax
DC loop (ohms/1,000 ft.)	0.320	0.318	0.300	0.380	0.290
With 1/4-inch support strand					
Bundle radius	0.492	0.579	0.750	0.820	0.468
Bundle weight (lb./ft.)	0.793	0.477	0.552	0.519	0.405
Ice and wind loading (NESC rule 250 in lb./ft.)					
Heavy	2.139	1.971	2.280	2.348	1.749
Medium	1.476	1.269	1.483	1.517	1.109
Light	1.133	1.041	1.303	1.380	0.860

Power distribution cable options

The choice of a cable for power delivery requires one to consider many factors. The reduction of cable resistance is simple enough–either add metal or use a less resistive metal. As is the case with most simple situations, the impacts of the change are somewhat more complex.

Traditional cable television coax could be used for power distribution, but it is limited in terms of DC resistance. Coax is designed with a 75 ohm input impedance, which matches the RF gear operating in the system. In order to maintain this impedance, the dimensions of a coaxial cable are fixed for a given diameter–the center conductor and shield must be held in a specific relationship. This fact makes the design of a low resistance cable difficult–once metal is added to the center conductor, the input impedance changes. With traditional coax, the DC loop resistance can be reduced by using a larger cable, but with the structural stiffness of coax increasing to the 4th power of the shield diameter, plant installation and maintenance quickly become an issue (see Figure 3). Removing the constraint of 75 ohm impedance is necessary to allow minimized resistance in a manageable package.

Coaxial cables with low DC loop loss have also been built using copper rather than aluminum. Copper center conductor cables have for years been available for just this reason. The DC resistance is lower because copper is less resistive than aluminum, but it is also heavier and more costly than aluminum.

Standard power conductors could also be used to deliver power, because the power inserter isolates any impedance mismatch. They also offer an interesting view of the relative advantages of copper and aluminum. A comparison of weight, size and loading quickly shows that copper, while occupying a smaller package, is much heavier and creates greater pole loading (See Table 1). Power conductors also present a craft issue: how do you terminate a 2/0 pair into a power inserter?

Having considered power cables and traditional coax, having removed input impedance as a design criteria, and having identified aluminum as the metal of choice, the development of a coaxial cable with DC loop resistance below 0.30 ohms per 1,000 feet in

Table 2: *Coaxial cable comparison.*

Coaxial cable comparison	625 standard	625 power feeder	1 inch trunk
Center conductor diameter, inches	0.137	0.325	0.220
Diameter, inches	0.625	0.625	1.000
Shield wall, inches	0.031	0.055	0.055
Loop resistance, ohms/1,000 ft.	1.10	0.29	0.40
Impedance, ohms	75	23	75
Weight, lbs./1,000 ft.	138	284	362

Table 3: DC loop resistance of available coaxial cables.

Diameter inches	Center conductor material	DC loop ohms/1,000 ft.
0.625	aluminum, power feeder	0.29
1.160	aluminum	0.30
1.000	aluminum	0.40
0.875	copper	0.41
1.125	aluminum	0.42
0.840	copper	0.46
0.625	copper, 50 ohm	0.46
0.860	copper	0.53
0.875	aluminum	0.55
0.750	copper	0.56
0.840	aluminum	0.60
0.860	aluminum	0.72
0.750	aluminum	0.76
0.625	copper	0.79
0.700	aluminum	0.84
0.715	aluminum	1.00
0.625	aluminum	1.10
0.500	copper	1.20
0.565	aluminum	1.30
0.540	aluminum	1.61
0.500	aluminum	1.72

a 0.625 size feeder seemed feasible. A shield thickness of 0.055 inches was suggested because of available materials, and the center conductor, which bears all the forward path current, was greatly increased in size. Connectors with insulators in place of RF sleeves have also been developed, and are capable of passing 25 amperes of current while managing the additional stress this cable design may exert. As the data tables reveal, this cable offers significant performance advantages for power insertion applications.

Conclusions

The new aluminum coaxial power feeder cable has the lowest DC loop resistance and pole loading available; a significant advantage over copper, coaxial or traditional power cables. Using this cable, a designer need not limit power supply location to the balance point in the network, or to the node, or to anything. Supplies and insertion points can be placed where they make the most sense. Best of all, this can happen over coax, which has craft familiarity from years of use. From ultra-low-loss, power-only feeder cables to 50 and 75 ohm solid-copper-center conductor cables to traditional cable television coax, cable alternatives are now available to meet the needs of virtually any application. CED

Acknowledgments

The authors would like to recognize the efforts of Joe Hohlmayer, William R. Kerr, Gilbert Engineering and many others within our own companies for their contributions.

Taking back-up power underground

Flywheels move closer to deployment

By Roger Brown

Once considered little more than a technical curiosity by some engineers, it now appears that backup electrical power from high-speed flywheel technology could be a viable option for telecommunications network providers within the next 12 to 18 months.

After more than a year of development, Cambridge, Mass.-based SatCon Corp. debuted its flywheel-based uninterruptible power supply during a power industry conference in early October, aiming the new product squarely at cable TV and telecom network operators who for years have had to rely on cumbersome and unreliable lead-acid batteries for backup power when commercial power suffered an outage.

SatCon, which demonstrated the flywheel at Intelec '96 in Boston, intends to repeat the demonstration at the Western Cable Show in Anaheim later this month.

But already, several top-level cable TV engineers are excited about the flywheel's possibilities and intend to be among the first to field test the units. "I'm very gung-ho on the project," says Bill Bauer, who heads tiny WindBreak Cable in Nebraska, but who is considered to be one of the industry's most forward-thinking engineers. "It appears to be a strong, viable way of doing things."

Nick Hamilton-Piercy, senior VP of engineering and technology at Rogers Cablesystems, is likewise optimistic–and looks forward to the day when he can cease purchasing batteries that often don't work as advertised without a lot of maintenance.

Other operators who intend to test, and perhaps deploy the units, provided they can be manufactured for about $2,000 per unit and deliver the necessary specifications (1 kilowatt of power for two hours), include: Cox Communications, Comcast, Tele-Communications Inc. and Buford Cable, among others. In fact, SatCon officials say they already have letters of intent amounting to about $11 million in equipment, or roughly 5,000 units.

How it works

SatCon first burst on the cable TV scene in January 1996, when company VP and chief technical officer Richard Hockney delivered a paper on flywheel technology at the SCTE's Conference on Emerging Technologies. The presentation surprised many and had others curious but doubtful that the solution could work economically.

The concept has moved from technological promise to a real product

SatCon is leveraging its research from various space program contracts it has worked on over the years. That work was designed to control spacecraft attitude and momentum control. The challenge to convert that knowledge into this product chiefly consisted of engineering out costs, something the company claims it has done.

"It (the $2,000 per unit price tag) is an aggressive target, but we're confident we can do it," says Peter LeBlanc, business development manager for SatCon's Energy Systems Division. "There are challenges, but it's what we're driving toward."

The $2,000 figure comes from the projected 10-year cost of buying lead-acid batteries and maintaining them, according to Hamilton-Piercy.

Since the first of the year, the concept has moved from technological promise to a real product. In fact, the company demonstrated a working prototype, showing how when commercial power is cut off, the spinning flywheel converts its stored kinetic energy to electrical energy that can power a network node.

The unit is said to last at least 20 years, with scheduled maintenance necessary only every seven to 10 years to keep the unit operating efficiently, according to Bauer, who has seen the company's working prototype.

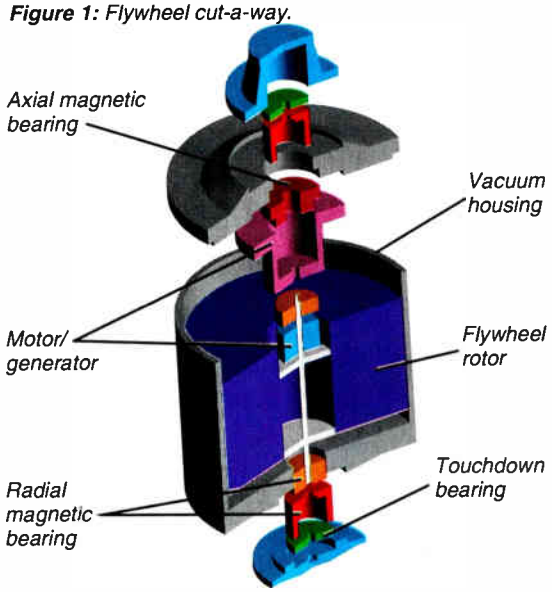
The flywheel module, which is designed to spin at a steady 30,000 revolutions per minute, is stored in an underground concrete vault for safety reasons. The flywheel itself is made of a fiberglass-like composite to insure safety to craftpersons as well as the general public.

"A lot of people think that this thing could explode and become shrapnel if it's made of metal," says Bauer, who notes that those concerns should be obviated now that the flywheel has been re-designed to be made of fiberglass and spins on magnetic, not mechanical, bearings. Tests are already underway at SatCon to determine exactly what happens when the flywheel module fails, but the unit should just delaminate, or "end up looking like cotton candy," says Hamilton-Piercy.

Bauer believes that a network monitoring system also provides new benefits to him and his cable colleagues. Through internal sensors, software can show how much energy has been stored, how much is left (if the unit has gone into a backup mode), the speed at which the flywheel is spinning, and other information. "This is the first time we can really find out what's going on with our power," he notes.

Although the technology has been designed for cable and telecom networks, it has application elsewhere in such systems. In fact, Bauer intends to

Figure 1: *Flywheel cut-a-way.*



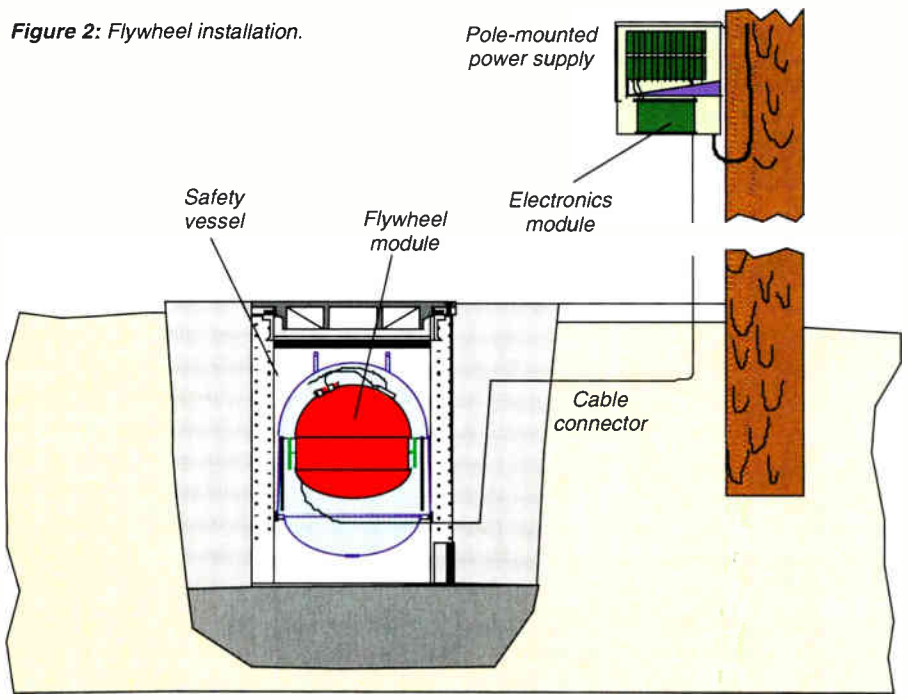


Figure 2: *Flywheel installation.*

eventually gang several flywheels to provide backup power to his headend. "It (the flywheel) will replace the batteries we currently use," Bauer emphatically states. "And with the cable industry getting into the telephony business, we have to be able to provide reliable service. This gets us there."

"This is the best alternative that's come forward so far," says Hamilton-Piercy, who notes other options include fuel cells and large generators. "The flywheel still seems to be the best, easiest to deploy" option.

Will two hours of backup be enough? With most cable operators backing off full-scale lifeline telephony deployment for the time being, Hamilton-Piercy says it ought to be plenty. Research has shown that 95 percent or more of all outages have a duration of four hours or less.

While SatCon is busily doing final design work and preparing for full-scale mass production of the unit, it's already working on an installation manual as well. "This is way past emerging technology," he notes. "It's much further along than most people realize."

Maybe not for long. CED

Effects of analog and digital signals

Can they happily coexist?

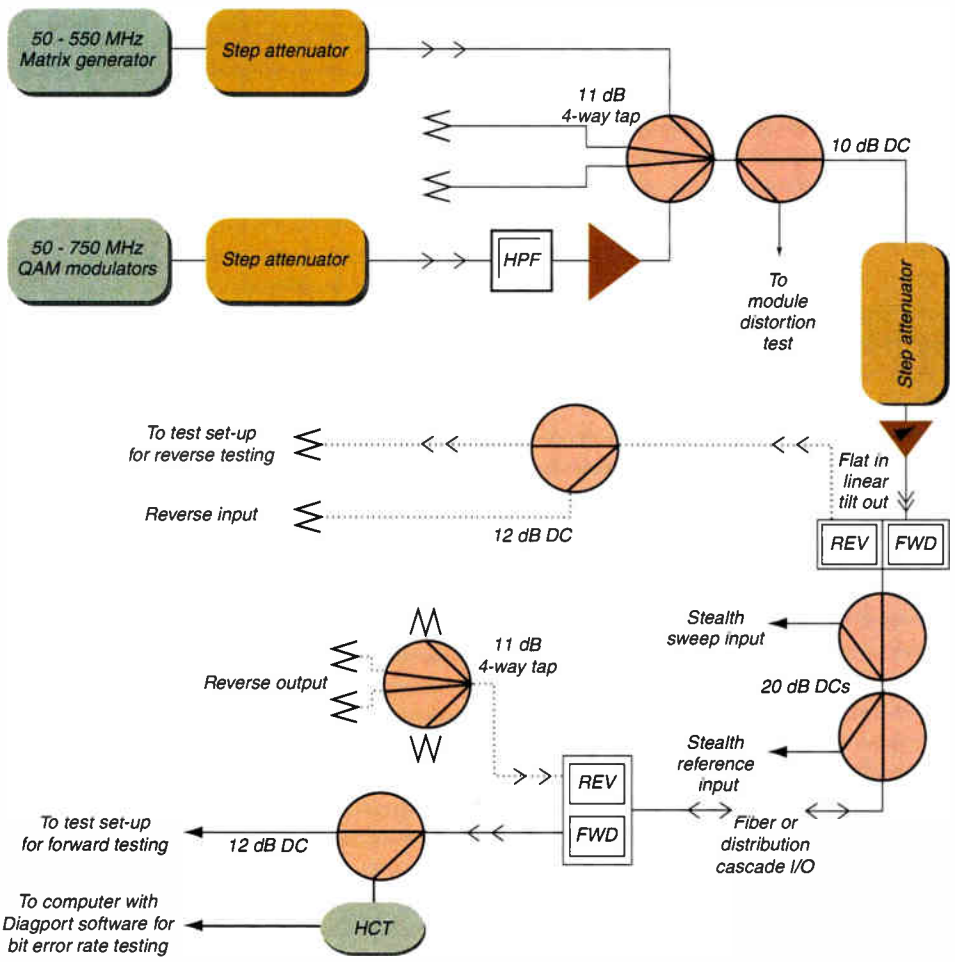
By M. Stephen McConnell, Associate Staff Applications Engineer, Scientific-Atlanta

The cable TV industry has always been looking for ways to expand channel capacity, therefore increasing revenue, while at the same time expanding the viewer's choice. The latest method is through the addition of 64 QAM channels. The digital channels can be placed anywhere in the plant's usable forward spectrum from 151 to 749 MHz. Typically the digital tier is placed in the upper frequency band that is unused by the analog channels. As more systems are being built or upgraded, the frequency range is being extended as well. As of this writing, the forward frequency spectrum is 50 to 750 MHz. Normally the cable operator reserves the 50 to 550 MHz spectrum for analog signals. This leaves the 550 to 750 MHz spectrum open for future digital signals. A 64 QAM signal has a signal bandwidth of 6 MHz: this would allow the cable operator to insert up to 32 QAM modulators in the 550 to 750 MHz range. One QAM signal can digitally compress and transport up to 6, 6-MHz AM VSB signals. If a cable operator chose the upper tier for 64 QAM digital signals, the operator could pack an additional 192 AM VSB channels into this region.

This addition of the digital tier presents various situations that will be discussed in this article. The following issues will be analyzed and tested.

1. What is the correct amplitude delta between the analog and digital channels (6, or 9 dB) to operate the 64 QAM digital signals in order to obtain the best performance of *both* the digital and analog signals?
2. What effect does the digital tier have on analog signals (CNR, CTB, CSO, and X-Mod)?
3. What effect do the analog signals have on the digital tier (CNR and BER)?
4. What effect does CIN have on the total system?

Figure 1: *RF signal equipment diagram*



Test parameters

Tables 1 and 2 detail the test parameters (see pages 118 and 120).

Each series of tests were divided into three sections: fiber, distribution, and fiber + distribution. Each of these sections were broken down into two tiers, analog and digital. Each tier was broken down into four individual tests: noise, distortion, cross modulation, and Bit Error Rate (BER was performed only on the digital tier using modulated 64 QAM modulators).

Different channel lineups were utilized in each tier to characterize their effects. The following is a list of those channel lineups and the tests that were performed for each of the three sections (See table on page 117).

The Modulated QAM channels begin at 555 MHz and are spaced on 6 MHz centers up to and including 741 MHz.

The CW analog channels include 55.25, 61.25, 67.25, 77.27, and 83.25 MHz. The analog channel alignment then begins at 109.25 and continues up to and including 547.25 MHz spaced on 6 MHz centers.

The digital tier signals were supplied by 32 Scientific-Atlanta, Model D9470 64 QAM modulators.

The analog tier signals were supplied by a Matrix Test Equipment Inc., Multiple Frequency Signal Generator.

In order to analyze the data, apples must be compared to apples. Therefore what is happening in the digital tier cannot be used to determine what is happening in the analog tier (as an example, noise degradation in the digital section cannot be used to determine noise degradation of the analog tier). But an analysis can be performed on each tier (analog and digital) and comparisons made within that tier.

The tests performed were to determine what effect the digital tier (550 - 750 MHz) had on the analog tier (50 - 550 MHz) and what effect the analog tier had on the digital tier. A number of tests were performed to help in determining the effects of noise, distortions and Bit Error Rate (BER).

The following Scientific-Atlanta test procedures were utilized during the test program. These test procedures are similar in concept to the NCTA testing procedures, and have been modified to allow testing of CW carriers in a non-active plant.

Test	S-A Part number
Setup:	545913
CTB:	545914
CSO:	545915
XMod:	545916
CNR:	545917

Analog tier measurements

The following tests were performed to determine the analog tier (50 - 550 MHz) performance, (CNR, and distortions). First the performance of the analog section was measured with no digital tier (550 - 750 MHz). Next the performance of the analog section was measured with the digital tier added at the two A/D deltas. The last test was to determine the CIN of the analog section with digital tier loading at the two A/D deltas.

Analog tier	Digital tier	Analog test	Digital test
78 CW channels	None	Noise, distortions, xmod	None
78 CW channels	32 Modulated 64 QAM	Noise, distortions, xmod	Noise, BER

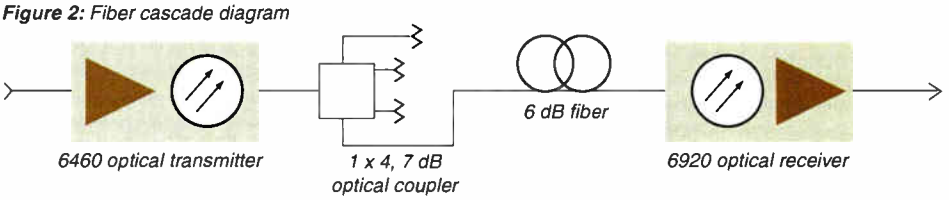
The analog tier was tested with the following channel loading: 78 CW Matrix carriers + no digital, 78 CW Matrix carriers + 32 modulated QAM modulators at each of the two A/D deltas.

Each of the above tests were performed on the fiber, distribution, and fiber+distribution.

In order to better understand the CTB and CSO distortion measurements, it is important to know what combination of carriers are creating the distortions. The beats that fall within a 6 MHz band of an analog channel that are of concern are as follows; -1.75, -1.25, -0.75, 0.0, +0.0, +0.75, +1.25, +1.75 MHz. The beats are comprised of the following;

1. -1.75 MHz: CTB analog ± analog ± digital
2. -1.25 MHz: CSO analog, CSO digital, & CTB analog ± digital ± digital
3. -0.75 MHz: CSO analog, & CTB analog ± analog ± digital
4. 0.0 MHz: CTB analog, & CTB analog ± digital ± digital
5. +0.5 MHz: CSO analog ± digital

Figure 2: Fiber cascade diagram



6. +0.75 MHz: CSO analog
7. +1.25 MHz: CSO analog
8. +1.75 MHz: CTB digital, & CTB analog ± analog ± digital.

Digital tier measurements

The following tests were performed to determine the digital tier (550 - 750 MHz) performance. The first test was to determine what effect the analog tier (50 - 550 MHz) had on the digital tier CNR, and the second test was to determine the effect the different A/D deltas have on the BER of the digital tier.

For the CNR measurement of the digital tier, each section was tested as follows: 78 CW matrix carriers + no digital, and 78 CW matrix carriers + 32 modulated QAM modulators at each of the A/D deltas.

For the BER test each section was tested as follows: 78 CW Matrix carriers + 32 Modulated QAM modulators at each of the two A/D deltas.

Although no distortion measurements were made of the digital tier, it is important to understand that distortions as well as CNR all determine how well the digital tier is performing. The overall performance of a digital channel is measured by the BER of that channel. In order to better understand the distortions, it is important to know what combination of carriers are creating the distortions. The beats that fall within a 6 MHz band of a QAM channel that are of concern are as follows: -1.75, -1.0, -0.5, 0.0, +0.75, +1.25 MHz. The beats are comprised of the following:

1. -1.75 MHz: CTB analog & CTB analog ± digital ± digital
2. -1.0 MHz: CSO analog
3. -0.5 MHz: CSO analog
4. 0.0 MHz: CTB digital & CTB analog ± analog ± digital
5. +0.75 MHz: CSO digital ± analog
6. +1.25 MH: CSO analog ± digital

Note: The output of the QAM modulators in ***CW*** mode are very spurious, there are spurs that fall ± 1.0, ± 1.75, ± 2.0, ± 2.5, & ± 3.0 MHz from the center of the QAM channel. This is just a point of observance; none of the tests were performed with the QAM modulators in this mode. It should also be pointed out that the QAM modulators were never designed to be operated continuously in this mode.

Digital Transmission of 64 QAM:

Correction scheme: Reed-Solomon Forward Error Correction.

Rate of transmission: 30 Mbps.

Compression scheme: MPEG.

Frequency range: 550 MHz to 750 MHz.

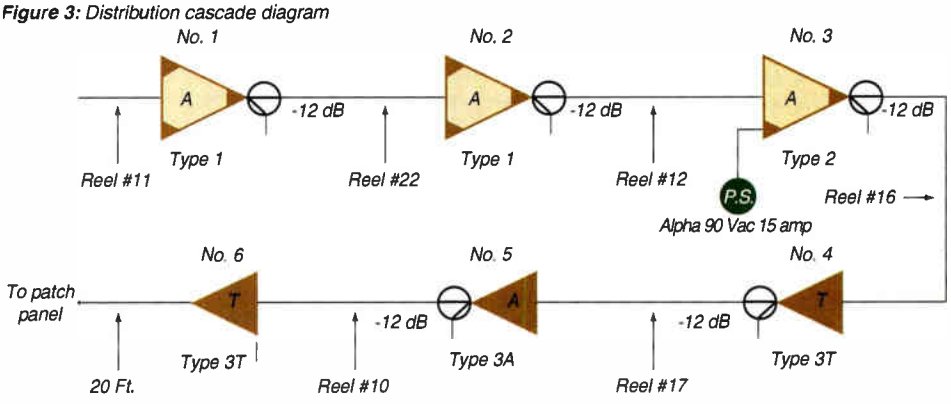
1 Block of data: 204 Bytes (1,632 Bits).

Cascade losses

The distribution cascade diagram has reel numbers shown between the amplifiers. The losses of these reels as well as the passive loss between the amps are given in Table 3.

✔ 50 - 550 MHz analog tier CNR data comparison. For the CNR graph, a frequency of 547.25 MHz was selected to analyze because

Figure 3: Distribution cascade diagram



of the greatest amount of degradation in CNR due to the digital tier (see Figure 4).

The CNR for the graph is un-corrected. The correction factor is -23.25 dB. The 23.25 dB corrects for the measurement bandwidth, resolution bandwidth filter shape, log amplification and IF detection. Please see the section on "Measurement Uncertainty."

Table 1: Test parameters

A/D deltas:	6,9 (dB)
Analog test frequencies (MHz):	55.25, 77.25, 211.25, 331.25, 439.25, 547.25 (MHz)
Digital test frequencies (MHz):	555, 603, 651, 699, 741 (MHz) (with QAM channel loading)
Optical link:	A 6460 110-channel Tx to a 6920 optical receiver
Total optical loss:	13 dB total optical loss = a glass loss of 6 dB + a coupler loss of 7 dB
Distribution cascade:	A 6 amp cascade consisting of three (3) SAIIs and three (3) LEIIs

The graph contains a plot for the fiber, the distribution, and the fiber + distribution test data.

Figure 4 shows the differences in the CNR of the analog tier as the digital tier is added, then the analog to digital (A/D) Delta is changed from 6 to 9 dB. The graph shows the increase or decrease in the analog CNR.

By observing in the CNR graph a change from the 78 CW only point to the 6 dB A/D delta point, a degradation of CNR is noted. This degradation occurs when the digital tier is added to the 78 CW analog tier. What also might be expected is an improvement in the CNR as the A/D delta is increased. A very slight improvement in analog CNR is seen from the 6 dB point to the 9 dB point. This is due to the amount of intermod created by the digital tier being reduced as the digital tier amplitude is being reduced. By examining the graph closely, the change is less than 0.5 dB. This may be attributed to equipment error, or the point within the 3 MHz frequency span where the measurement was taken.

What causes this degradation of CNR may be explained as a 6 MHz "wide" beat (the power of a QAM channel is spread out over a 6 MHz area and contains no residual carrier power, whereas a single 6 MHz AM VSB carrier has the power concentrated in a very small spectral area, thus creating a "narrow" beat), mixing down into the analog section. When this occurs, the "wide" beats appear to combine in 6 MHz "humps," thus creating what appears to be a raised noise floor.

The change in CNR as shown by the graph would indicate that the CNR improvement/degradation is caused by the addition/level change of the modulated digital tier.

For the CTB comparison, a test frequency of 55.25 MHz was selected to analyze. Figure 5 shows the differences in the CTB of the analog tier (50 - 550 MHz) as the A/D delta is added to each system, then varied from 6 to 9 dB. The graph contains a plot for the fiber, the distribution, and the fiber + distribution test data.

The fiber, distribution, and fiber + distribution plots of Figure 5 depict the analog tier with 78 CW matrix channel loading and the digital tier with 32 modulated QAM channels.

The fiber plot of Figure 5 depicts only a slight degradation from the 78 CW only point to the 6 dB A/D delta point of 0.5 dB, and a slight improvement of 0.7 dB from the 6 dB point to the 9 dB point (instrument or test variation).

The distribution plot of Figure 5 depicts a slight deviation from the 78 CW Only point to the 9 dB A/D Delta point. The graph is fairly flat (0.1 dB) again, because the digital tier has very little to add in the form of CTB to the analog tier and there is no apparent phase cancellation caused by the digital tier.

The fiber + distribution plot of Figure 5 depicts the degradation from the 78 CW only point to the 6 dB A/D delta point to be approximately 0.6 dB. There is a slight improvement (0.2) in the CTB at the 9 dB A/D Delta point.

Figure 4: 50-550 MHz analog tier CNR data comparison

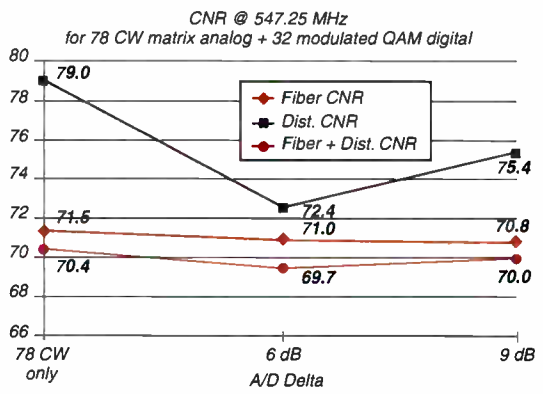
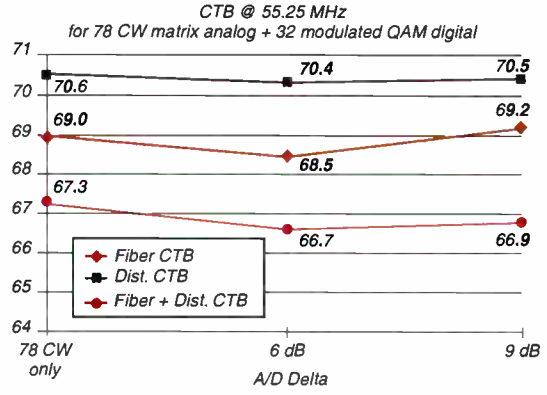


Figure 5: 50-550 MHz analog tier CTB data comparison



For the +1.25 MHz CSO comparison, a test frequency of 439.25 MHz was selected to analyze because of the greatest amount of degradation in CSO. The distortion used for comparison was +1.25 MHz in relation to the 439.25 MHz carrier.

Figure 6 shows the differences in the CSO of the analog tier (50 - 550 MHz) when there is no digital tier (78 CW only), and then when the digital tier is 32 modulated QAM modulators and the A/D delta is varied from 6 to 9 dB.

The graph contains a plot for the fiber, the distribution, and the fiber + distribution test data.

The fiber plot of Figure 6 shows that when the digital tier is modulated QAM, there is no improvement or degradation of the analog CSO. The slight deviation from the 78 CW only point to any point on the graph may be due to variations in testing.

The distribution plot of Figure 6 shows that when the digital tier is modulated QAM, there is only a slight deviation from the 78 CW only point (0.4 dB). This indicates that the digital tier has little or nothing to add to the +1.25 MHz CSO of the analog tier.

The fiber + distribution plot of Figure 6 shows a slight deviation from the 78 CW only point to the 9 dB A/D delta of only 0.2 dB. As can be seen by the graph, the CSO is fairly constant; this is because the digital tier has very little to add to the +1.25 MHz CSO of the analog tier.

For the XMod comparison, a test frequency of 331.25 MHz was chosen to analyze.

Figure 7 shows the differences in the XMod of the analog tier (50 - 550 MHz) when there is no digital tier (550 - 750 MHz) and when the digital tier is added and the A/D delta is varied from 6 to 9 dB.

The graph contains a plot for the fiber, the distribution, and the fiber + distribution test data.

The fiber plot of Figure 7 shows that the

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XMod improves from 63.2 to 64.0 dB when the modulated QAM is added to the system at an A/D delta of 6 dB. The graph then shows a degradation from 64.0 to 63.8 dB as the A/D delta is increased from 6 to 9 dB. This may be due to due instrument error or testing methods.

The distribution plot of Figure 7 shows that the XMod improves and degrades slightly when the modulated QAM is added to the system at any of the A/D deltas. The difference from the 78 CW only point to the 6 dB point is 0.4 dB. This slight deviation may be contributed to test variations.

The fiber + distribution plot of Figure 7 again shows that the XMod improves and degrades slightly when the modulated QAM is added to the system at any of the A/D deltas. The difference from the 78 CW only point to the 6 dB point is 0.7 dB, and from the 6 dB to the 9 dB point a deviation of only 0.9 dB.

For Figure 8, a frequency of 555 MHz was selected because of its close proximity in frequency to the analog tier and because it would exhibit the greatest degradation.

The initial starting point for Figure 8 at 1 CW only also includes modulated QAM channels.

Figure 8 shows the differences in the CNR of the digital tier (550 - 750 MHz) when the digital tier is 32 modulated QAM modulators and the A/D delta is varied from 6 to 9 dB.

The graph contains a plot for the fiber, the distribution, and the fiber + distribution, test data.

As can be seen by the fiber plot in Figure 8, the CNR at 555 MHz degrades approximately 1 dB for each 1 dB that the A/D delta is changed. When the 78 CW matrix loading is added to the analog tier, there is a slight degradation of noise in the digital tier, as would be expected.

As can be seen by the distribution plot in Figure 8, the CNR at 555 MHz remains constant from the 6 dB point to the 9 dB point.

In the distribution plot of Figure 8, when the 78 CW matrix loading is added to the analog tier there is a slight degradation of noise in the digital tier as would be expected.

As can be seen in the fiber + distribution plot of Figure 8, the CNR degrades as the A/D delta varies.

In the fiber + distribution plot of Figure 8, the plot depicts a one-for-one degradation in CNR as the A/D Delta is varied from 6 to 9 dB. When the 78 CW Matrix loading is added to the analog tier, there is a slight degradation of noise in the digital tier, as would be expected.

The CNR for the graph is un-corrected. The correction factor is -23.25 dB. The 23.25 dB corrects for the measurement bandwidth, resolution bandwidth filter shape, log amplification and IF detection. Please see the section on "Measurement Uncertainty."

Figure 9 depicts the Bit Error Rate (BER) of a digital channel located at 555 MHz. The analog tier remains at a constant level of 0 dBmV at a frequency of 547.25 MHz as the digital tier levels were changed.

In the fiber plot of Figure 9, the BER degrades from 1.7 x 10^{-9} to a BER of 3.5 x 10^{-8}. At this error rate, there still were no un-corrected blocks or errors.

In the distribution plot of Figure 9, the BER remained constant at the 6 and 9 dB A/D deltas–no errors (depicted on the graph as 1 x 10^{-10}).

In the fiber + distribution plot of Figure 9, the BER degraded from the 6 through the 9 dB A/D Delta point. The amount of degradation went from a BER of 3.3x10^{-9} to a BER of 1.2x10^{-8}. At this error rate, there still were no un-corrected blocks or errors.

Figure 10 depicts the carrier to composite intermodulation noise (C/CIN) of an analog channel located at 547.25 MHz This measurement was performed with the A/D delta at 6 dB.

The C/CIN in the fiber section of Figure 10 is the greatest because the effect of the QAM is not as great. The actual drop in the total noise floor was 1.75 dBc. One reason there is little effect of CIN is the low CNR of the optical link, 71.5 dB (un-corrected).

The C/CIN in the distribution plot of Figure 10 is beginning to show the effects of the QAM loading. One reason there is a larger effect of CIN is the high CNR of the distribution link. The actual drop in the total noise floor was 3.75 dBc.

The C/CIN in the fiber + distribution plot of Figure 10 is beginning to add up. The total system C/CIN is 71.3 dB (un-corrected). The actual drop in the total noise floor was 4.6 dBc. In theory, the CIN of the fiber + distribution should be the $20\log_{10}$ addition of the fiber and distribution CIN numbers.

Table 2: *Test parameters: output levels*

	55.25 MHz	547.25 MHz	749 MHz
Optical node	26 dB	35 dB	38 dB
Driver amp	24 dB	31 dB	34 dB
SAII UBT	26 dB	35.5 dB	38.5 dB
SAII HGD and LEII	35 dB	44.5 dB	47.5 dB

Figure 6: *50-550 MHz analog tier CSO @ +1.25 MHz data comparison*

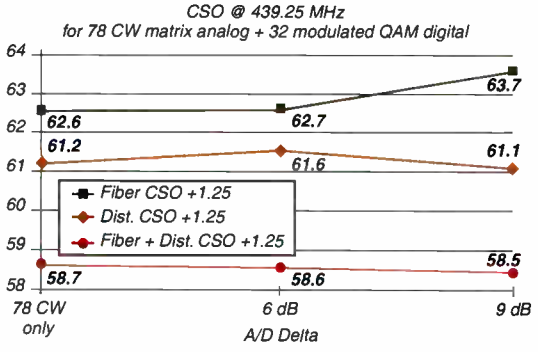
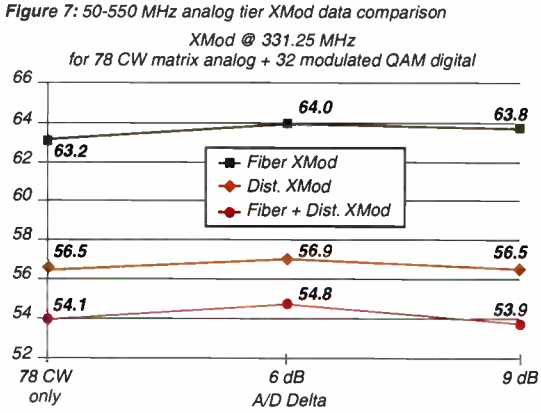


Figure 7: *50-550 MHz analog tier XMod data comparison*



Summation

The results for a "real world" (fiber + distribution) cascade appear to point to one A/D delta. By reviewing the data, an A/D delta of 6 dB seems to allow the best performance of both the analog and digital tiers. This A/D ratio enables an operable BER based upon digital tier CNR and distortions. This ratio also allows for good CNR and distortions of the analog tier.

The digital tier has a profound result on the CNR as well as the distortion levels of the analog tier. The less the A/D delta (6 dB), the greater the impact on the CNR. This is attributed to intermod distortions.

The analog tier does not appear to have as much of an impact on the digital tier. The only impact is in the form of analog CTB (CTBA), located -1.75 MHz in relation to the digital carrier center frequency. The effect of the CTBA is not apparent in the BER measurements. The one factor having the greatest impact on BER is the amplitude of the digital carrier.

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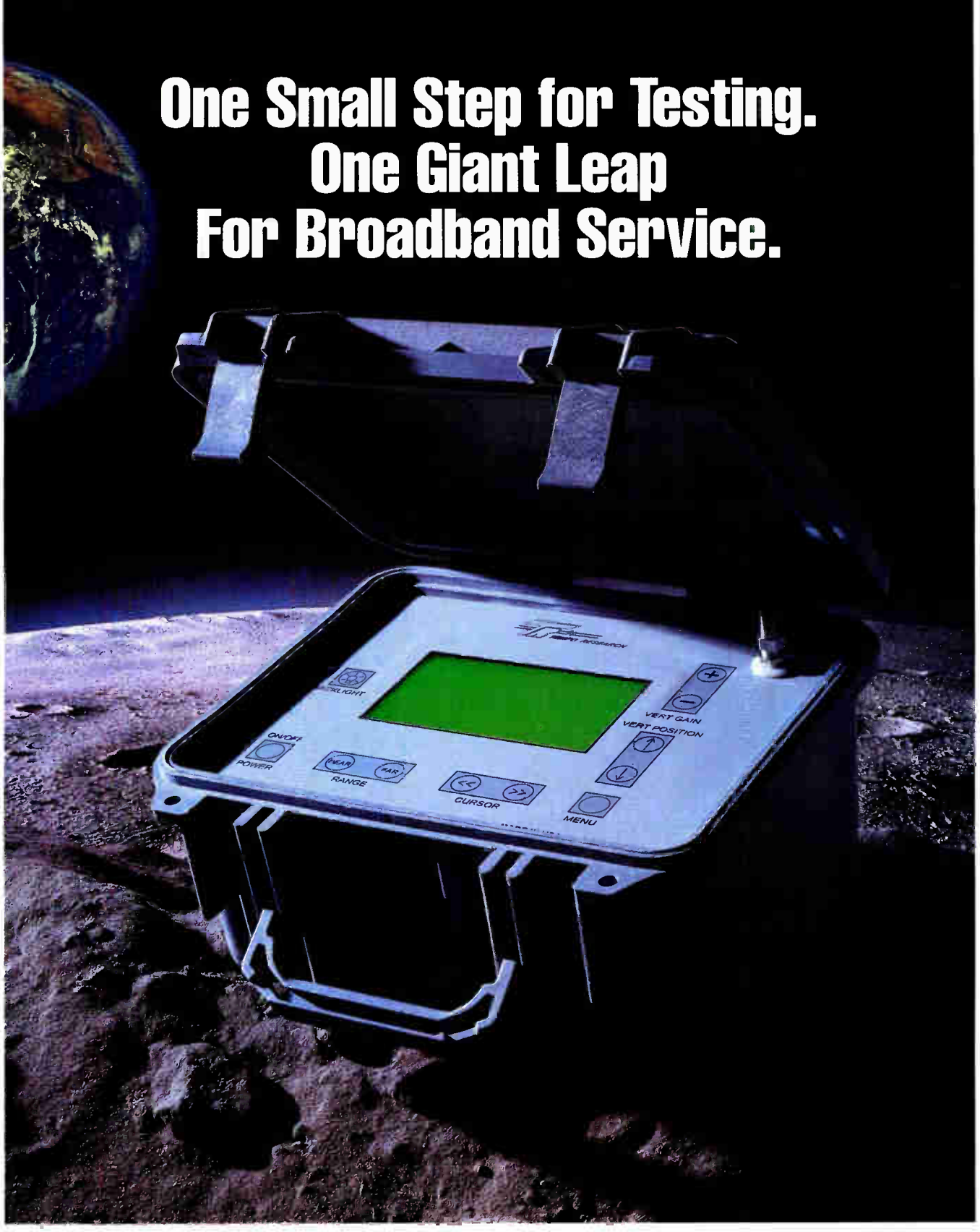

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Table 3: Cascade losses.

Description	Reel #	Coax/passive loss @ 50 MHz	Coax/passive loss @ 550 MHz	Coax/passive loss @ 750 MHz
Launch amp to amp 1	11	7.7/1.5	22.7/3.6	26.5/3.3
Amp 1 to amp 2	22	7.5/0.6	22.5/1.3	26.3/1.6
Amp 2 to amp 3	12	7.7/0.6	22.8/1.4	26.6/1.7
Amp 3 to amp 4	16	5.1/0.6	15.4/1.3	18.0/1.6
Amp 4 to amp 5	17	7.3/0.6	21.5/1.3	25.2/1.6
Amp 5 to amp 6	10	5.7/0.6	17.2/1.3	20.2/1.6

Note: All coax is 0.5-inch Comm-Scope PIII. All passives are Scientific-Atlanta DC-12s.

All of the BER measurements, even without Forward Error Correction (FEC), were not at a level that created un-corrected errors (split second still pictures).

As stated above, the greatest impact on BER was the amplitude of the digital carrier. This also translates to the amount of RF input into the Home Communication Terminal (HCT). If the plant is designed in accordance with FCC specifications, this number would theoretically be 0 dBmV for the analog tier at the highest analog frequency, typically 547.25 MHz. This would yield a digital tier input level to the HCT of -6 dBmV based on an A/D ratio of 6 dB.

Figure 8: 50-750 MHz digital tier CNR data comparison

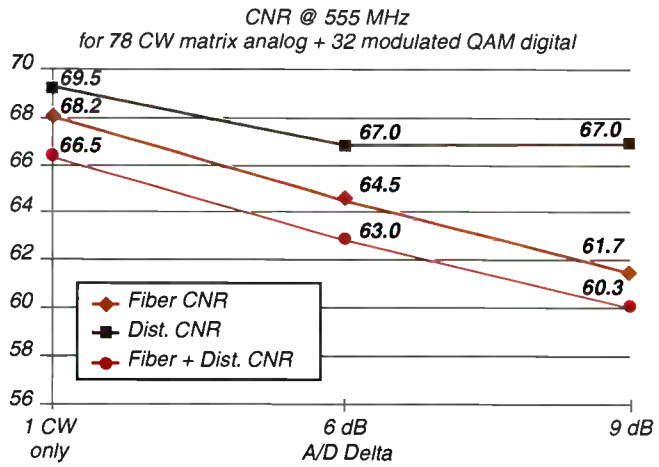
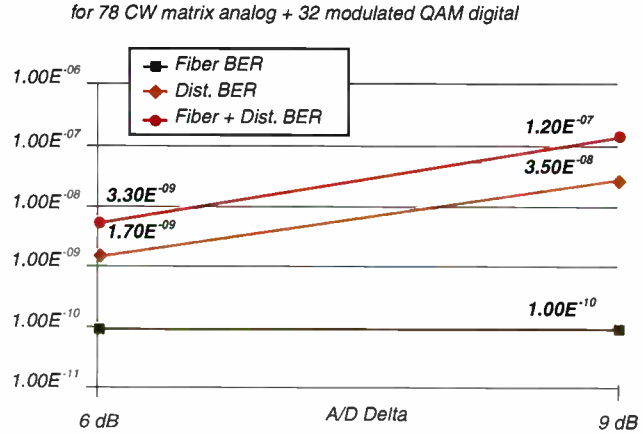


Figure 9: 50-750 MHz digital tier BER data comparison



Definitions and explanations

CIN: Random noise in a distribution system arises from the thermal motion of atoms in all components. Composite intermodulation noise (CIN) is created when pseudo-random digital signals are mixed with analog carriers due to device non-linearities. A quantitative value of CIN can be defined as the difference in level between noise caused by digital carriers and the thermal noise of the device under test. The carrier-to-noise ratio provides a description of the noise floor of a system, regardless of how the noise was generated. Specifically, the carrier-to-noise ratio is "the power in a sinusoidal signal, whose peak is equal to the peak of a visual carrier during the transmission of synchronizing pulses, divided by the associated system noise power in a four megahertz bandwidth. This ratio is expressed in dB."[1]

A/D delta: The difference in the analog carrier level and the digital carrier level (i.e., If the analog carrier level is +38 dBmV, and the digital carrier level is +32 dBmV, then the A/D delta is 6 dB).

Analog test frequencies: The video carrier frequencies as produced by a multiple signal frequency generator.

Digital test frequencies: The center frequencies of the 64 QAM carriers as produced by the Scientific-Atlanta Model D9470 64 QAM modulators.

SAII: Short for system amplifier II. An SAII is typically used as an express amplifier.

LEII: Short for line extender II. An LEII is typically used to extend express runs for the purpose of feeding drops.

UBT: Short for unbalanced triple. This is a type of SAII containing three RF outputs.

HGD: Short for high gain dual. This is a type of SAII containing two R.F. outputs.

AM: Amplitude modulated.

VSB: Vestigial side band.

Measurement uncertainty

The NCTA definition of carrier-to-noise ratio uses the noise power in a 4 MHz bandwidth. The resolution bandwidth specified in this procedure is 30 kHz. To convert the 30 kHz bandwidth of the noise power displayed on the spectrum analyzer to the 4 MHz needed for the NCTA specification, the following conversion is used:

$$10Log_{10}\left[\frac{4\ MHz}{30\ kHz}\right] = 21.25\ dB.$$

The noise level measured by the spectrum analyzer is also corrected for resolution bandwidth filter shape (-0.5 dB), IF envelope detection, or Rayleigh distribution (+1.05 dB), and logarithmic amplification (+1.45 dB) for a total correction of 23.25 dB.

The other correction factor used in the measurement of carrier-to-noise ratio is the noise-near-noise correction. This accounts for the addition of noise power by the spectrum analyzer and post amplifier.

The measurement of carrier-to-noise ratio consists of two relative measurements, from the peak carrier to the system noise floor and from the system noise floor to the spectrum analyzer noise floor. The accuracy of a measurement made with the spectrum analyzer's Δ marker mode is equal to "the sum of scale fidelity and frequency response uncertainty between the two markers."[2] The cumulative scale fidelity of the log scale is less than or equal to ±1.0 dB from 0 to 80 dB on the display. The noise floor measurement for carrier- to-noise is close enough in frequency to the carrier that uncertainty in the frequency response of the analyzer is negligible. The relative measurement from the system noise floor to the spectrum analyzer noise floor need

only be considered if the drop in noise level is less than about 10 dB. With the spectrum analyzer display scale set to 10 dB/division, this measurement covers one division or less; therefore, only the incremental display fidelity of ±0.1 dB/div is used. The bandwidth accuracy of the resolution filter contributes to the accuracy of this measurement by way of the noise power bandwidth conversion. The specified accuracy of the resolution bandwidth filter is ±10 percent. This will change the 21.25 dB bandwidth correction to 21.25 ± 0.45 dB. If digital (quasi-noise) channels are used in addition to CW carriers, the second and third order non-linearities of the amplifier under test will cause the digital channels to be mixed into the analog carrier frequencies. The modulated digital channels will degrade the overall carrier-to-noise ratio of the amplifier. Composite intermodulation noise (CIN), as this effect is known, is dependent on the power level of the digital signals at the input to the amplifier. Therefore, the accuracy of the output power level measurement contributes to the accuracy of the carrier to noise measurement. The uncertainty in the output power level when adjusted according to the method described here is ±0.75 dB. Third order CIN will change the noise power of the amplifier 2 dB for every 1 dB change in output power level. The total measurement uncertainty from log scale fidelity (due to the two relative measurements) and resolution bandwidth accuracy is ±1.0 ± 0.1 ± 0.45 = ±1.55 dB. When the effects of CIN due to mixed analog and digital channel loading are considered, the total measurement uncertainty becomes ±1.55 ± 1.5 = ±3.05 dB.

Figure 10: 50-550 MHz analog tier CIN data comparison

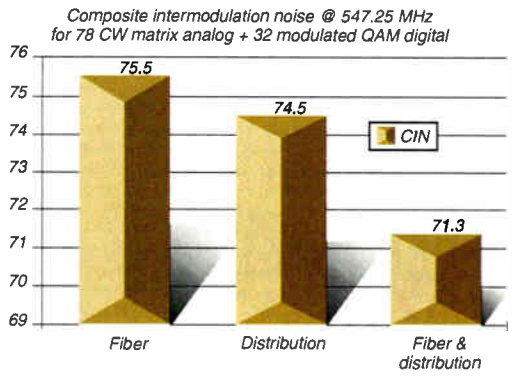
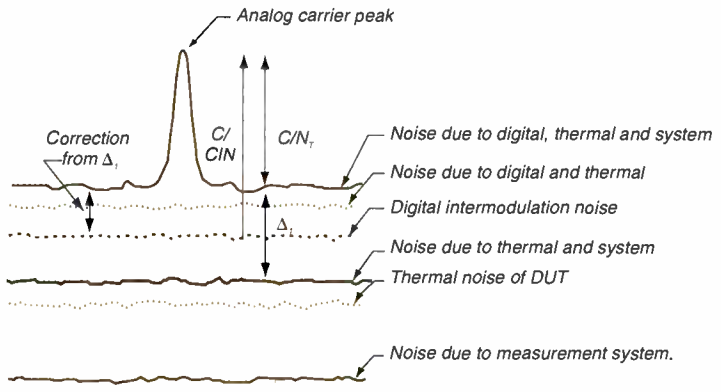


Figure 11: Sketch of noise levels



CIN measurement procedure

Tune the bandpass filter so that the carrier being tested is maximized and approximately in the center of the passband of the filter. Adjust the variable attenuator so that the peak level of the carrier under test is between -5 and 0 dBm (43 to 48 dBmV). Increase the attenuation setting of the variable attenuator by 10 dB and verify that the level of the carrier drops by 10 dB on the 8568B display. Return the variable attenuator to its original setting. Use the following settings on the spectrum analyzer: Center frequency–carrier frequency of channel; frequency span–3 MHz; reference level–peak carrier level; input attenuation–10 dB; resolution; BW–30 kHz; video BW–100 Hz; scale–10 dB/div.

Set the reference level of the analyzer to the peak carrier level with the marker functions NORMAL, PEAK SEARCH and MKR→REF LVL. Place a zero reference marker at the peak carrier level using the marker mode Δ key. Turn the carrier signal at the test frequency off at the matrix. Turn on video averaging by pressing SHIFT VIDEO BW and enter 10 (dBm) for the number of averages. Place the marker about 1 MHz above the carrier frequency for the channel under test. Using the adjustment knob, search for the average noise level. Record the drop from the carrier peak to the average noise level as C/N_T. With the marker still at the average noise level reading, place a reference marker using the marker mode Δ key. Disconnect the digital carrier input from the device under test. Record the drop in level as Δ_1. Calculate the noise-near-noise correction factor for Δ_1 from the formula below. Calculate CIN using the following formula:

$$CIN_{dB} = \left(C/N\right)_T + Correction(\Delta_1) - 23.35$$

The following formula should be used to calculate noise near noise correction factors:

$$10\text{Log}(1-(10^{(-\text{drop}/10)}))$$

CIN calculation

In the absence of well-defined standards for measuring the effects of digital channel loading on analog carriers, a measurement has been defined internally that estimates the noise level that can be expected when intermodulated digital noise is taken into account. The CIN measurement defined in this test procedure gives the level of the noise generated by digital intermodulation relative to the peak analog carrier level of the device under test. The correction factor is necessary due to the inability to measure digital intermodulation noise directly. See Figure 11 for a sketch of the various noise levels.

Note that only the solid lines represent noise levels that can be measured directly. The ratio Δ_1 is the difference between the measured noise level due to digital intermodulation, thermal noise of the DUT and thermal noise of the measurement system and the measured noise level due only to thermal noise of the DUT and the measurement system. The near-noise correction of Δ_1, found in the table, is the difference between the measured digital, thermal and system noise and the digital intermodulation noise alone. CIN, defined as the relative level of the digital intermodulation noise to the peak analog carrier level, can be calculated using the equation:

$$CIN_{dB} = \left(C/N\right)_T + Correction(\Delta_1) - 23.35$$

The 23.25 dB corrects for the measurement bandwidth, resolution bandwidth filter shape, log amplification and IF detection. Once the CIN is known, its impact on the overall carrier- to-noise ratio under different carrier to noise conditions can be calculated with the following formula:

$$C/N = 10Log\left[10^{\frac{+C/N\ thermal}{10}} + 10^{\frac{-CIN}{10}}\right]$$ CED

References

1. *NCTA Recommended Practices for Measurements on Cable Television Systems*, Second Edition, revised 1993.

2. *HP 8568B Spectrum Analyzer Operator's Handbook*, 1984.

Acknowledgments

Thanks to Kevin Murphy for his assistance in the CIN theory, and measurement techniques. Thanks also to Dan Cleere for his assistance in the many hours spent gathering the data.

Web giants hope to bridge multimedia gap

Video streaming standard sought

By Fred Dawson

A moment of truth has arrived in efforts to forestall balkanization of the customer base for Web-distributed video, audio and high-end graphics. Fortunately, there's reason to hope the differences can be overcome.

In a nutshell, the question boils down to whether a large group of companies led by Netscape Communications and Progressive Networks who are backing an approach to standardizing multimedia streaming over the Internet known as RTSP (real-time streaming protocol) can come to terms with demands by Microsoft Corp., Intel Corp. and their allies that the video conferencing capabilities of the H.323 standard be incorporated into the streaming protocol.

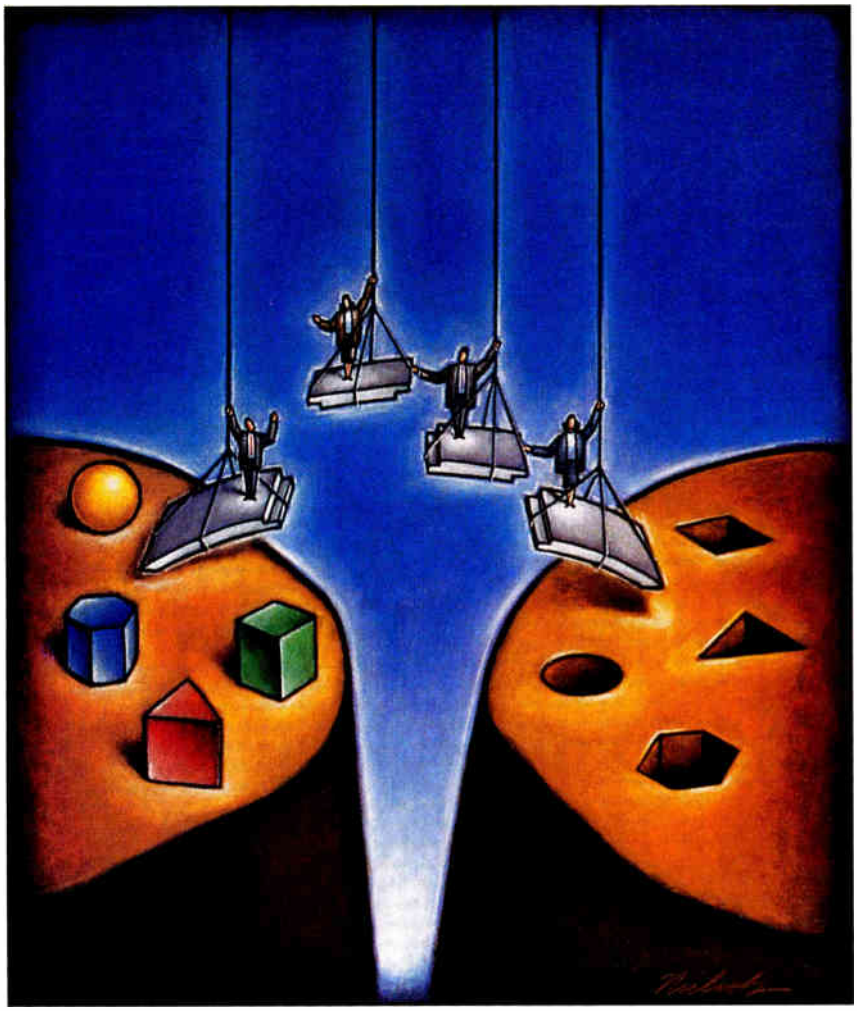


ILLUSTRATION BY GARRY NICHOLS, SIS

The Netscape/Progressive initiative, backed by 40 companies, seeks to persuade the Internet Engineering Task Force to endorse RTSP as a standard way for clients and servers from multiple vendors to deliver real-time media over the Internet. But Microsoft and Intel, as well as the leading supplier of video streaming software, VDOnet Corp., were missing from the agreement.

"RTSP will do for streaming multimedia what HTTP (hypertext transport protocol) did for text and graphics publishing," said Rob Glaser, founder and CEO of Progressive Networks, which co-developed the protocol with Netscape and is the supplier of RealAudio, the leading Internet audio streaming software. Supporting him in that claim are such giants of the hardware and software communities as Apple Computer, 3Com, Adobe Systems, Cisco Systems, Digital Equipment Corp., Hewlett Packard, IBM, Macromedia, Silicon Graphics and Sun Microsystems.

For Netscape, the initiative represents an opportunity to raise the comfort level for businesses that are building their data communications networks on IP-based protocols, said Atri Chatterjee, Netscape's director of server product marketing. "As the walls break down between what exists behind the corporate intranet firewall and on the Internet, people will look for solutions that span both boundaries and are compatible with a variety of different appliances," he said.

As described by Martin Dunsmuir, general manager of Progressive's server product group, the protocol performs two key functions–call set-up, which establishes a streaming connection between the host site and the user's PC; and data activation, which lets the client know what approach is taken to supplying the content, whether it be Xing Corp.'s Streamworks, RealAudio, VDOnet's Live Media or something else.

RTSP does not eliminate the requirement that each user be equipped with a specific plug-in software package to access a particular audio or video clip at a particular Web site, but it does have the ability to ensure that the approach taken to setting up streaming sessions is universal. Standardization would give content and site developers confidence that the entire market base will use the same means for on-demand access of stored audio/video files, live real-time feeds or stored non-real-time feeds, Dunsmuir said.

Where's Microsoft?

While this step represents the minimum action necessary to capping the ever broader schism in Web content development brought on by the intensifying battle between Netscape and Microsoft, it remains to be seen whether Microsoft will sign on to the initiative. The company said it was considering the proposal and had some modifications to suggest, but it was not happy with the handling of the proposal.

"One of our problems with the initiative is that the proposal was sent to us 24 hours before the deadline for endorsing it," said Blake Irving, group manager

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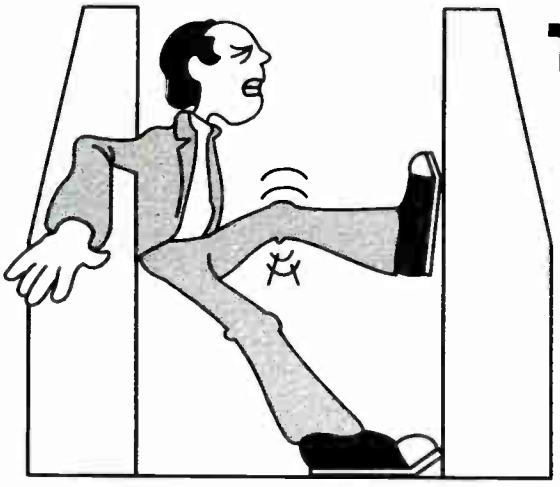

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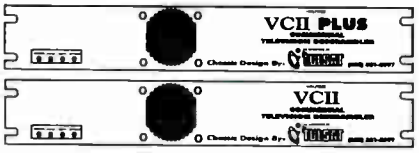

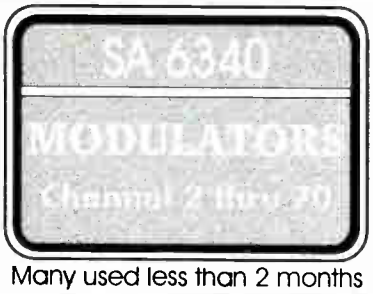

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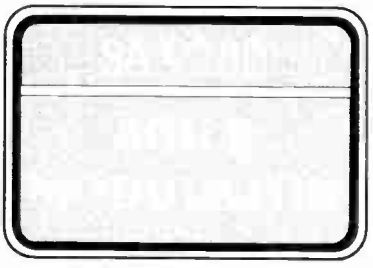

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for Internet platforms at Microsoft. "There's no disagreement on the principle of finding an open standard, but there needs to be more time spent on weighing the options."

Dunsmuir suggested this interpretation was misleading, because Microsoft has been privy to the discussion about standardizing on RTSP since Progressive and Netscape decided to push the idea about two months ago. "Microsoft and Intel waited until the very end to say whether they'd join in the announcement or not, and therefore we hoped they'd come in," Dunsmuir said. "We think it's possible they still may join."

Indeed, Irving said RTSP "is very interesting" as a candidate for the streaming part of the standard envisioned by Microsoft, although it is missing some essential items, such as fast forward and reverse. "We see value that can be added to RTSP through the capabilities VDOnet offers," Irving said.

But RTSP "will never be a robust telecommunications protocol," which means H.323 must be brought into the equation, Irving said. "There is no call control mechanism and no means of bridging an H.323 call into other conferencing domains over the switched telephone network," he noted.

Microsoft's position appeared to reflect more flexibility than some in the RTSP group anticipated. To them, the problem with Microsoft's stance was that it went too far in pushing H.323.

"We looked at H.323 very carefully and concluded that while it could be extended to support the broadcast environment, to achieve that through the standard-setting process of the ITU (International Telecommunications Union) would create major delays," Dunsmuir said. "Besides, we don't think you can just jury-rig H.323 and get an optimum approach to broadcast, although Microsoft and Intel might believe otherwise."

Backers of the initiative were slated to hold an ad hoc meeting in November

Room for agreement

Apparently, they don't, which means there's room for compromise. "This is a welcome initiative, but it requires a very thorough engineering evaluation before we can give it our full endorsement," said Yuval Cohen, vice president of marketing for VDOnet.

While RTSP is "not exactly what we have" at that level in the streaming transport hierarchy, VDOnet is willing to make adjustments in its system to accommodate a standard approach, Cohen said. What's important, he added, is that all parties take a hard look at all the options, including H.323, to ensure that the standard approach is the best one possible.

"The issue is market acceptance," Cohen said. "It's important that everyone be willing to comply with whatever approach is taken, and we're not there yet."

Netscape and Microsoft, along with 14 other Internet interests, a few weeks ago did come to terms on another part of the streaming equation by agreeing to support IP Multicast as the protocol for setting up multicast sessions on the Internet. RTSP is compatible with IP Multicast, officials said.

RTSP also works with the two main Web content development formats, Microsoft's ActiveX and the Netscape-backed Sun Java, Glaser noted. "RTSP makes it easy to integrate content with video streaming plug-ins," he said. "By agreeing on a single approach, we're creating an opportunity for all suppliers to drive growth, which means we create a bigger pie for all of us."

Backers of the initiative were slated to hold an ad hoc meeting in November to review suggestions on any modifications of RTSP and then to submit the protocol for consideration by the IETF at its meeting in December. "If all goes well, RTSP would become a draft (proposal) at that meeting and go out into circulation as part of the formal standardization process," Dunsmiur said.

The financial aspect

Clearly, now is the time for an agreement to be reached. What's at stake can be seen in the effort by US West's Media Group and Microsoft to drive content development for broadband access through their new affiliation with VDOnet. If all sides don't go down this road together, it will be hard to persuade content developers to exploit the full potential of a technology like VDOnet's.

US West and Microsoft said they have invested undisclosed amounts in VDOnet, giving each a seat on the board of a year-old firm that has already played a major role in bringing video to the Internet. As previously reported ("Does broadband data need eye candy?" *CED*, Oct. 1996, p.78), VDOnet is moving to new levels of performance in the narrowband realm while offering a means to ensure even better performance from a given Web site if a particular user has access to the site over a wide- or broadband link.

Last month, VDOnet president Asaf Mohr said his firm was about to demonstrate a new generation of its technology that enables delivery of a full-screen video image to PCs at about seven frames per second over conventional analog modems, with smaller screen sections operating at much faster frame rates. Assuming new 56 kilobit-per-second modems perform up to advanced billing, the improved VDOnet performance would move narrowband video to a level which surpasses what can be done with current versions of the technology at 128 kbps, which is the combined rate of two ISDN (integrated services digital network) B channels.

"We have some of our next-generation capabilities in place now and are already getting roughly 60 percent improvement in performance," Mohr said. "The technology is moving very fast."

The three companies said they expect the strategic relationships to accelerate development of a wide range of capabilities that are now taking shape around VDOnet's and Microsoft's technologies, including Internet live multicasting, video conferencing and group activities as well as more video-rich Web sites. They all pointed to the scalability of VDOnet's video

Latency will be cut to close to that of a live TV broadcast with audience response call-ins

stream, which adjusts automatically to fit the bandwidth limitations of the user's access link, as the most attractive component of the technology.

"As we provide cable bandwidth to our customers, the video quality and speed of delivery automatically improves," said John O'Farrell, president of US West Interactive Services, a unit of the Media Group, which is the division that oversees US West's cable holdings. "This sets VDOnet apart and is pivotal to our strategy."

One of the reasons interactive television proved to be a nonstarter was the fact that network operators could not deliver a large enough audience base quickly enough to justify content developers' investment in the medium, O' Farrell noted. "It's extremely important to have an environment where content offerings can span the range of delivery speeds so that the content is not solely dependent on the availability of customers for broadband access," he said.

To date, much of VDOnet's efforts have been focused on encouraging video-enchanced content development for users accessing the Web at 14.4 or 28.8 kbps, which has meant developers typically encode for a presumed top access speed of 128 kbps at best. But, "for a little extra money," developers could readily encode to take advantage of cable modem and DSL (digital subscriber line) access speeds of 1 megabit per second and higher, making a single site viable for users across the full spectrum of access speeds, O'Farrell said.

"Part of our agreement with VDOnet includes a significant commitment from them to customize their applications for delivery over cable modems," he added. "VDOnet can play a big role in encouraging content developers to encode to the higher rates."

Making it more friendly

The companies will also work on ways to make video streaming easier to use, officials said. For example, where today, a user must download software (the "client plug-in") to enable delivery of a VDOnet-enabled video stream, in the future, cable modems used in US West's systems might come with the software installed, O'Farrell said.

Other efforts aimed at making the video-enhanced content as consumer-friendly as possible include development of advanced navigation tools and inclusion of means to block access to sexually explicit or other content that is unacceptable to the user. "The availability of sexual content over the Internet is one of the big concerns when we do market research," O'Farrell noted.

Along with promoting development of multimedia-rich content, VDOnet's new backers expect the deals to accelerate progress in Internet-based video conferencing and other forms of telephony-like services. "Our vision is to tie together communications and streaming applications into one set of standardized protocols," Microsoft's Irving said.

As an example of how the system might work, Irving suggested a "Meet the Press" type of programming format might be set up to stream the live discussion as multicast audio/video from a server while permitting direct interaction between the on-line audience and the commentators. The protocol suite would include H.323, the Web conferencing standard of the International Telecommunications Union; a protocol for capturing the video at the server, and a protocol for delivering a multicast stream to end users.

VDOnet's strength in this scenario lies in the ability to capture the conference material at the server and prepare it for mass distribution, Irving noted. "Their architecture and scalable codec means you can author once and stream over multiple feeds to thousands of people over links that run the gamut from 28.8 kbps to ATM (asynchronous transfer mode)," he said.

Presently, the combination of low bandwidth access and the time it takes to store and set up the captured video feed for scalable streaming produces latency of a few seconds, making interaction with a live conference on the scale suggested by Irving very difficult. But the latency will be cut to close to that of a live TV broadcast with audience response call-ins once high bandwidth access is implemented, Irving said.

Some final pieces

Another piece of the equation that must come together to make standardized conferencing platforms with these capabilities a reality is the means of prioritizing the bits as they pass through routers on their way to end users, Irving noted. Version 6 of the Internet protocol, now under discussion at the Internet Engineering Task Force, is likely to include a "bandwidth reservation" protocol, RSVP, which would address this capability, but it will have to be implemented in routers, which will take time.

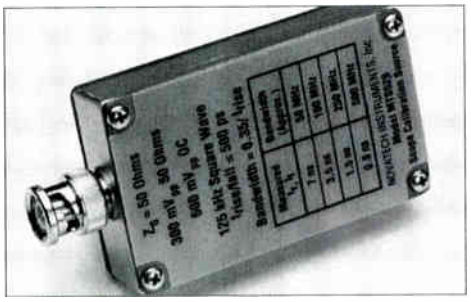
As part of the agreement with Microsoft, VDOnet has licensed the software company's NetMeeting conferencing software, which is based on H.323, and NetShow, which provides live multicasting of audio and video streaming in keeping with the IP Multicast protocol backed by Netscape and others as well as Microsoft. "The combination of streaming and conferencing technologies opens the opportunity for development of very powerful applications," O'Farrell said.

All parties stressed they are intent on pushing applications built around open standards. US West's Dive In, a set of Web-based services, and the content it's fostering for broadband access will be made widely available, O'Farrell said, although he acknowledged there may be "most-favored-nation" price breaks for US West cable systems that distribute the media-rich content.

But without concurrence on an overall streaming standard, it will be hard to persuade content developers to invest what it's going to take to make the media-rich broadband version of the Web a reality. Ironically, technology and the on-line market momentum behind it have reached a point where the old chicken-and-egg problem that stopped ITV in its tracks is no longer the issue. Instead, it's now a matter of whether a shootout between Microsoft and Netscape is going to claim chicken and egg alike. CED

New scope calibration source

SEATTLE, Wash.–Novatech Instruments Inc. has introduced the Model MTS529 Scope Calibration Source, which is battery-operated and small enough to fit in the palm of the hand. It has a BNC plug at one end and is



Novatech's Scope Calibration Source

designed to be directly connected to the BNC input of an oscilloscope.

The MTS529 generates a crystal-controlled, 125 kHz squarewave that has a fast rise time and calibrated amplitude. The period of the generated squarewave has a time accuracy of 0.05 percent and is used to test the horizontal timebase. The squarewave rise time is less than 500 picoseconds, and this enables the unit to test oscilloscope bandwidths beyond 500 MHz. The unit's amplitude accuracy is 5 percent and can be used to verify the vertical amplifier of the oscilloscope.

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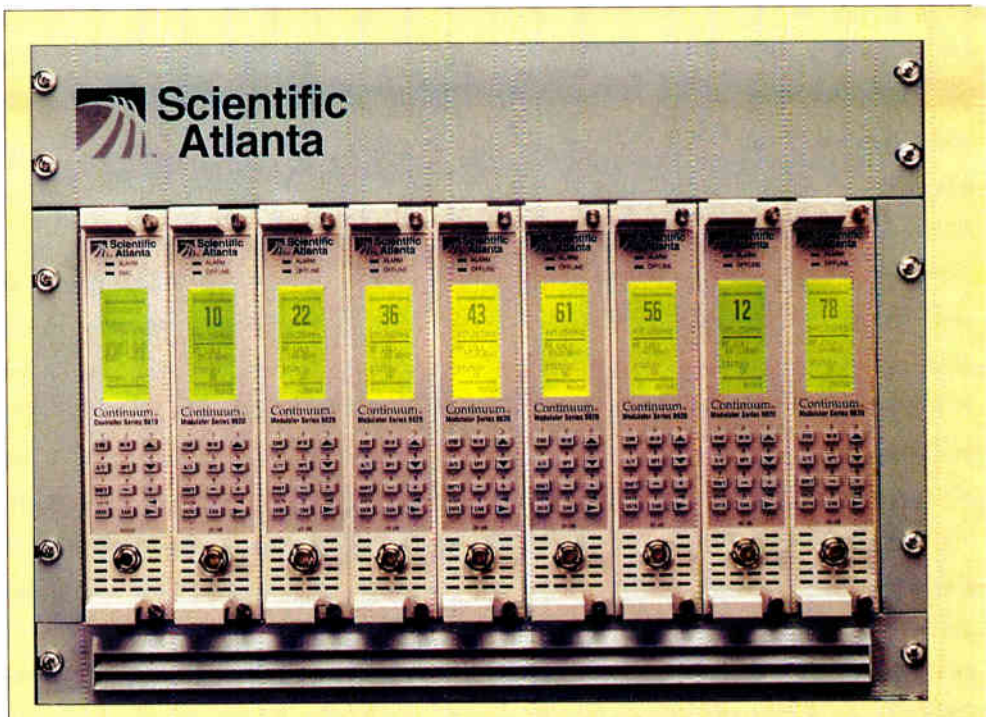


Headend system to debut at show

ATLANTA, Ga.–Scientific-Atlanta Inc. is introducing its new Continuum Headend System product family at the Western Cable Show. The system includes an advanced client/server element manager and new analog and digital hardware.

The Continuum products feature a new space efficient, modular, vertical packaging

Decoders feature TDSS

SCaT, Bombay–TV/Com International Inc., a subsidiary of Hyundai Electronics America, has expanded its SIGMA analog product line with the addition of a family of low-cost, video scrambling set-top decoders. The SIGMA "X" Series decoders offer Time Domain Sync Suppression (TDSS) and are the first products in the line with enhanced pirate protection.

The decoders are well-suited for use in countries which are building their cable infrastructure, according to TV/Com officials. The "X" Series decoders are part of the company's SIGMA analog product line of addressable encryption systems for cable, satellite and MMDS. The series includes three models: the CX add-on decoder module for use with set-top convertors; the DX set-top decoder for use in the homes of subscribers who do not have an existing convertor; and the LX set-top, which adds volume control. The decoders also feature program tiering and have special events and pay-per-view capabilities.

All decoders in the series operate from the SIGMA Control System, which allows operators to add various levels of features and capabilities, such as interactivity, and to migrate to the next series without the expense of changing headend components.

Circle Reader Service number 97

Security seals

MINNEAPOLIS, Minn.–Engineering Unlimited Inc. has introduced Sterling One-Shots, which provide security by combining elements of a padlock and of a seal. The durable, single use permanent seals are zinc-plated for corrosion resistance and are not affected by heat or cold. The user simply rotates the shackle until the opening is inside the body of the seal, where it is securely locked into place. The devices cannot be accidentally opened, according to information released by the company, and require a tool for removal.

Sterling One-Shots

The environmentally-safe seals contain no lead and can be serialized, color-coded, or date stamped and are available in two sizes. The Sterling Senior features a 5/16-inch diameter shackle, with a 2 3/8-inch outside diameter, while the Sterling Junior has a 1/4-inch diameter shackle and a 1 13/16-inch outside diameter.

Circle Reader Service number 98

Mini variable attenuator

BERKELEY, Calif.–DiCon Fiberoptics Inc. has announced its Miniature Variable Attenuator, a compact, 2-port fiber optic component used to set attenuation levels in the range of 0 to 60 dB. The attenuation level is screw set, offering continuous adjustment with better than 0.1 dB resolution.

The new attenuator features low back-reflection (-50 dB) and low PDL (0.05 dB max.). Measuring 46 x 12 x 10 mm (LxWxH), the durable aluminum package is designed for

Scientific-Atlanta is introducing its Continuum Headend system product family at the Western Cable Show.

design, which is expected to reduce typical rack space requirements by more than 50 percent, according to S-A executives. The rack-mount chassis will accommodate up to eight, independently functioning application modules and one controller module with integrated universal AC power supply and -48 volt DC power backup.

The first products in the Continuum Headend System will be the Series 9810 controllers, Series 9820 NTSC modulators, Series 9830 PAL modulators and Series 9890 stereo encoders. The 9810 controllers support chassis functions such as power conversion and distribution, status monitoring and control, backup controls and inter-module communications.

To reduce costs and increase flexibility in channel lineups, the modulators will be frequency agile up to 860 MHz.

Continuum's element management software will be a client/server application utilizing the latest LAN/WAN networking technologies, says S-A.

Circle Reader Service number 95

DiCon's Miniature Variable Attenuator

panel and circuit board mounting.

Also new from DiCon is its MxN Matrix Switch, a fully passive fiber optic switch that routes signals without optical to electrical conversions in dense WDM, FDDI, Sonet and fiber channel networks. Two models are available in up to 16x16 simplex or duplex configurations. Directional matrix switches connect each input to one output. Distributional matrix switches connect each input to one, several or all outputs simultaneously. Features include: insertion loss (1.5 dB type.), high isolation (80 dB min.), low back-reflection (-55 dB max.), manual, RS-232 and GPIB control.

DiCon's MXN Matrix Switch

Circle Reader Service number 99

Singlemode WDMS

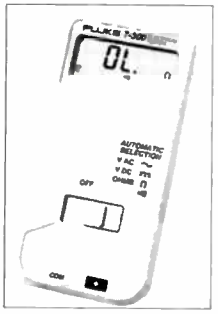
BUENA PARK, Calif.–Selco Products is now offering Sifam Ltd. WDMs (wave division multiplexers) in a variety of standard and custom wavelengths. Sifam's singlemode fused WDMs are available for any two wavelengths between 780 nm and 1700 nm with a minimum spread of 25 nm. Typical insertion loss is under 0.3 dB, and isolation ranges from 12 dB to 25 dB, depending upon wavelength range. Various package sizes are available, and WDMs can be concatenated for higher isolation.

Standard WDMs include 980/1550, 1480/1550, 1300/1550, 1550/1650, 1017/1300, and 1064/1550; examples of custom WDMs include 780/1550, 1245/1319, 1117/1240 and 800/1060. In addition, the standard versions have passed Bellcore 1209 and 1221. New applications include EDFAs and other types of fiber amplifiers.

Circle Reader Service number 100

Electrical tester

POWAY, Calif.–Time Motion Tools introduces Fluke's 7-300 Electrical Tester, a fast, compact troubleshooting tool. When the user turns the tester on, it automatically switches to the correct setting–volts AC or DC, continuity and ohms–and shows the results on a 4000 count digital display.



Fluke's 7-300 electrical tester

The Fluke 7-300 measures AC and DC voltage to 300 volts. In addition, it's user-friendly, rugged and reliable.

Circle Reader Service number 101

Power backup

READING, Pa.–Yuasa-Exide Inc. has announced its new HT High Temperature series of VRLA batteries and its NP series batteries for back-up power applications.

The HT series batteries are specifically designed for back-up power in applications where harsh temperatures will affect the life of the battery, such as cable and telephone locations in remote sites. The HT series offers 28 and 40 Ah of capacity and will operate in temperatures ranging between -40 degrees F and 176 degrees F.

Yuasa-Exide Inc.'s HT Series batteries are designed for harsh-temperature applications.

Yuasa-Exide also manufactures the NP26-12 battery, which provides a 26 Ah (20 hr.- rate), making it the highest capacity battery within the industry-standard case size, according to Yuasa-Exide. Its high density makes it suited for back-up use in UPS and other applications where reliable backup power is required. Also, the company manufactures its NP18-12B battery, a high-capacity, lead-acid unit. The battery's capacity is rated at 17.2 Ah (20-hour rate). It provides reliable performance and its ergonomically-designed handles ease installation.

Finally, the company manufactures the "Phoenix" Series of sealed, valve-regulated batteries, which range in capacity from 90-150 Ah. They also provide interim sizes between small VRLA batteries and large, flooded cells. They are suited for use in remote sites and outside plant applications.

Circle Reader Service number 102

Single flex clips

LAKEWOOD, Colo.–Telecrafter Products is introducing Single Flex Clips at this year's Western Cable Show. Designed to attach single cable from RG-59 Standard through RG-6 Quad, the new Single Flex Clips provide long-lasting, damage-free holding power.

Manufactured of a durable, UV-stabilized polyethylene, the flexible clip wraps around the cable, adjusts to size and holds securely, with no compression or crimping of the cable. Because the pliable clip will not damage the cable, signal integrity is not compromised. This is increasingly important as more and more operators migrate to digital signal technology and upgrade for increased bandwidth.

The company has had system operators and cable installers testing the clips for months, according to Warren West, sales manager for Telecrafter.

Another feature of the product is a screw that accommodates Phillips-head, slotted-head or hex-head drivers, and which comes pre-inserted into each clip.

Circle Reader Service number 103

Frequency convertor

INDIANA, Pa.–Quintech Electronics and Communications Inc. has introduced the newest members of its family of PLL frequency conversion products. Model PUL 070D (70 MHz to L-band) and PDL 070D (L-band to 70 MHz) are data grade derivatives that feature improved phase noise and stability performance that exceeds the IESS 308/309 standard. The units are suitable for all currently-used high-speed data transmission rates and advanced digital modulation schemes.

Quintech's single channel up/down convertor

The operating L-band frequency is factory preset to any customer specified L-band channel, within the 950-1450 MHz frequency range. The units also make it easy to build Application Specific Satellite Communications Links by simply selecting one single RF carrier frequency for the up or down link. This is then converted to a uniform IF frequency of 70 or 140 MHz.

Circle Reader Service number 104

Marking stake decals

HOUSTON, Texas–VIP Products has introduced its Marking Stake Decals which feature black lettering on a telecommunications orange background and are screen-printed with UV resistant inks to enhance their durability.

Printed on durable .004-inch vinyl, the labels have a tough permanent adhesive that will withstand temperature extremes from -25°

Visual Identification Products' Marking Stake Decals

to 165° F. The 3x13-inch labels are available in three stock legends, in custom or reflective formats. The decals are available individually or with VIP's 66-inch fiberglass marking stake.

Circle Reader Service number 105

Amplifier and multitaps

HORSHAM, Pa.–Toner Cable Equipment Co. announced the availability of its new TDA-R-115 1-GHz Broadband Drop Amplifier and its SMT-10 Series 1-GHz Multitaps.

The TDA-R-115 drop amp is designed for long cable drops or multiple subscriber outlets and amplifies signals with minimal increase in noise. The unit's low noise figure on the forward bandwidth is 3.0 dB, typical, and 4.0 dB, maximum.

The drop amp's forward bandwidth of 54 MHz to 1 GHz provides forward gain of 15

Toner's TDA-R-115 1-GHz Broadband Drop Amplifier

dB ±1 dB and has a passive reverse bandwidth of 5-40 MHz. On both the forward and reverse bandwidths, flatness is 1 dB and frequency response is ±.75 dB.

The unit features integral reverse diplex filters and the ability to use coaxial cable between the amp and its 12 VDC/110V AC plug-in transformer. (A 220V transformer is optional) This last feature allows the drop amp to be relocated at a remote site up to 120 feet away from the installation. A six-foot RG-59 jumper is also provided with each unit.

Toner's SMT-10 Series 1-GHz Multitaps utilize surface-mount technology for true 5

Toner's SMT-10 Series 1-GHz Multitaps

MHz-1 GHz bandwidth and minimal insertion loss. The taps are available in 2-, 4- and 8-port configurations with factory-installed terminators. They are designed for aerial strand mounting and underground cable applications in pedestals and vaults. Other features include removable tap plates and solid brass "F" ports with drip wells.

Circle Reader Service number 106

Handheld OTDR

PARSIPPANY, N.J.–Boonton Electronics Corp. has introduced the Lynx, a light, handheld Optical Time-Domain Reflectometer (OTDR). It measures loss and locates faults in singlemode optical fiber communications

Boonton's Lynx OTDR

networks operating at either 1310 nm or 1550 nm at a distance of up to 80 km with accuracy of +/-1 m (+/-10^{-4}) of instrument range. Dynamic range is 22 dB at 1310 nm and 20 dB at 1550 nm, and loss resolution is 0.1 dB.

The Lynx can measure the location, loss and reflectance of every splice in the network and display them on its backlit 320 x 240 pixel LCD display. The instrument automatically numbers faults, their position from the instrument in meters, attenuation and reflection in dB, and link budget.

Measurement times range from 30 seconds to 10 minutes, depending on the complexity of the test. Up to 25 sets of measurements can be stored internally in nonvolatile memory. Measurement data can be downloaded to a PC via the instrument's RS-232C serial communications interface. The serial interface can also be used for producing hard copy on a printer.

Circle Reader Service number 107

Underbed boxes

CRYSTAL LAKE, Ill.–Knaack Manufacturing Co. is featuring its new Weather Guard underbed boxes made of heavy .100 thick diamond plate aluminum.

Weather Guard underbed box

All seams on the boxes have been fully arc welded for extra strength.

Other features include a rotary-style, two-position "safety" catch latch system to prevent accidental opening. The door also features a welded-on reinforcing channel for increased rigidity and a weather-tight seal. Aircraft type cable with swedged fittings support the door when open, or they can be disconnected to allow a full drop down position.

Circle Reader Service number 108

F-connector

WESTLAKE VILLAGE, Calif.–Trompeter Electronics Inc. has debuted its one-piece, field terminable F-connector (PL130C) for broadband applications.

The new one-piece body and integrated center pin have been designed to provide high performance, two-way transmission for all indoor headend applications. The return loss of the PL130C is <-36 dB at 1 GHz and <-23 dB at 2 GHz, compared to the typical <-18 dB at 1 GHz.

Trompeter's broadband F connector

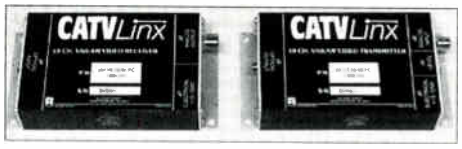
Built in compliance with both Bellcore GR1503 and SCTE indoor specifications, the connector accommodates standard strip dimensions and existing industry crimping tools.

Circle Reader Service number 109

Video link

CHRISTIANSBURG, Va.–Force Inc. has announced the availability of the CATVLinx Model 2811 VSB/AM Broadband fiber optic video link. Applications for the link include cable TV narrowcasting, campus video distribution, satellite back-haul at 70 MHz IF, multimedia retrieval and videoconferencing.

The CATVLinx provides a laser-based transmission system for 10+ video channels over singlemode optical fiber with complete EMI immunity. The link offers analog bandwidth from 5 MHz to over 330 MHz.



CATVLinx Model 2811

In conjunction with VCRs and camcorders with standard cable TV modulators, or a cable television feed, the Model 2811 can transport 10 or more TV channels (within 1 octave) over a distance of 15 km at 1300 nm. CNR typically exceeds 55 dB, but varies with distance and channel loading.

Circle Reader Service number 110

Fiber management system

AUSTIN, Texas–3M Telecom System Division has introduced the 3M FibrMax 2700 System. It has been designed for use with 96 or more fibers and holds up to five times the number of connections found in other fiber optic housings.

Accommodating both multimode and singlemode fibers in the same splice, additional hardware such as splice trays or factory-loaded modules are not necessary in changing between modes. The system also accommodates the addition of optical splitters, couplers, attenuators or WDMs all on one connector card.

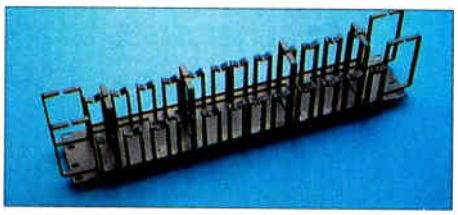
3M's FibrMax 2700 System

The remateable connector technology used in the fiber management system has been designed to decrease technician time while requiring only splicing skills to terminate.

Circle Reader Service number 111

Wire management panel

PAWCATUCK, Conn.–Ortronics has introduced its new Wire Management Panel which has been designed to provide organized movement for horizontal and vertical distribution of patch cables. This allows defined routing of individual cables on all standard 19-inch EIA relay racks or hinged stand-off brackets.



Ortronics' Wire Management Panel

The panel is constructed from 16 gauge steel, with each panel featuring four vertical and four horizontal distribution rings. Each panel also has 24 individual routing clips to provide greater cable management for adds, moves and changes.

Circle Reader Service number 112

Fiber optic tool kit

PHOENIX, Az.–Jensen Tools Inc. is now offering its JTK-4000 Fiber Optic Termination Kit with an enhancement package that gives the kit all the versatility of a complete fiber optic workbench in the field. The kit has been designed for engineers who work with a variety of fiber applications.

Jensen Tools' Termination Kit

The kit contains a standard selection of 38 basic tools. This includes a cable tie tool, ties and labels, coax cutter, tape dispenser, fiber scribe, hook blade knife, micro fork & reamer, penlight, pliers, polishing film and plate, fiber optic scissors, spudgers, adjustable wrench, wire strippers, tweezer and more. Buyers can supplement the selection with the fiber termination tools and accessories of their choice.

The JTK-4000 adapts easily to any combination of SMA, AT&T, ST, FC/PC connectors, and to other fiber technologies. The optional enhancement package also provides a complete FiberVue microscope kit, a curing oven and an AMP crimping tool, plus two fiber cable test instruments (all-in-one model 410 and ST source-only model 420) from Darkstar Technologies.

Circle Reader Service number 113

Relay interface unit

CONOVER, N.C.–Norscan Inc.'s 2000 Relay Interface Unit (RIU) has been designed to create maximum efficiency for rack-mounted office tone location transmitters and cable monitoring systems.

Norscan's 2000 Relay Interface Unit

In normal operating mode, the 2000 RIU grounds the cable armor as per NESC code, while allowing cable monitoring signals to pass. When remotely activated, the switch allows tones generated from rack-mounted equipment to be placed on the armor which allows for remotely activated tone and fault location.

Circle Reader Service number 114

New software version

SALT LAKE CITY, Utah–FrameRate Corp. has released Version 2.0 software for its Millennium and Chameleon products.

Through Microsoft ActiveX Internet technology, the software now imports and broadcasts Internet Web pages. It also supports Web pages containing Java scripts and Java applets. With this new version, operators can broadcast and advertise their own Web pages over television and use Java scripts to enhance the action.

Circle Reader Service number 115

A Marriage made in Cyberspace

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CED

COMMUNICATIONS ENGINEERING & DESIGN
THE PREMIER MAGAZINE OF BROADBAND COMMUNICATIONS

The issue: Status monitoring

Monitoring network performance and achieving unprecedented levels of reliability are the kingpins of telecommunications networks in a competitive environment. Yet cable TV operators have traditionally avoided use of such monitoring systems. This survey is designed to determine if that's changing.

The questions:

1. Does your system presently utilize any network status monitoring devices?

❑ Yes ❑ No ❑ Don't know

2. If so, what type of status monitoring system is used?

❑ Power supply ❑ End-of-line

❑ Entire system ❑ Don't know

3. If not, why are such devices not used in your system?

❑ Too costly ❑ Don't work ❑ Other

4. How important will status monitoring systems become to you in the future?

❑ Very ❑ Somewhat ❑ Not at all

5. Is your system's management more interested in status monitoring as a concept now than it was a few years ago?

❑ Yes ❑ No ❑ Don't know

6. Have the FCC technical standards sparked an interest in using status monitoring equipment in your system?

❑ Yes ❑ No ❑ Don't know

7. Would your system prefer to purchase a more expensive and complex monitoring system, or a less expensive system that offers simple alarms?

❑ Complex system ❑ Simple system ❑ Don't know

8. Which features of status monitoring systems are more important: Internal hardware info (temperature, bias, etc.) or external info (carrier-to-noise, etc.)?

❑ Internal info ❑ External info ❑ Don't know

9. Do you think a standard communications protocol should be developed for all status monitoring systems?

❑ Yes ❑ No ❑ Don't know

10. Should a monitoring system just provide data, or actually be able to control and manage a system through modules for fleet management, spare parts inventory, etc.?

❑ Provide data only ❑ Help manage ❑ Don't know

Your comments:

Fax us at 303-393-6654

Make a copy of this page and fax it back to us at the number above, or mail it to *CED*, 600 South Cherry Street, Suite 400, Denver, Colo. 80222.

*Every month, we'll pick one response from those we receive and award $50. See official rules below.

Names won't be published if you request your name to be withheld, but fill out the name and job information to ensure that only one response per person is tabulated.

Your name and title

System name:

Location:

Your MSO:

Your job function:

Daytime phone #:

Official rules: No survey response necessary. Enter by returning the completed survey via fax or mail to the locations indicated above, or print the words "CED Return Path" on a 3"x5" card and mail it along with your name, address, daytime phone number and signature. To be eligible for the drawing, entry forms must be received by 5 p.m. on January 31,1997. CED is not responsible for lost or misdirected mail. One entry per person. Forms mutilated, illegible or not in compliance with these rules shall be considered ineligible in the sole discretion of the judges. Odds of winning depend on the number of entries received. A random drawing from eligible entries will be held on or about February 1, 1997. Winner will be required to provide his/her social security number and proof of identification and is solely responsible for all federal, state and local taxes incurred. Prize is not transferable to any other person. Sweepstakes participants agree to waive any and all claims of liability against CED magazine, Capital Cities Media Inc., Capital Cities/ABC Inc. and its affiliated and independent contractors for any injury or loss which may occur from participation in this sweepstakes or receipt of the prize. Winner consents to publication of his/her name for publicity purposes without further compensation. Participants must be 18 years of age or older. Employees of CED magazine, Capital Cities Media Inc., Capital Cities/ABC Inc. and its affiliated and subsidiary companies, and their respective employees, agents and independent contractors, and their immediate families are not eligible to participate. Void wherever prohibited, license required, restricted or taxed by law. Sweepstakes sponsors reserve the right to change or modify the sweepstakes rules while the sweepstakes is in progress. Participation in the sweepstakes constitutes acceptance of all sweepstakes rules.

RESULTS

The issue: Emergency alerting

A recent FCC rulemaking that overhauled the Emergency Broadcasting System has a direct impact on cable operators, most of whom now have to be prepared to add headend equipment and be an active participant in the new, modern Emergency Alert System. MSOs have until July 1 of next year to comply. Are you ready?

The results:

Every one of the respondents to this survey was aware that the cable industry is expected to be an integral part of the new emergency alerting system, and roughly half plan to add emergency alerting hardware in the next year, but they remain concerned about the potential costs.

For example, a large majority expect to spend more than $1,000 to comply with the new rules, but a substantial number aren't even sure how much it's going to cost.

As expected, only about four out of 10 respondents say their systems are currently active in the EBS program, although a much greater number say their franchise agreements with local authorities require that they have emergency alerting gear in their systems.

Those who already have installed program override equipment have chosen to purchase hardware that overrides all channels, while a huge majority test it regularly, either weekly or monthly.

Congratulations to Steve Pacheco of TCI Cable in Merced, Calif., who won $50 for responding. To become eligible for a future drawing, fill out the survey on the previous page and send it in!

1. Is your system active in the current EBS locally?

Yes	No	Don't know
38%	**62%**	**0%**

2. Is your local geographic area prone to numerous emergencies on an annual basis?

Yes	No	Don't know
25%	**62%**	**13%**

3. Are you aware of the FCC proceeding that made the cable industry part of the new national alerting system?

Yes	No	Don't know
100%	**0%**	**0%**

4. Does your franchise agreement require emergency alerting capability?

Yes	No	Don't know
62%	**38%**	**0%**

5. Do you have plans to add emergency alerting equipment to your headend in the next year–or have you already done it?

Planning to	Already did	No
50%	**38%**	**12%**

6. How much will your system have to spend to comply with the EAS rules?

More than $1,000	$500 to $1,000	Don't know
62%	**0%**	**38%**

7. Does your system presently have programming override equipment in place in the headend?

Yes	No	Don't know
62%	**38%**	**0%**

8. If so, does it override audio only, or audio *and* video signals?

Audio only	Audio and video	Don't know
60%	**40%**	**0%**

9. If your system has such equipment, does it override all channels, including broadcast?

Yes	No	Don't know
80%	**20%**	**0%**

10. If you have emergency alerting equipment, how often has it been activated and/or tested?

Monthly	Few times a year	Don't know
40%	**40%**	**10%**

Your comments on EBS:

"Most systems have no idea what is needed to comply, or how much it is going to cost. The smaller systems are going to have problems with the cost."
– Larry Langevin, Greater Media Cable, Ludlow, Mass.

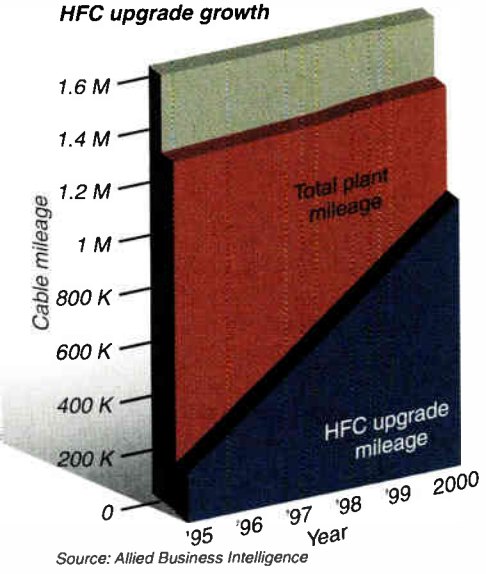
"Who plans to pay for it? We have no intention, with headends serving as few as 60 subs and phone line access charges over $60 per month."
– Name and location withheld by request

"We have one main headend that fibers out to five cities. Each transmitter has its own EBS that is tested weekly. City officials find these helpful."
– David Walker, Continental Cable, Elyria, Ohio

In 2000, 69 percent of plant will be HFC

OYSTER BAY, N.Y.–By the year 2000, about 69 percent, or one million miles of the cable industry's total plant mileage, will be configured as part of hybrid fiber/coax networks, according to a report that has been released by Allied Business Intelligence.

"CATV Systems Design Changes: Advances and Implications for CATV Equipment Markets," takes a look at the historical development of the cable industry and defines its relative financial, technological and market positions in relation to the communications world in general; then, it uses that data to make forecasts.



Source: Allied Business Intelligence

ABI's report looks at trends in the full range of headend equipment, optical electronics, RF electronics and the coaxial and fiber cable markets.

AM, ADC collaborate on sourcing

QUAKERTOWN, Pa.–AM Communications has announced a joint marketing and product sourcing agreement with the Broadband Division of ADC Telecommunications Inc. Under the terms of the agreement, AM will develop status monitoring based on its OmniStat System for ADC's Homeworx, HWX and ISX video distribution equipment. In addition, AM will be providing ADC Broadband Communications with transponder units for Homeworx, HWX and ISX that are compatible with other third-party video distribution equipment.

AM is currently shipping element management transponder products to the Broadband Division of ADC Telecommunications Inc. for the Southern New England Telecommunications network management and integration effort.

In other news, AM Communications announced that it has been awarded a project to deliver its OmniStat system to the Time Warner, Memphis organization. The project will consist of the delivery and integration of OmniVU element management and control software, supporting Alpha 9061 power supply transponders, 1 GHz 9016 end-of-line transponders, 9013 Echo end-of-line transponders, the Scanning Ingress Management System (SIMS) and the integration of ADC's Homeworx, HWX and ISX products.

Ortel acquires piece of China venture

ALHAMBRA, Calif.–Ortel Corp. has acquired an interest in Photon Technology, based in Shenzhen, China, for $2.4 million. Photon was established in 1993 to manufacture fiber optic components and systems and has been a distributor of Ortel's linear fiber optic products. In conjunction with the investment, Photon will begin an expansion of its manufacturing operation.

"Photon is one of very few companies in China that has a low-cost manufacturing structure," said Wim Selders, Ortel's president and CEO, "and the technical capability to manufacture fiber optic components. Photon sells a variety of devices and modules for digital communications systems, as well as optical transmitters and receivers for cable TV applications.

Siecor moves TE operations

HICKORY, N.C.–Siecor Corp. has relocated its Fiber Optic Test Equipment Operations from its corporate headquarters building to: 1978 8th Ave. Northwest.

The new location, which was specifically designed for the fiber optic test equipment manufacturing facility, doubled in size to increase efficiency of operation. The division's research and development department also increased by nearly 50 percent.

The test equipment operation, owned and operated by one of Siecor's parents–Siemens Corporation–manufactures fiber optic test equipment under both the Siecor and Siemens brand name.

C-COR to supply Paragon with 750 MHz

STATE COLLEGE–C-COR Electronics Inc. is providing FlexNet 750 MHz equipment to Paragon Cable in San Antonio, Texas. FlexNet trunks, bridgers and line extenders will be installed in a 3,400-mile upgrade that will occur over the course of three years. The equipment is being installed with active return capabilities in order to provide interactive services to Paragon customers. The project, which began in 1996 and is expected by be completed by the end of 1998, will result in a hybrid fiber/coax network that will pass approximately 510,000 homes.

Axicom announces ADvantage beta site

OVERLAND PARK, Kan.–Axicom says that its ADvantage digital ad insertion system is running at a second location in beta mode. The company was scheduled to begin shipping the system by the end of last month.

ADvantage is an integrated solution which consists of hardware, software, installation, maintenance and training.

Motorola modems go to Korea

ARLINGTON HEIGHTS, Ill.–Motorola Inc.–Multimedia Group has been selected to provide cable modems to Korea Electric Power Data Network Company (KDN), a wholly-owned subsidiary of Korea Electric Power Corp.

KDN will deploy Motorola's CyberSurfr modems to establish broadband services over its two-way HFC network, which currently covers 70 percent of the Republic of South Korea. Scheduled for introduction in mid-1997, it's the first deployment of high-speed data services, which KDN plans to offer nationwide.

The Multimedia Group will also provide cable modems to Marubeni Corp., a Tokyo-based general trading company which is backing a large broadband network in Japan. Motorola will provide Marubeni with 1,000 of its CyberSurfr modems by the first quarter of '97. Those modems will be deployed sometime in mid-year, as the first installation of a phased rollout of cable modem service in Japan.

HP, Turner team on server solution

PALO ALTO, Calif.–Hewlett-Packard Company and Turner Entertainment Networks (T.E.N.) announced that an HP Broadcast Video Server will launch Turner Broadcasting System Inc.'s new Cartoon Network Brazil. The server will assist TBS in expanding and customizing its spot insertion for the new network and is part of the company's strategic move toward digital technology.

The server will be controlled by Pro-Bel's MAPP automation software, a media management system.

In early 1997, T.E.N. Network Operations plans to integrate HP's next-generation broadcast servers, the HP MediaStream Server–Broadcast Series into the broadcast facility. CED

The 1996 Western Show

3Com Corporation 4747
408-764-5533
3Com will be demonstrating complete end-to-end system solutions for cable data networking services such as Home Internet Access, Small Business Networking, Telecommuting, and Metropolitan Area Networking at the Western Cable Show. 3Com offers complete solutions from the switches and routers in the cable infrastructure through the cable modem, Ethernet network interface cards and LAN solutions at the subscriber side. Come and see our solutions at booth 4747. Call (408) 764-5533 for more information.

ABC Cable Products, Inc. 1127

ADC Broadband Communications 1444
800-504-4443
ADC has created a live end-to-end video, telephony and data transport and distribution network at booth 1444. This real-world display demonstrates how a live signal feed is transported through a working headend, over a distribution network and into an actual home. Equipment includes digital video supertrunks and a complete headend area with a live demonstration in conjunction with CableNet, a Cable Labs sponsored group, that integrates video, voice and data onto an HFC distribution network. There's also an outside plant area displaying optical nodes and wireless PCS equipment, and a residential services area that includes video, voice and cable data modem demonstrations.

ADC Telecommunications, Inc. . . .1444
800-366-3891 x 3475
ADC's Homeworx™ access platform will be featured at Western Cable's CableNET '96. The Homeworx platform's ability to deliver integrated high-speed data and telephony over a single platform using advanced OFDM modulation technology will be demonstrated. In addition, ADC will introduce its new RF Worx™ system, a line of modular, high-performance RF distribution and management products designed to meet changing headend

requirements. For more information, call 1-800-366-3891 ext. 3475.

Adtec Incorporated 1114
615-256-6619
Adtec, Inc. is a manufacturer of automated video controllers and commercial insertion equipment. Our new Ad-Maestro and Soloist Digital Video Player provides an economical and easy mechanism for providing commercial insertion on multiple networks. A complete digital commercial insertion system designed to insert commercials on as many as 512 cable networks can be purchased for less than $3,000 per network.

Alcatel Telecommunications Cable . .4482

Alcoa Fujikura Ltd.
Telecommunications Division

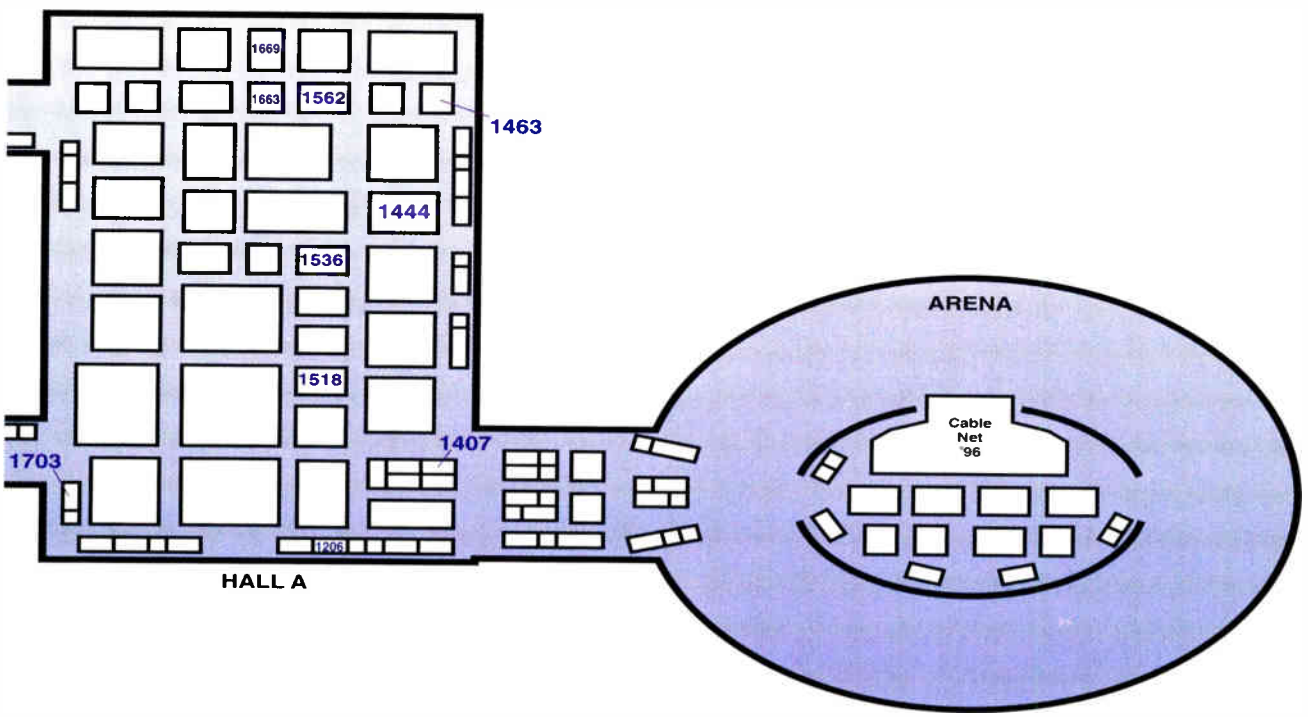
Alcoa Fujikura Ltd. 1206
800-235-3423
Alcoa Fujikura Ltd. is a highly recognized leader in the manufacture of fiber optic cable and accessories. We offer a wide variety of fiber optic products for your fiber management system including patch panels, splicers, coupler modules, connectorized assemblies, connectors, and adapters, as well as offering the services to install. Look for demonstration of the FSM-30S and FSM-15S fiber optic fusion splicers at our booth.

Alpha Technologies, Inc. 3326
800-421-8089
Alpha Technologies is the world's leading manufacturer of power solutions for voice, video and data communication systems. Alpha's full line of power products include: standby, non-standby and uninterruptible power supplies, surge suppressors, status monitoring, enclosures and batteries. Visit Western Show booth #3326 for the latest-breaking news on broadband powering — including the all new Centralized Power Systems.

AM Communications, Inc. 3421
Ampex Corporation 4322

Amphenol

Amphenol Communication & Network Products Division 3138
800-881-9913
Amphenol Communication & Network Products Division manufactures a complete line of semiflex/hardline and drop cable connectors, adaptors and tools for broadband communication interconnect applications. Semiflex connectors feature a unique non-rotational three piece design with a minimum 40 dB return loss at 1 GHz. Meeting all SCTE, Bellcore and other industry performance and environmental specifications. Call 1-800-881-9913, fax: 203-796-2032. Web: http://www.amphenol.com.



Anaheim Convention Center

1996 Western Show Technical Floor Plan

Amphenol®
Fiber Optic Products
Illuminating the world of fiber optics™

Amphenol Fiber Optic Products . .3138
800-944-6446
Amphenol manufactures interconnect products for telecom, CATV, datacom and test & measurement systems including fiber management systems (wall and rack mount); couplers (splitters and WDMs); fixed and variable attenuators; complete termination tooling kits; single mode and multimode cable assemblies; FC, SC, ST, and SMA connectors; and distributes Ando test equipment. Amphenol also announces the addition of 4 channel dense wavelength division multiplexers (DWDM) to its coupler product line.

ANTEC

ANTEC Corporation 2602
847-439-4444 or 800-TO ANTEC (862-6832)
ANTEC Corporation is an international communications technology company that specializes in the design, engineering and manufacturing of hybrid fiber/coax (HFC) broadband networks and the engineering, manufacturing, product development and distribution of products for these networks. Publicly traded on the NASDAQ exchange with the symbol ANTC, ANTEC has an employee base of 2,000 with several office and warehouse facilities located worldwide.

Integration Technologies
Answers you need. From people you know.

Antec/Integration Technologies . .2602
800-211-8424
Intergration Technologies is a vendor-independent network engineering, systems and software integration firm focused on providing "best of class" solutions for operators seeking to provide advanced services to consumers. We provide analog and digital network design, facilities and applications engineering, technical services, industry research, technology review, project and program management, and advanced software products and Operational Support System integration services to clients worldwide.

ANTEC Network Technologies

Antec/Network Technologies 2602
847-439-4444
ANTEC Network Technologies specializes in engineering and manufacturing products that deliver your signal from headend to home. We devote more engineering resources to this critical link than any other company today. We manufacture a complete line of rock-solid products — Laser Link® Optical Transmitters, Gateway Optical Receivers, LightLink Fiber Management System, ANTEC Fiber Cable, Fiber Pak® Family of Splice Closures, Fiber Apparatus, ANTEC RMT Network Passives, Regal Drop Passives and Digicon™ F-Connectors.

Applied Digital Technology 1135
Applied Instruments, Inc. 4939
Applied Signal Technology 4767
ARCOM 2731
ARNCO 2747

ARROWSMITH TECHNOLOGIES, INC.

Arrowsmith 4732
800-330-8920
Arrowsmith's workforce management system, FLEETCON™, provides routing, dispatch and mobile data communications, which enable users to improve customer service while reducing operating costs. FLEETCON uses an embedded GIS, GPS, and an intuitive map-based GUI to enable operations personnel to proactively manage the scheduling and dispatch process. The system offers managers access to real-time and historical information about operations with its powerful management reporting tools and robust application interface.

Avantron

Avantron 4724
514-725-6652
Avantron is proud to announce the 2000 series as a truly portable RF spectrum analyser weighing under 19 pounds including the internal battery with options such as Non-Interfering RF Sweep system and CATV return Alignment. Measurement performances up to 1 GHz, greater than 70 dB of dynamic range and a built-in frequency counter with 200 Hz accuracy. Come and see us at the Western Show in Anaheim at booth #4724.

BARCO

Barco Inc. 4382
770-218-3200
Barco headends combine hardware and software capabilities that improve both the quality and reliability of signal delivery. Barco headends incorporate advanced capabilities to remotely monitor and control signal distribution system-wide, maximizing up-time and subscriber satisfaction. These performance monitoring/remote provisioning features, coupled with superior signal processing, are key to Barco's reputation as a high value equipment provider worldwide.

Bay Networks
LANcity Cable Modem Division

Bay Networks 1048
800-8BAYNET
Now approaching one full year of active deployment, the LANcity cable modem division of Bay Networks has developed the industry's highest performing, easiest installing, lowest maintenance cable modems. Bay Networks is the only vendor offering a one-hundred percent end-to-end solution for cable access that is available today, the industry's best-selling cable modem technology from LANcity and market-leading routing and switching equipment for your head-end from Bay Networks.

Belden Wire & Cable Company 2269
Bellcore 4207
Ben Hughes/Cable Prep 1146
Blonder Tongue
Laboratories, Inc 2102
Broadband Networks, Inc. 1215

Budco

Budco 2104
800-331-2246
Budco is a marketing and distribution company

for installation tools, construction supplies, marking, identification, and security products for cable plant and equipment. Budco's display includes products from the following manufacturers: Aervoe Pacific, Arrow, Benner Nawman, Cable Maid, Cable Prep, Cable Pro, Cable Ready, Cable Tek, DFS, Diamond, Engineering Unlimited, F-Conn, Jameson, Klein Tools, Lemco, Lowell, M & B, Masterlock, Morrow, Preformed, Redington, Repnet, Ripley Cablematic, Sargent, Sturgeon Bay, Tech Products, Times Fiber, Tyton, and Work Area Production. And, as always, the taplock, the industry standard for marking drops.

Business Systems, Inc. 4876

C-COR®
ELECTRONICS INC

C-COR Electronics, Inc. 2360
800-233-2267
C-COR offers digital and AM fiber optics, RF amplifiers, network management systems, modems, passives and 90 Volt powering options. Services include network design, field engineering, technical training, equipment repair, 48-hour emergency repair service and a 24-hour emergency hotline. C-COR is ISO 9001 Registered.

Cabelcon Connectors 4771
CABLE AML, INC. 3264
Cable Innovations 4540
Cable TV Supply, Inc. 4520
CableData 1700

CADIX

Cadix International Incorporated 4690
714-223-8881
CADIX International develops Fiber and RF cable plant Design and Management Software. CADIX's unique "Single Pass Design Process" combined with a superior graphical user interface allows cable plant design speeds up to 12 miles/day utilizing a scanned base map. The management software uses the plant design itself as the graphical interface into a database containing inventory, network and subscriber information.

Carlon Telecom Systems 4293
Channell Commercial Corporation 3338
Channelmatic, Inc.. 1044
Chyron Corporation 4312
Coast CATV Supply, Inc. 3465
Com21, Inc. 4835

CommScope
GI General Instrument

CommScope - General Instrument 2406
704-324-2200 or 800-982-1708
CommScope is an ISO 9001 registered quality manufacturer of cables for telecommunications and for voice, video, data and other digital applications; the only US manufacturer of a complete line of coaxial and fiber cables for use in HFC networks and a world leader in cable innovation. Products include; NEW PowerFeeder™; a NEW family of Cables-in-Conduit; QR®; PIII®; Optical Reach® and a full line of drop cables including many that are available in EZ-Pak® packaging. Web: http://www.commscope.com, Fax: 704-328-3400.

COMSONICS An Employee Owned Corporation
COMSONICS, INC.
We set the standards.

ComSonics, Inc. 1536
540-434-5965
ComSonics, Inc. impacts the Western Show in a powerful way with the introduction of two new products — WindowLite Digital and TDR Tech. Now — measure digital, C/N & HUM on active carriers without intrusion, and see a larger, higher contrast display on the new WindowLite Digital. The TDR Tech is the new hand-held fault locator that makes finding cable faults both quick and easy. Both at ComSonics booth 1536.

CONTEC
First in Converter Repair

Contec, L.P. 2757
518-382-8000 x 144
Contec is an authorized General Instrument Warranty Repair Service Center with its 7 locations nationwide, it can provide fast turn-time on all types of converters from General Instrument, Scientific Atlanta, TV/Com, Panasonic, Zenith, etc. We also provide a complete line of quality remote controls. For more information, please call your Account Representative at 800-382-2723

Contech Systems, Inc. 2219
CSG Systems, Inc. 1552
CUO, Inc. 1700
dB-tronics, Inc. 3420
Diamond Communications Products, Inc. 1212
Digital Equipment Corporation 4464
Digital Video - Division of Arris Interactive 2602
Display Systems International 2773
DiviCom, Inc. 4490
Drake 4828
DSC Communications 3370
DX Communications, Inc. 4520

EAGLE
COMTRONICS INC.

Eagle Comtronics 2100
315-622-3402 or 800-448-7474
Come and see us at the Western Show, Booth 2100, and let us show you: Improved ESN series of negative traps, improved ESD jamming carrier decoding filters, newest positive (non jamming carrier) decoding filters called Sideband Interdiction System (SIS), encoders, channel droppers, metal shields, telephone ingress elimination filters and diplex filters, end user and OEM. Let Eagle Comtronics show you the solution of an industry wide problem — "Elimination of offensive language of premium services" by offering split tuned traps.Web Site: http://www.eaglefilters.com, E-mail: eagle@eaglefilters.com

ELECTROLINE

Electroline Equipment, Inc. 3164
800-461-3344
Electroline, number one worldwide in Broadband Off-Premises Addressable Systems, will be featuring its 1 GHz "SuperTap" that can be used as a standard multitap or, with a simple change of faceplate, as an addressable tap. It will be showing its "CLEARPath" that locates reverse path ingress immediately. It will be showing its 1 GHz ultra low-noise drop amplifier ("DROPAmp"), as well as its Compact Addressable Tap ("CAT"), an addressable splitter. Electroline will be exhibit-

ing its upgraded state- of-the-art Multi-Tier System ("MTS"), aimed at MDU's and resort applications. On display will be Electroline's Addressable Drop Extender ("ADEX").

Ericsson, Inc. 4376
EXECUTONE Information Systems, Inc. 1404
Exide Electronics, Emerging Techologies Group 1763
FamilyWare, Inc. 1001
FONS Corp. 1334
Force Incorporated 1402
FrameRate Corp. 4859
Furukawa Electric Co., Ltd. 4765
GAD Line Ltd. 1015
GE American Communications 3148

General Instrument

General Instrument Corp. 2502
. . . . . .& CableNet '96
888-GEN-INST or 215-674-4800
Enter the mall of technology for today into the new century when you approach the General Instrument area in Hall B. You'll experience a live digital system and see the only digital terminals now being delivered for Cable TV. See demonstrations of interactive services on digital and advanced analog CFT-2200 terminals. Witness the introduction of NETadvantage systems and services. Compare two digital compression systems. View a special Wink Communications presentation. Play some Sega Channel games. Get an update on the progress of the SURFboard cable modem. You'll have a better understanding of how General Instrument stays years ahead in technology. Web: http://www.gic.gi.com

Gilbert Engineering Co., Inc. 1638
Graybar Electric Company Inc. 4544
Great Lakes Data Systems, Inc. 1210

Harmonic *Lightwaves*

Harmonic Lightwaves 4557
800-788-1330
Harmonic Lightwaves is a leading supplier of highly integrated fiber optic transmission systems for the delivery of video, voice and data over hybrid fiber-coax broadband networks. Harmonic's products include the MAXLink™ 1550 nm transmission system, the PWRLink™ DFB transmitter, the YAGLink™ transmitter, optical receivers and accessories for bi-directional communications and a sophisticated Windows-based network management system.

Headend in the Sky - (HITS) 4530

HEWLETT PACKARD

Hewlett-Packard 3454
800-452-4844 x HPTV
Hewlett-Packard will have on display a comprehensive offering of cable TV test and measurement products as well as a wide variety of products that will enable customers to enjoy two-way services in the home. At our booth you will find the HP CaLan Sweep/Ingress Analyzer and the 8591C Cable TV Analyzer as well as our new data management software which will help you to find trends and predict failures in your cable TV system. Also on display will be cable modems, video servers and more.

@ Home Network 4756
Hoti Electronics Co., Ltd. 4854
Hughes Communications, Inc. 2460
Hybrid Networks, Inc. 4300

IBM Telecommications and Media Industry 2470
908-885-3552
IBM will be featuring an end-to-end solution showing how the needs of cable operators are met. The booth will show typical cable content moving through various functions used by MSOs. The Internet is used to manipulate and deliver content. The booth starts with web design and creation, and includes video server solutions as well as both headend and subscriber functions for MSOs.

ITOCHU Cable Services Inc.

ITOCHU Cable Services (ICS) 4520
800-327-4966
iCS is a new leader in the field of CATV suppliers. iCS is the reliable partner you need for the full range of products and repair services. iCS sales and service centers are located throughout North and South America. iCS unites the resources of Vuescan, Cable TV Supply, Kelly Cable Services and DX Communications. Booth 4520.

Imedia Corporation 4782
Insulation Systems, Inc. 1204
INTEGRATED SYSTEMS, INC. 3411
Intel Corporation 4483
Interaxx Television Network, Inc. . . .1662
International Billing Services 1700
IPITEK 1639
IRIS Technologies 1021
Jameson Corporation 1338
Jones Broadband International 1752
KGP Telecommunications 1350
LANcity Corporation 1048
Laser Technology, Inc. 4564
Lavender Cable TV Services 1708
Leaming Industries 2259
Lemco Tool Corporation 4165
Lockheed Martin Missiles & Space . .3004
LSI Logic Corporation 1011
Lucent Tech-Microelectronics Group 4213

MACROVISION

Macrovision Corporation 3407
408-743-8600
Macrovision Corporation develops and markets technologies to protect electronically transmitted and prerecorded video programs from unauthorized copying or viewing. The company's PPV copy protection is becoming a standard feature in digital set-tops, and is designed to allow operators to obtain the earliest possible PPV windows without threatening studios' downstream revenues.

Main Line Equipment 2249

Mega Hertz 4840
800-525-8386
The Mega Hertz "Sub-Alert", on display, is the first complete "Audio and Video" Emergency Alert System specifically designed to interrupt baseband "Audio/Video" sources, composite "IF" or separate A/V "IF" loops, as well as, 4.5 MHz audio loops individually or jointly and simultaneously. The "Sub-Alert" can be activated via touch tone telephone or automatically by the sage "ENDEC", encoder/decoder.

Microphase Corporation 4566

Microware Systems Group 4316
515-223-8000
Microware is the creator of the DAVID system software standard for digital television. DAVID has been licensed by over 20 manufacturers of digital set-top decoders for use in full-service and broadcast networks around the world. Stop by to learn more about DAVID and new extensions that add Internet access to the television.

Midwest Cable Services 4735
Molex Fiber Optics, Inc. 1213
Monroe Electronics, Inc. 4541
Motorola - Multimedia Group 4334

MultiLink, Inc. 1663
216-366-6966
Multilink is a quality manufacturer of fiber optic enclosures and accessories. Also a provider of MDU steel security enclosures, steel and plastic molding, plastic demarcation enclosures and drop material products. New products that are featured are a compression tool for LRC snap and seal connectors, adjustable Sno-Shoe for fiber optic cable, premise wiring patch panel cabinets, and a new high count fiber optic enclosure.
NaCom 4542
NCA Microelectronics 4625
NorTel 1768

Objective Systems Integrators (OSI) 3332
916-353-2400
Objective Systems Integrators (OSI) is the industry leader in the design, development, implementation and support of integrated Operational Support Systems (OSS), and network management solutions. NetExpert™, OSI's flagship product is a powerful standards-based software framework that provides applications including: network management; data collection; electronic bonding; service management, including provisioning and activation; change control, and fault management.

Optibase 4864
Ortel Corporation 4113
Pace Micro Technology USA, Inc. . .3700
PCI Technologies, Inc. 2769
Phasecom, Inc. 1006
Philips Broadband Networks, Inc. . . .2300
Photonic Components, Inc. 1356

Pico 1703
Pico Macom **818-897-0028 / 800-421-6511**
Pico Products **315-437-7525 / 800-822-7420**
Pico Products offers a complete line of PT mini traps, filters, tier traps, lifeline tier traps, low-pass and high-pass filters, Promo Encode/Decode system, CATV security accessories, low-noise drop amplifier line. At the show, Pico will be featuring its new line of window traps for return plan problems. Pico Macom offers a full line of 1 GHz drop and installation passives, splitters, couplers, switches and connectors for CATV/MMDS/SMATV. Pico Macom is a full line manufacturer of headend components, and will be featuring a new agile modulator, commercial satellite receiver/descrambler, agile demodulator, and an agile signal processor. Pico Macom will also be debuting a new controlled access pay TV system.

Pioneer New Media Technologies, Inc. 4346
310-952-2111
In the rapidly evolving world of cable television, Pioneer continues to make advances and develop innovative products. Pioneer will be displaying its latest advanced analog "Command Station" with Wink applications and a prototype of an interactive digital set-top unit. Plus, an Advanced Home Entertainment Center with DVD-Video and large screen projection receiver. Come see how Pioneer is helping set tomorrow's CATV standards today. Western Show Hall D, Booth #4790.

Pirelli 4370
Polotec Inc. 1200
Power & Telephone Supply Company 2739

PPC (Production Products Company) 4340
315-431-7200, 800-800-6652
PPC is a high quality manufacturer of aluminum connectors for coaxial trunk and distribution equipment, brass universal "F" fittings, both crimp and compression type, indoor reusable push-on "QUIK-LOK" connectors, Fiber Optic applications, and a full range of negative and positive notch filters in the low band, mid-band, high-band and superband ranges.

Progressive Electronics, Inc. 3153
Qintar Inc. / Allied Bolt / Scott Cable 2273

Quality RF Services, Inc. 4471
561-747-4998
"NOW OFFERING ISOLATION AMPLIFIERS". Quality RF Services, Inc. produces replacement RF modules/circuit board upgrades for

Original Equipment Manufacturers (Jerrold/GI, SA, Philips/Magnavox & Texscan) line amplifiers, indoor multi-dwelling amplifiers plus replacement OEM equalizers and pads. QRF is also one of the largest Independent distributors of replacement electronic components for RF amplifier repair. Our latest products include 55C MHz replacement modules and base chassis for "SJ" trunk stations, two-way 550 MHz replacement modules for SLR/SLE line extenders, a new 600 MHz circuit board upgrade for Scientific Atlanta Distribution Amplifiers and 750 MHz quadra-powered headend amplifiers. (QRAM750)

Quintech Electronics & Comm. Inc. (QEC) 1130
Racal-Datacom 4836
Radiant Communications Corp. 1324
Raychem Corporation 1002

RELTEC™

RELTEC 1463
216-460-3600
RELTEC is a global provider of a broad range of wireline and wireless communications products and services to companies servicing the local subscriber loop. The Company operates manufacturing plants in the U.S., U.K., Canada, and Mexico and is a participant in joint ventures in China and Japan. Its business units include Lorain Products, Reliable Electric, RTEC Systems, RELTEC Services and Rainford Group.

Ripley Company / Cablematic 2711
Riser-Bond Instruments 1208
Ronco Industrial Supply, Inc. 3465
RR Enterprises 4276
Sadelco, Inc. 4288
Sargent Quality Tools 1125
Satcon Technology Corporation 4873

Scientific Atlanta™

Scientific-Atlanta, Inc. 2542
800-433-6222
Go digital with the Explorer 2000™ set-top — On-target, reasonably priced, with a built-in, real-time reverse path. Shift into overdrive with dataXcellerator™ cable modem — Low cost, times faster than the fastest telephone modem, and operates over one-way plant. CoAxiom™ telephony over HFC system — Your rapid, field-tested route to more revenues. Developed in cooperation with Siemens to meet your most stringent requirements. A full range of top quality, reliable transmission products including SA III system amplifier, LE III line extender, 1310 and 1550 optoelectronics, and Multimedia stretch tap. And the new Continuum™ headend system for analog and digital applications, flexibility, and frequency agility. Plus the 8600x™ advanced analog set-top and other products for a complete end-to-end solution.

SEACHANGE TECHNOLOGY

SeaChange International 1562
508-287-4499 x 267
SeaChange International provides integrated systems to manage, store and distribute digital video for the television industry. With installations in over 130 cities, SeaChange is the world leader in video server-based systems. SeaChange demonstrations include its patented MediaCluster software technology, fault tolerant, node resilient, with linear scalability-platform for the new NVOD/PPV Movie System; SPOT ad insertion system; and VOD movie delivery with partner IPC Interactive.

SecaGraphics, Inc. 3602

SENCORE

Sencore, Inc. 2743
605-339-0100 x 204
Sencore has been in the business of designing and manufacturing test instruments for the electronic service industry for over 45 years. During that time one aspect has always been of the utmost importance: "Provide a quality, highly accurate and reliable instrument that will be a benefit to the technician at a price they can afford." Sencore's new line of cable analyzed testing equipment feature innovative tests specifically designed to give the engineer or technician the information they need for complete system performance testing or just getting the customer back on line. Sencore knows the importance of keeping your customers satisfied with your service, after all they've been doing it for over 45 years. If you have questions about any of Sencore's new line of cable system analyzing equipment call 1-800-SENCORE today.

SIECOR

Siecor Corporation 2753
704-327-5963
Siecor Corporation, owned equally by Corning Incorporated and Siemens Corporation, leads the industry in developing and manufacturing fiber optic and copper communications products for voice, data, and video applications. Siecor is the largest manufacturer of fiber optic cable in the United States and is a major supplier for cable television operating companies, telephone companies, customer premise communications systems, intelligent transportation systems and utility applications.

SIEMENS

Siemens 2542
561-955-6054
Siemens, with its partner Scientific Atlanta will feature CoAxiom™, their jointly developed cable telephony product. Siemens also provides a full range of telephony solutions from advanced switching services with EWSD® to PCS via GSM and PACS Edge™, all managed by Siemens Service Coordinator™. Web: http://www.ssc.siemens.com

Signal Vision Inc. 1762
Society of Cable Telecommunications Engineers 2719
Sony Electronics, Inc. 3618
South Wold Enterprises Co. Ltd. ...1701

SPECTRUM

Spectrum 4840
800-628-0088
Spectrum is proud to announce the digital version of Adtec's Ad-Maestro. This full- featured commercial inserter is now capable of full-random digital insertion using the Soloist digital video player. With the Ad-Maestro's Conductor software version 7.0, scheduling and verifica-

tion has never been easier. Like the analog version, this Ad- Maestro offers built-in network tone cards, AGC audio circuitry, and remote access.

Sprint North Supply

Sprint North Supply .....Hall D, 4620
800-639-CATV , Fax 800-755-0556
Sprint North Supply is a leading nationwide provider of integrated solutions for voice, data, videoconferencing and cable television product needs through its 11 strategically located distribution centers. The company offers more than 30,000 products and represents over 1,200 manufacturers. Sprint North Supply offers customized Materials Management Services and turnkey solutions. E-mail: sarah.goodman@nsc.sprint.com

Standard Communications Corp. 2332
800-745-2445 or 310-532-5300
Standard Communications Corporation is the industry's leading manufacturer of rebroadcast quality satellite reception and RF broadband products. At this year's show, Standard will showcase its new DSVR-8800 and DSVR-9000 digital IRDs. Standard will also be demonstrating the self-healing, 80-channel Stratum Modulator. System along with the complete line of CATV headend products including satellite receivers, frequency agile modulators, integrated receiver descramblers and BTSC stereo generators. Stop by booth #2332 for a complete demonstration of quality Standard Communications Corp. products.

Stanford Telecom,
Telecom Comp. Prod. 3415
StarNet 1755
StarSight Telecast, Inc. 2534
Summit Software Systems, Inc. 4392

Superior Electronics Group, Inc. 3364
941-756-6000
Superior Electronics Group, through its Cheetah® product line, is the world's largest provider of network monitoring systems. The Cheetah solution includes CheetahNet, a UNIX or Windows NT software package for fault detection, resolution and analysis. Cheetah monitors multi-vendor plant including headend and distribution devices, and fully integrates with third-party operational support systems. Only Cheetah provides a fully integrated performance monitoring system that includes non-interfering distortion measurements, return path analysis and automated FCC compliance testing. Cheetah improves plant reliability and facilitates the successful delivery of new revenue generating services.

Synchronous Group, Inc. 1754
Tektronix, Inc. 4358
Telecorp Systems, A Suntellect Co. .2713
Telecrafter Products 4546
Telect 1201
Telelynx, Inc. 1330

TeleWire Supply 2602
1-88-TELEWIRE
TeleWire Supply, an ANTEC company, is a leading nationwide distributor of products needed to build and service communications networks. It stocks an expanded selection of brands from numerous manufacturers to meet the changing requirements of today's communications networks. A centralized National Service Center, located near Denver, Colorado, and multiple warehouse locations provide enhanced customer service capabilities to network providers.

Tellabs 4565
630-378-8800
Tellabs is a global company applying leading-edge technology to worldwide communications problems. Our CABLESPAN™ telephony-over-cable system allows cable operators to deliver traditional telephone (and other new) services to residential and business customers. TITAN® cross-connects economically provide SONET capability at headend, hub or point-of-presence locations and provide a seamless, end- to-end SONET solution.

Terayon Corporation 4400
Texscan Corporation 1726
Thompson Sun Interactive Alliance .4774
Time Warner Cable's Road Runner .4628

Times Fiber Communications Inc. 3138
203-265-8500 or 800-677-2288
Times Fiber Communications, Inc. is an ISO 9001 registered manufacturer of coaxial cables for the telecommunications industry. Committed to quality, service and technology, TFC is standardized on 1 GHz bandwidth for trunk, feeder and drop cables, featuring T10 Semi-flex, TX10 Low-Loss and T10 Drop cables with lifeTime. With over 40 years of experience, we continue to lead the industry in product advancement and innovation. TFC is proud to be a part of bringing information and entertainment into the homes of your customers in the United States and in over 30 countries around the world.

Titan Information Systems 4262
Toner Cable Equipment, Inc. 2763

TRILITHIC

Trilithic 1407
800-344-2412
For over 25 years, Trilithic has been a trusted supplier of Cable TV and RFLAN test equipment. At this year's show, Trilithic is featuring a full-range of products including Trilithic's new EAS compliance system and EAS-AB1 switches, Trilithic's 9580 Return Path Sweep and Ingress Monitoring System, a rugged fiber optic power meter and laser source, and the complete Tricorder SLM family of products. Stop by our booth for a full demonstration of these outstanding Trilithic products.

Trilogy COMMUNICATIONS INC.

Trilogy Communications, Inc. 2223
800-874-5649
Manufacturer of low-loss, air dielectric MC2 trunk & feeder cables, featuring up to 13% lower attenuation. Ideal for all CATV architectures. Also offering a full line of quality MVP drop cables and latest 50-Ohm AirCell Radiating & Non-radiating transmission line cables for wireless and RF communications. Trilogy is ISO-9001 registered at all facilities. Stop by booth #2223 to find out how Trilogy cables can wire your system at lower cost. Fax: 601-939-6637

Triple Crown Electronics, Inc. 1747

TV/COM
A Subsidiary of Hyundai Electronics

TV/COM International, Inc. 2450
888-998-8266
TV/COM International, Inc., a subsidiary of Hyundai Electronics, is a worldwide leader in supplying broadband communications for the cable, satellite and terrestrial industries. Products include digital compression systems, headend equipment, conditional access systems, and analog scrambling/encryption systems for subscription, pay-per-view and interactive entertainment. TV/COM will introduce its new SIGMA "X" Series decoders and P2000 Series of Integrated Receiver Decoders.

TVC Incorporated 1524
U.S. Electronics Components Corp. .1668
Ubiquinet Inc. 1132
Underground Service Alert 2203
Universal Electronics Inc. 3155

Vela Research™

Vela Research Inc. 3706
813-572-1230 x 7186
Vela Research Inc. designs and manufactures broadcast quality MPEG-2 encoders and decoders. Vela's Centaur and Argus MPEG-2 encoders digitally compress raw video into MPEG-2 compliant video data streams which are stored for later retrieval. Vela's MPEG-2 decoder boards are single board, audio/video decoders that reconstruct the compressed video and output NTSC or PAL. The decoders are designed for SCSI-2, PCI, EISA and VME bus architectures. Vela also has a four channel SCSI-2 decoder.

Video Data Systems 4840
Vikimatic Sales Inc. 2725
VUESCAN, INC. 4520

WAVECOM ELECTRONICS INC.

Wavecom Electronics Inc. 4855
306-955-7075
WaveCom is a leading Canadian designer and manufacturer of cable television modulators. WaveCom also does research, development, and manufacturing of electronic communications products including, but not limited to, CATV equipment, high speed spread spectrum modems, bi-directional amplifiers, digital video modulators, MMDS/LMDS equipment, and cable modems. Fax: 306-955-9919

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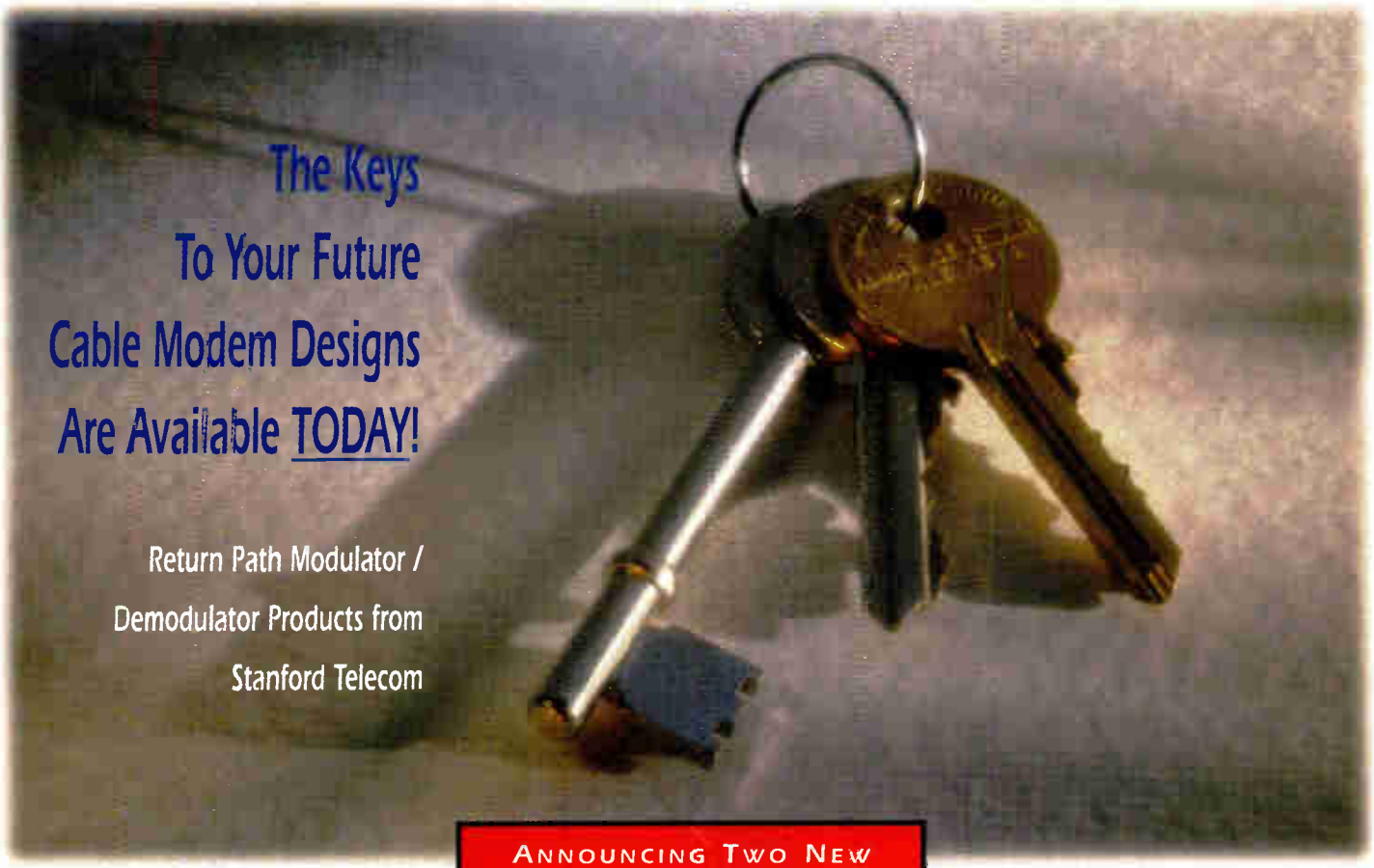

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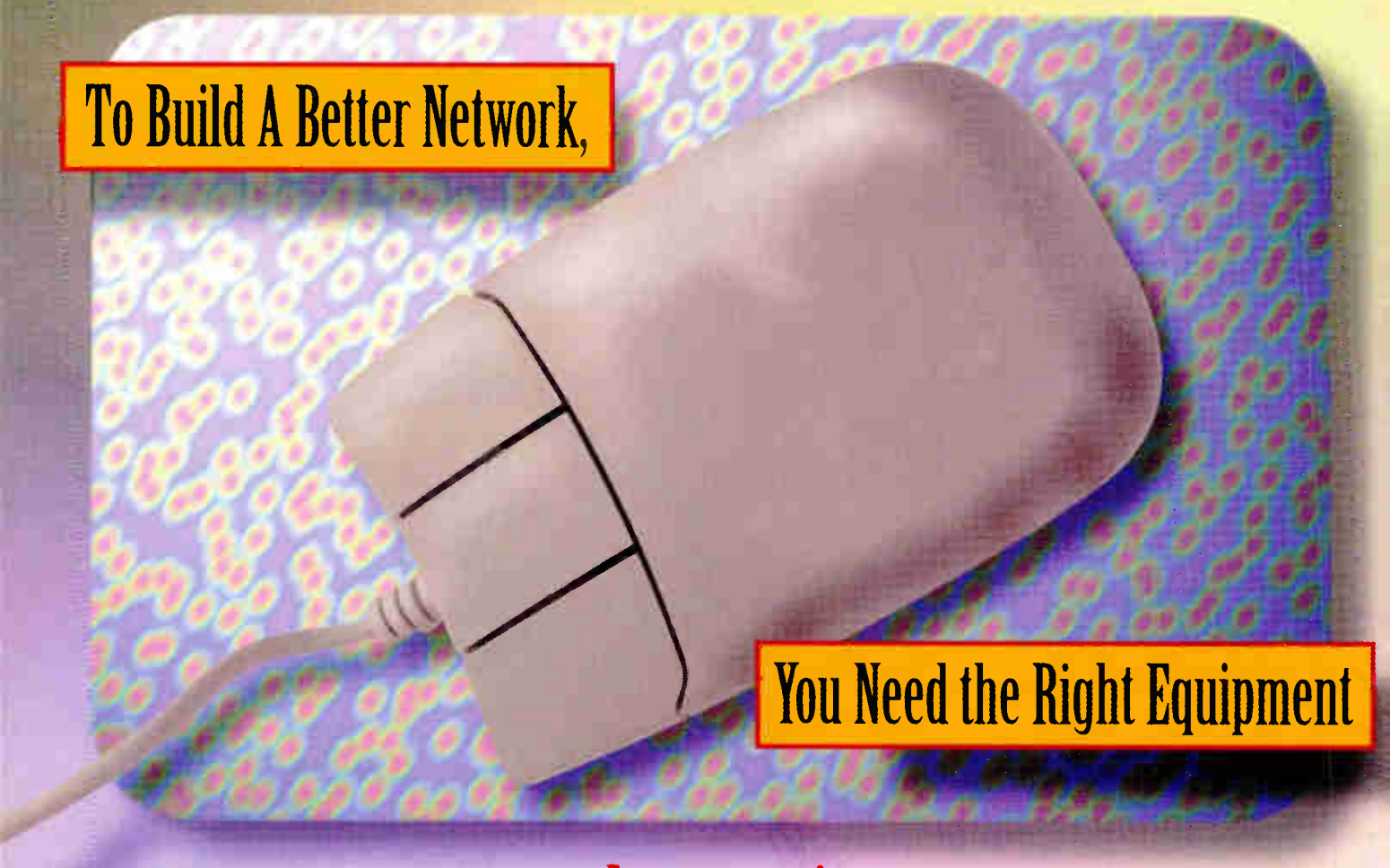

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4 T-1 Technical Seminar, produced by ADC Telecommunications. Location: Minneapolis, Minn. Call (800) 366-3891, ext. 2040.

4-5 Fiber Optic Technical Seminar, produced by ADC Telecommunications Inc. Location: Columbia, S.C. Call (800) 366-3891, ext. 2040.

4-6 Hand-Held & PDA Expo and Forum, hosted by PDA Inc. Location: San Francisco Bay Area. Call (415) 252-8008.

5-6 Competition in Local Telco & Cable Markets, produced by Strategic Research Institute. Location: The Loews L'Enfant Plaza Hotel, Washington, D.C. Call (800) 599-4950.

9-12 Fiber Optics 1-2-3: Installation, Design & Maintenance. Produced by The Light Brigade. Location: Sunnyvale, Calif. Call (800) 451-7128.

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11-12 Fiber Optic Technical Seminar, produced by ADC Telecommunications Inc. Location: Salt Lake City, Utah. Call (800) 366-3891, ext. 2040.

16-19 Hands-On Fiber Optic Installation, Maintenance and Restoration for CATV Applications, produced by Siecor Engineering Services Training. Location: Hickory, N.C. Call (800) 743-2671 ext. 5539 or 5560.

JANUARY

13-16 Telecommunications Engineering/Operations ComForum. Location: Dallas, Texas. Call the International Engineering Consortium (312) 559-4100.

16-17 Basics of Telephony. Produced by C-COR Electronics Inc. Location: Orlando, Fla. Call C-COR Technical Customer Services (800) 233-2267.

22-24 Women in Cable & Telecommunications' Leadership Conference. Location: Loews Coronado Bays Resort, San Diego, Calif. Call Molly Coyle (312) 634-2353.

27-30 Fiber Optic Training, produced by The Light Brigade Inc. Location: Tampa/St. Petersburg, Fla. Call (800) 451-7128.

FEBRUARY

3-6 Hands-on Fiber Optic Installation, Maintenance and Restoration for CATV Applications. Produced by Siecor Engineering Services Training. Location: Hickory, N.C. Call (800) 743-2671 ext. 5539 or 5560.

16-19 CompTel '97. Location: Palm Springs, Calif. Call the Competitive Telecommunications Association (202) 296-6650.

24-26 Cable Television Technology. Produced by C-COR Electronics Inc. Location: Pittsburgh, Pa. For more information, call C-COR Technical Customer Services (800) 233-2267.

Trade shows

December

11-13 The Western Show. Location: Anaheim, Calif. Call the California Cable Television Association at (510) 428-2225.

January

8-10 SCTE Conference on Emerging Technologies. Location: Nashville, Tenn. Call SCTE National Headquarters (610) 363-6888.

February

3-6 ComNet '97. Location: Washington, D.C. Call IDG World Expo (800) 545-3976.

11-14 Expo Comm Telecomunicaciones Mexico '97, organized by E.J. Krause & Associates Inc. Location: World Trade Center, Mexico City. Call Caroline Ruggieri or Steve Sasse (301) 986-7800.

16-21 OFC '97. Location: Dallas, Texas. Call the Optical Society of America (202) 416-1980.

19-21 Texas Show '97. Location: San Antonio, Texas. Call the Texas Cable & Telecommunications Association (512) 474-2082.

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William G. Mc Gorry, Vice President/Group Publisher, October 1, 1996

Finally, a cable/CE breakthrough

By Walter S. Ciciora, Ph.D.

The issue of cable/consumer electronics compatibility has seemed almost endless. Much like the movie, "Groundhog Day," it seems to never end. But recently, there was a sort of breakthrough. The breakthrough came at a meeting of the Cable Consumer Compatibility Advisory Group, called C³AG. The suggestion was made to consider having two levels of "cable ready" products.

The consumer electronics side of this negotiation is very concerned about cost and about being able to use the terminology "cable ready" on as many products as possible. The cost pressures are due to the competitiveness of the consumer electronics industry. That competitiveness stems from tremendous over capacity to produce. Simply put, the consumer electronics industry has more production capacity than customer demand.

Because of this over capacity, it is impossible to raise prices, yet there is a need for features to cause consumers to select products. Products which did not have the name "cable ready" would have a significant disadvantage compared to those which could be advertised as "cable ready." Of course, price is critical.

The consumer electronics industry simply wants to use the terminology "cable ready" and spend the absolute minimum to be allowed to do so. Prior to the 1992 Cable Act, using the term "cable ready" was a unilateral decision. No permission was required from the cable industry or from any governmental agency. The Cable Act changed that. The FCC is required to determine a technical definition for "cable ready."

The cable industry is anxious to get the consumer interface problem solved. The problem is one of managing expectations. When consumers buy a "cable ready" product and are told (or it is implied) that the product will work when directly connected to cable, they expect that this applies to all cable services and all features in the product. The salesperson either doesn't understand the distinction or sees no reason to give a negative message. Consumers thus find that they must make some hard choices when they get home. Either they must be satisfied with just basic cable service, which is unscrambled (and maybe a trapped pay service), or they must forego certain features on their new TV or VCR. If they are aware that these choices need to be made at the time of purchase, they can make intelligent decisions. But the free market is impaired when information is either not available or not understood at the time of purchase.

If you consider which are the "ends" and which are the "means," you quickly conclude that the TV or VCR is the "means" and the cable services are the "ends." That is to say, consumers want access to programming. The TV's or VCR's features are secondary–but not unimportant. If it were the other way around, consumers would be satisfied with the basic cable service and be thrilled with the joys of their remote controls, Picture-In-Picture, etc. Because this is not the case, the consumer is angry over being sold features that can't be used with the services he wants. He feels "taken." Because the consumer electronics sale is a one-time relationship and the cable subscription is renewed monthly, the cable operator is the only one who is available for retribution.

How two levels solve the problem

These two polar positions seemed to be beyond solution. Having two levels of "cable ready" has the potential to solve the problem by allowing a low-cost, low-end set of models which are appropriately named to avoid confusion, and a high-end line of models which provide access to nearly all services while using nearly all features.

The level-one product will be that which is defined by the current draft standards, IS-105.1 and IS-105.2. Level two will be defined in extensions to the standard. These will be IS-105.3 and IS-105.4. Level one will be restricted to just one video and one audio line serving as inputs to the TV or VCR. Level two will have multiple bi-directional video and audio lines and the direct pass-through of remote control signals.

Appropriate naming of the two levels is crucial. If it is conceded that the management of expectations is a critical element of this process, then the names applied are as critical. The names must be fully descriptive without being negative. The lower level should have an adjective that distinguishes it from the previous usage of the term "cable ready." To continue just using the term "cable ready" is to invite continued confusion. One suggestion has been to call the lower level "basic cable ready." Because subscribers know what basic cable service is, and because the lower level of "cable ready" will work well with this level of service, this name is appropriate.

The second level should be inviting, yet include the terminology "cable ready." The reason for including this terminology is to ensure that the FCC's technical definition authority applies. Without "cable ready" in the name, all control is lost, and the features and specifications included can be anything that can be sold on the retailer's floor. The critical aspect of managing expectations will be lost. Suggested names include "advanced cable ready" and "media cable ready."

The C³AG is in the process of drafting an FCC ex parte filing to advise the FCC of the recent progress. IS-105.1 is essentially complete. Some sections are being drafted to explain how this draft standard satisfies the requirements of the 1992 Cable Act. The additional purpose of this text is to demonstrate that nothing short of this standard will accomplish that result. IS-105.2 still has work to do. Then there is the engineering requirement to field test the standard.

These additions to IS-105.1 and IS-105.2 are non-trivial, but not nearly as large a task as the original work.

Of course, the FCC must find all of this acceptable for the job to be finally done. CED

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