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Communications Technology

Official Trade Journal of the Society of Cable Telecommunications Engineers

October 1999

PLANNING 2000

PART 1

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CHEETAH TECHNOLOGIES

Reader Service Number 1


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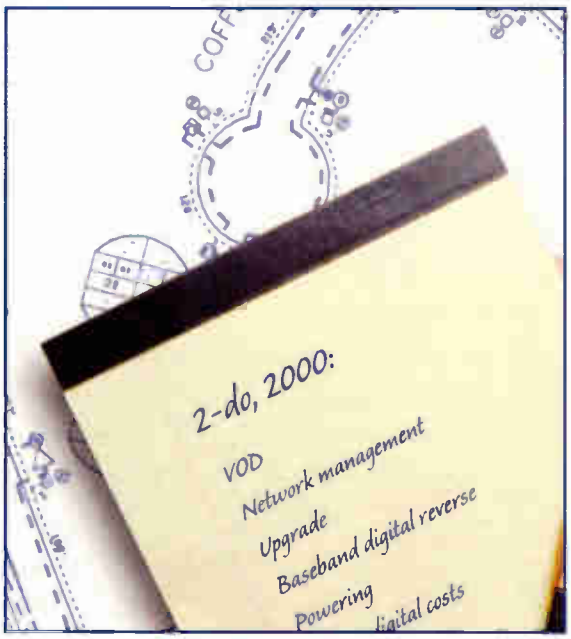
contents

FEATURES



Planning 2000 • 42

Expand Your Return Path Toolkit • 76

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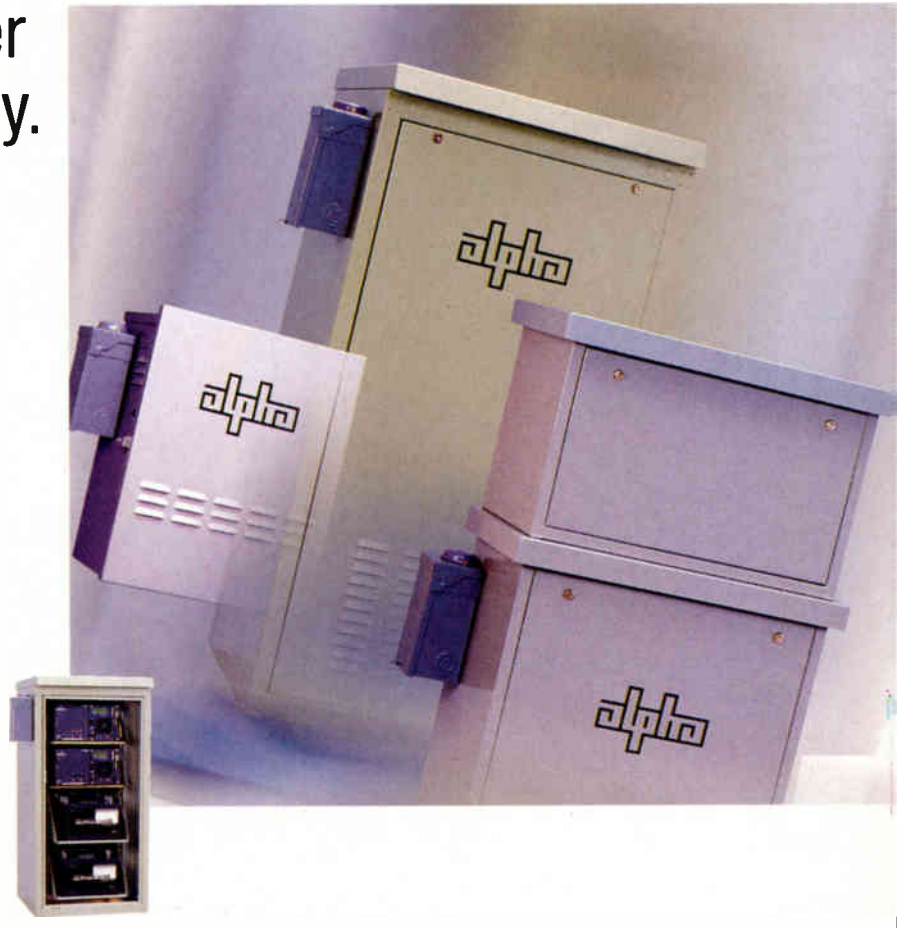

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Reader Service Number 3

contents

What Happens When the Lights Go Out? • 86

Return Path Testing • 116

DEPARTMENTS

NEWS & OPINION

REFERENCE

COLUMNS

Finally. A Cable Modem That Can Be Self-Installed.

Anyone can do it. Grandma, the kids, even Dad. Just ask TCA Cable TV. A full 80 percent of their Terayon modems are self-installed by subscribers. That means fewer truck rolls and service calls. You can lower subscriber installation fees, which adds up to satisfied subscribers and more money in the bank for data services.

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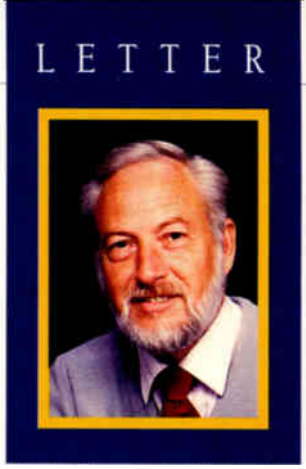
Reader Service Number 4

By Rex Porter



A Friend—An Engineer

In August, the coble industry lost one of its finest people. Harold Henry Kronberg was born on Oct. 7, 1947, in Clintonville, Wis. I first met Harald back in the Storer days, and I thought, "What a great man." He was quiet in a crowd, but pleasant to all.

Then I followed his career from Storer to United Cable in Scottsdale, Ariz. I worked for Gilbert Engineering back in the '80s, and I remember being down in the dumps during a hectic week of scurrying around Phoenix, calling on customers. Needing to talk to someone, I phoned Harold.

He said he was working on some microwave gear way out in North Scottsdale, but he said that I ought to come on by, and he would spend a little time with me.

I arrived early in the morning and spent the day with Harold, talking about how the industry was changing. Harold kept working in the headend, and I kept following him around as he moved from receiver to receiver. I didn't leave until late in the afternoon. That's the only time I ever really got to spend any personal time with him.

We didn't have an easy time forming the Society of Cable Telecommunications Engineers' Cactus Chapter. But it seemed like Harold was there at all of the board meetings. And when we ran the Cable Games during the Arizona Cable Show, he would volunteer for the jobs no one else seemed to want to do.

There are only a few "cowboy" engineers left. You can always recognize them by their western hats and boots, sometimes a mustache, and always a grinning nod. That was Harold. He usually preferred to stay in the background, but he always was close enough to make sure that things got done.

When Harold's time came, I went to pay my respects to someone for whom I always had the highest regard. At his funeral, a grandchild had placed a teddy bear with a note to Grandpa on Harold's arm to keep him safe. And I couldn't resist slipping an old, worn SCTE 704 pin by his other arm.

Harold Kronberg came to the end of a very successful life as an engineer. He did his work, made his mark on our lives, and we'll miss him. Perhaps we should all consider how our peers will speak of us when we go on to a better world.

Rex Porter
Editor-in-Chief

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Reader Service Number 8

LETTERS TO THE EDITOR

Birthday Wishes

This is just a letter to ask for help from some old friends. My father, Ed Allen, is turning 75 this year, and his health hasn't been great over the last few years. Ed's birthday is Nov. 7, and the family is going to have a birthday party for him at his home in Lake San Marcos, Calif.

Ed loves hearing from his old friends and staying in touch with the cable industry, which has been his love for so many years. He has taught us many valuable things, including "Ed's Magnificent List of Sayings," printed by Tom Kerver some years ago.

I'd like industry friends to send Ed birthday cards, either directly to Ed or to me now, and I'll make sure he receives them on his birthday. Ed's connection to the industry via contact with friends and his daily *CableFAX* are instrumental to his health and attitude these days. It's amazing how the "reach out and touch someone" adage applies to old business acquaintances.

Please help me get this out to other Pioneers or people who have worked with Ed. Cards may be sent directly to: Ed and Geri Allen, 1418 La Loma Drive, Lake San Marcos, CA 92069.

Steve Allen
3361 Sundance Trail
Placerville, CA 95667

Editor's response: Steve, as past board chairman of the National Cable Television Association, Ed Allen led this industry through some of our most fearful years. I've read some of Ed's words of wisdom you have posted on the SCTE-List. Perhaps even some of our younger people, who never worked with Ed but have enjoyed his wisdom, might also want to join us in wishing Ed a happy birthday. —RP

Open Access Outrage

I want to comment on "Will Open Access Burst Cable's Pipe? Prepare Yourself for the Fight," by Arthur Cole in the July issue. I believe it to be very inappropriate for a technology magazine. It is mostly editorial—not technology at all. The small amount of technology in it is WRONG!

Cole writes: "The technology simply does not exist for a cable system to provide a direct connection to every ISP (Internet service provider). As a shared network, in which users tap into a steady stream of information, cable does not devote a dedicated switch to each and every household. For ISPs to reach directly to broadband cable users, offering them a choice of providers other than Road Runner, @Home or some other preferred provider, they will have to utilize a portion of that finite amount of bandwidth. The issue then becomes one of bandwidth allocation.

"'Say AOL, Microsoft and @Home are sharing a network. What if @Home gobbles up more of the network, and AOL and Microsoft are not getting enough?' said Milo Medin, chief technical officer at @Home. 'ISPs have to be able to turn customers on and off, service them online when there's a problem, provide ISP information back to the customer .... If you can't do that, you can't run a business. It's not just a question of where to send packets.'"

The technology does exist—it's called a router. The technology works. DirecPC (satellite) has been doing it for years. So do most multichannel multipoint distribution

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Reader Service Number 10

service (MMDS)-modem operators. It depends on your intent. If you don't want it to work, it won't. If you do, it will.

I believe in open access, but I don't argue the issue with cable TV technicians or engineers. They should just do whatever management asks them to.

Sruki Switzer

Editor's response: Sruki, thanks for the remarks. I agree that this article wasn't purely technical. But cable engineers can't hide behind their slide rules and ignore issues that affect them and their jobs.

Reading the daily discussions on the SCTE-List shows that engineers are interested in open access. Engineers are concerned with any issue that affects their careers, and rightly so. I have to take exception to your statement that technicians and engineers "should just do whatever management asks them to." Technicians and engineers have a responsibility to maintain networks capable of supporting all services: entertainment TV, data, high-speed Internet access, telephony and others we haven't thought up yet.

I hope our engineering community will never blindly follow instructions from management types who think fiber is just something we need in our diets. —RP

Customer Service Concerns

It's amazing what your article ("Customer Service in the Age of Bandwidth," August 1999) proposes—customers are treated badly. If our executives are being treated this way, you can bet our customers are.

Some say stockholders are complaining, but when a stockholder gets the same customer service as either Drew Stone or Michael Walsh, letters and memos fly, and then a new policy magically appears.

Our customers should come first. All stockholders can do is sell out, but customers make or break the business.

Eric Williams

Write to Us

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

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Reader Service Number 13

CommScope Named NCTC 1999 Vendor of the Year

Once again, **CommScope** has won the Vendor of the Year award from the **National Cable Television Cooperative**, which serves the hardware purchasing and programming needs of independent U.S. cable operators.

The Co-op presented the award to Larry Stiffelman, senior sales manager and NCTC corporate account manager for CommScope. Over the past 10 years, four companies have received the award.

This year marks the third time CommScope has been honored for its commitment to independent cable operators in the midst of pressures to serve the huge multiple system operator (MSO) market.

"It has always been our philosophy to only make the selection when a vendor has clearly set themselves apart from the other suppliers in terms of helping the Co-op achieve its mission of helping our members lower their cost of doing business," said Mark Bishop, director of hardware purchasing at the NCTC, during the award presentation. "And of course in hardware, the cost of doing business is much more than simply price."

CommScope Senior Vice President Jim Hughes (at podium) speaks at a meeting of the National Cable Television Cooperative, where CommScope received NCTC's Vendor of the Year award. Behind him at left is NCTC's Mark Bishop.

CommScope was the first company to participate in the NCTC's "Preferred Vendor" program; the first to assemble a comprehensive package of benefits to its members, including price, delivery, terms, shipment time and complete service support; and supported the NCTC's partnership with a dedicated support team and national cooperation between various sales regions.

The NCTC narrowed the field of 1999 nominees to four: **JerryConn** for **LRC** and **Tektronix** equipment, **TeleWire** for hardware and **Antec** power products, Antec for optical electronics, and CommScope.

"(From the beginning) I think we recognized the opportunity that the Co-op was giving CommScope and realized the potential of this relationship," said Jim Hughes, CommScope's senior vice president.

The NCTC has about 980 active members, which operate roughly 6,000 systems that serve an estimated 8.5 million subscribers.—*DL*

Industry Ponders Cable's Future

Cable visionaries addressed a host of technical, regulatory and strategic planning questions that loom over the industry at the Future Cable conference in Broomfield, Colo., last month.

Sponsored by Nortel, Tellabs, Cabletron Systems, Lucent and CSG Systems, the conference kicked off with a "Telephony Solutions Over Cable" preconference technical workshop, which included a presentation from Cox Communications. Mark Davis, Cox's vice president of engineering, telephony technology, discussed the ins and outs of his company's "reality-based engineering."

Among Davis' talking points was his company's unique solution to a common system design challenge. Called SPURS, the Cox design is used to connect distant, isolated nodes and to avoid high-cost ring closures where obstacles exist.

"Occasionally, you will run up on situations where … you've got a river that would cost you $100,000 to bore under twice, and you can't get to the fiber nodes in the extremities of the network without spending $100,000 for just 1,500 customers," explained Davis. "We have a technique there that we call SPURS, where we just connect those two extremities by having a ring out to a junction point and then fold the ring out to those last two fiber nodes.... Ninety-nine percent of the reliability is still there compared to the rest of the network because it is ring up until that point. The good thing here," joked Davis, "is that you just set up a guard at the bridge and make sure you shoot anybody that is digging in that area, and you're okay."

In addition to the ever-popular open access discussion, the general session also included a presentation by Oscar Rodriguez, vice president and general manager of Nortel Networks' Broadband Technology Division. Rodriguez implored the operators in the audience to "differentiate, differentiate, differentiate" their service offerings and move outside the realm of being entertainment-only providers. "Like competitors will always be driven to lower prices," said Rodriguez, who cautioned operators about becoming commodity-oriented providers. "Re-establish yourself in a new and different type of space."

One of the technology tracks included a system upgrade presentation from Kelvin Smith, vice president of engineering and construction at Cable One. Smith, like many other speakers at the conference, stressed the importance of planning and well-trained personnel. After taking inventory of their current assets, Smith suggested that operators carefully select their contractors and design firms. "My advice is that you (hire) someone who is creative and experienced," he said. "If you're planning a digital … or full service network, it's not the time for inexperience." —*DL* ➤

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Reader Service Number 14

NEWS BITES

- MediaOne has awarded Lucent Technologies a contract valued at about $250 million for communications systems and software. Lucent will provide switching and optical networking systems, plus communications software. MediaOne will offer local telephone, high-speed Internet, and broadband TV services.
- Denver-based Peregrine Communications won a master headend rebuild contract for Charter Communication's St. Louis system upgrade, to consist of a two-way, fiber-rich 870 MHz design, headend facility and high-speed digital transport ring. CT

1999 CT Buyers' Guide Addendum

The following companies were not listed in the August 1999 edition of the *CT Buyers Guide*. We apologize for the oversight!

Cable Management Products

HellermannTyton
7930 N. Faulkner Road
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Sales contact: Bob Portmess
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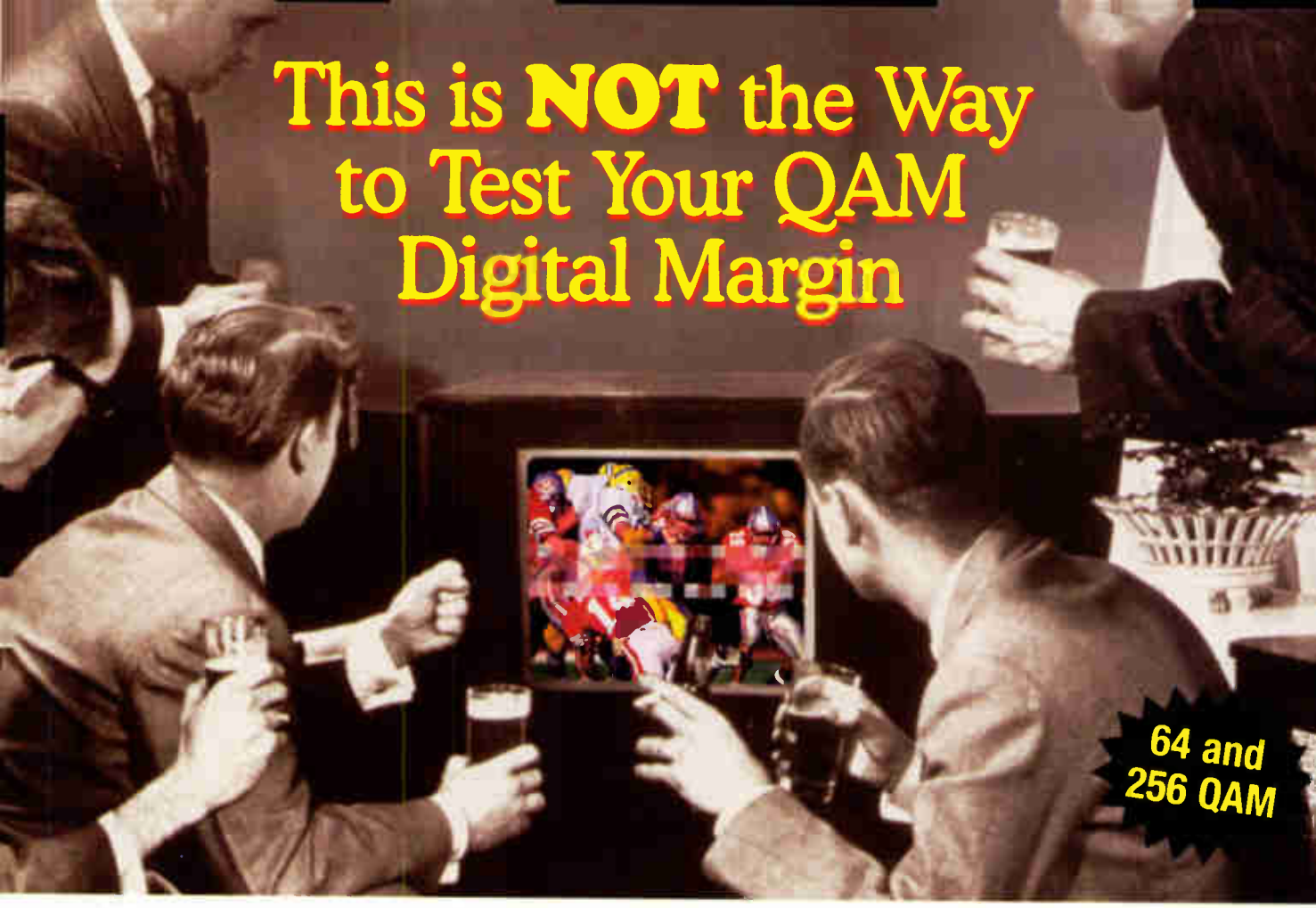

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Reader Service Number 16

DEPLOYMENTWATCH

By Arthur Cole

Time Warner Tests VOD Waters—Again

Video-on-demand (VOD) is a step closer to reality at Time Warner with the launch of field tests in the company's Tampa, Fla., and Austin, Texas, systems. Based on TW's experiences with the Full Service Network in Orlando, Fla., in the early '90s, this new breed of VOD is expected to deliver the goods to large numbers of customers at a reasonable price.

TW executives are following through on their commitment to use multiple vendors for advanced digital systems by selecting Concurrent Computer Corp. for Tampa and SeaChange International for Austin.

The hardware

In both instances, TW will operate the VOD systems over the Scientific-Atlanta Explorer 2000, which means a lot of heavy integration with billing systems, traffic management and network operations, and third-party content providers.

But with several years of research and development under their belts, much of it working with the Explorer 2000, Concurrent and SeaChange say they have hardware and software issues under control.

"Everything has been focused on engineering," said Yvette Gordon, director of interactive technologies at SeaChange. "Now, we focus on deployment issues, which are much more diverse."

In Orlando, TW Vice President of Engineering Gene White said Concurrent's MediaHawk servers will be placed in system hubs, each of which pass about 20,000 homes. The MediaHawk delivers 400 simultaneous streams, which should be plenty, even at peak usage.

Content will get to the hubs via five optical carrier (OC)-48 rings, White said. "Actual distribution of media is up for discussion, either tape or satellite."

E. Courtney Siegel, chairman and chief executive officer of Concurrent, said the first phase of the deployment will cover 18 hubs, although White said as many as 25 could be outfitted by the end of the year.

"Everything is already shipped," Siegel said. "We'll be in homes before the end of the calendar year with paying customers."

One obstacle is channel allocation, a matter that probably won't be settled until real subscriber data comes in.

> "As in the Orlando FSN trial, the initial launch will take place mostly among TW employees."

Upgrade needs

Another key issue was upgrading Tampa's infrastructure to handle a more interactive environment. One key system was a new local database to handle billing.

"Our legacy system was not set up to handle impulse-driven, instantaneous transactions," said John Dickinson, director of network operations in Tampa.

The solution was Oracle hardware running Concurrent's database package in the local and master headends.

As in the Orlando FSN trial, the initial launch will take place mostly among TW employees, though the company hopes to have customers online early next year.

In Austin, TW officials declined to comment on the deployment, saying it was still experimental. However, SeaChange's Gordon said the installation will offer one of the first real-world examples of a fully deployed VOD system.

"It has all the components working together in a plant environment: engineering, operations, content management—a complete business," she said.

System variations

Austin is much smaller than Tampa (266,000 subs, as opposed to 877,000), so there are no concrete plans to push the servers out into the hubs, Gordon said.

As for the two companies' VOD systems, there are some key differences.

SeaChange's Interactive Television System relies on the company's MediaCluster server system. It consists of multiple high-powered computers networked together to form a single server. This provides a great deal of redundancy because the system will continue to function even if one or several computers goes down.

The system also relies on a patented RAID technology that allows different start times from a single digital movie file, thus cutting down on storage requirements.

Concurrent's MediaHawk tackles redundancy in a slightly different manner. The system utilizes Interactive Video Modules grouped into a Dual Video Array capable of supporting 400 Moving Picture Experts Group (MPEG)-2 transports at variable or constant bit rates (VBR or CBR). Disks in the system are striped and mirrored to ensure continuous play if a disk goes bad.

Both systems come with the requisite back office management software. CT

Art Cole is a contributing editor to "Communications Technology."

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Status Monitoring Success

The Society of Cable Telecommunications Engineers Hybrid Management Sub-Layer Subcommittee successfully completed its first interoperability workshop.

The vendors, **Alpha Technologies**, **Cheetah Technologies**, **C-Cor.Net**, **Electroline**, **Hewlett-Packard**, **Silcom** and **Tollgrade Communications**, demonstrated basic interoperability of their status monitoring transponders and headend controllers before representatives from **AT&T Broadband and Internet Services** and **Time Warner Cable**.

The vendors built prototype hardware that conformed to the draft specifications outlined in the HMS Subcommittee documents "Specifications for the Physical Layer" and "Specifications for the MAC/DLL Layer." The first testing workshop was intended to encourage collaboration among suppliers and help refine the current HMS draft specifications.

HMS Subcommittee Chairman Esteban Sandino described the process as working with vendors "trying to set up standards and then reach consensus." He added that standardized status monitoring will allow cable operators to spread the cost of the system over all the services they provide, rather than being caught in the position where a status monitoring system might not cover all of an operator's services.

"Status monitoring has always been sort of an elusive goal for cable operators," he said. "The initial goal was to leverage the investment. The deployment of advanced services has increased the urgency."

Vendors cooperate to achieve interoperability.

The initial tests consisted mainly of establishing interoperability between a headend controller from one vendor with a single transponder from another vendor, Sandino said.

The second round of tests, tentatively scheduled for the week of Nov. 15 at SCTE headquarters in Exton, Pa., will center on demonstrating interoperability between a headend controller from one vendor and several transponders at once, all manufactured by different vendors. Between rounds one and two, HMS will refine the specifications for the physical layer and the media access control (MAC) layer, Sandino said.

SCTE will hold workshops in October to work toward full interoperability. For more information about this workshop or the SCTE HMS Subcommittee, call HMS Chairman Esteban Sandino at (303) 267-5974 or e-mail Sandino.Esteban@tci.com.

SCTE Names New Directors of Marketing, Membership Services

SCTE has hired Lawrence Moore as its new director of marketing and communications and Melissa Hicks as its new director of membership services.

Moore, who has extensive background in marketing, sales and administration in the cable, publishing and association fields, will be responsible for coordinating the Society's communications and marketing activities. His areas of expertise include developing new programs, revenue expansion and cost control.

"I look forward to working with John Clark and the SCTE staff, building on a strong base to expand participation in the key components of training, certification and standards," Moore said.

Moore joins the Society from *TV Guide* where he served 22 years over two tours of duty. He began as a cable marketing analyst and worked his way up to marketing and publishing management.

Lawrence Moore

Melissa Hicks

"The combination of cable, publishing and association experience makes Larry a perfect fit for the marketing and communications challenges ahead," said SCTE President John Clark.

Hicks joins the Society from GAMA International, an 8,000-member international professional association that provides education and training resources for the financial services industry.

Hicks' duties at SCTE will include creating membership recruitment and retention programs, developing membership benefits, analyzing membership needs, researching new services, and tracking membership demographics.

"I'm looking forward to working with the SCTE professional staff and volunteers to ensure that SCTE membership meets the evolving needs of its constituents," Hicks said.

"Melissa's association and membership services experience will add fresh ideas and insights as we focus on ways to better serve our members." Clark said. CT

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By Ron Hranac

The Ongoing dB "d-Bate"

Undoubtedly, you've been hanging on to the edge of your seat waiting for this exciting conclusion to last month's column. The subject of so much anticipation is the decibel and how it can be used indirectly to represent absolute signal levels. I say indirectly because, when you deal with decibels, you're really dealing with ratios.

Let's see, where were we?

I believe we had taken a couple of arbitrarily chosen signal powers (0.0000133 watt and 0.000000133 watt) and converted them to voltages using a variation of the formula $P = V^2/R$. In that formula, P is power in watts, V is voltage in volts, and R is resistance, which in this case is the 75-ohm impedance of our coax networks.

Hey, we all make mistakes

As I look at the manuscript for the first installment of this drama, it appears that I inadvertently got my answers backwards (oops!) because 0.0000133 watt is 0.03162 volt (31.62 millivolts) and 0.000000133 watt is 0.003162 volt (3.16 millivolts), not the other way around. If you spent the past few weeks trying to figure out why your calculator gave you the correct answers instead of the ones I gave, consider it a test to see if you were able to stay awake through the whole exercise!

Anyhow, dealing with all those zeroes and decimal places can get confusing and clearly can lead to mistakes (ahem!) when sorting through calculations. This could get even nastier if we had to interpret system signal levels on a signal level meter (SLM) that displayed those levels in volts, millivolts or microvolts.

Fortunately, there is a much easier way to deal with these often cumbersome numbers. In the world of cable TV and our 75-ohm impedance networks, the solution is based on the decibel, but with a reference appended to it: decibel millivolt, or dBmV.

Stand by for math

Invoking good ol' ratios, we can compare signal voltages in millivolts to a so-called zero dB reference of 1 millivolt, where 1 millivolt equals 0 dBmV. Mathematically, dBmV = 20log(level in millivolts/1 millivolt). A side note here: Converting from watts to volts via Ohms Law gives us "20log" in the voltage world instead of the "10log" used in the power world.

All that being so, what's 3.16 millivolts expressed as dBmV?

dBmV = 20 x [log(level in millivolts/1 millivolt)]
dBmV = 20 x [log(3.16 mV/1 mV)]
dBmV = 20 x [log(3.16)]
dBmV = 20 x [0.5]
dBmV = 10

It's +10 dBmV. In other words, 3.16 millivolts is 10 dB greater than the 1 millivolt reference. If you plug 31.62 millivolts into the formula, you get +30 dBmV, which simply says 31.62 millivolts is 30 dB greater than the 1 millivolt reference.

dBmV = 20 x [log(31.62 mV/1 mV)]
dBmV = 20 x [log(31.62)]
dBmV = 20 x [1.5]
dBmV = 30

It's all about ratios. One nice thing about working with decibels is that much of the math is reduced to addition and subtraction. Back to that amplifier gain example I used in last month's column for a moment: If the input is +10 dBmV (3.16 millivolts, or 0.000000133 watt) and the output is +30 dBmV (31.62 millivolts, or 0.0000133 watt), the gain is 20 dB. Or, (+30 dBmV) - (+10 dBmV) = 20 dB.

Now then, which would you rather deal with: Signal voltages such as 0.003162 volt and 0.03162 volt, or +10 dBmV and +30 dBmV? See how easy all of this becomes using the decibel? By the way, if you feel so inclined, you can convert dBmV to millivolts using the formula:

millivolts = $10^{(dBmV/20)}$

Suppose you want to figure out how many millivolts +6 dBmV is. Plug the number into the formula, and work a little magic with your scientific calculator. Well, not really magic. You have to use the exponent key. On my calculator, it's the one marked 10^x. The equations follow. ➤

Conversion table

dBmV	millivolts
-10 dBmV	0.3162 mV
- 9 dBmV	0.3548 mV
- 8 dBmV	0.3981 mV
- 7 dBmV	0.4467 mV
- 6 dBmV	0.5012 mV
- 5 dBmV	0.5623 mV
- 4 dBmV	0.6310 mV
- 3 dBmV	0.7079 mV
- 2 dBmV	0.7943 mV
- 1 dBmV	0.8913 mV
0 dBmV	1.0000 mV
+ 1 dBmV	1.1220 mV
+ 2 dBmV	1.2589 mV
+ 3 dBmV	1.4125 mV
+ 4 dBmV	1.5849 mV
+ 5 dBmV	1.7783 mV
+ 6 dBmV	1.9953 mV
+ 7 dBmV	2.2387 mV
+ 8 dBmV	2.5119 mV
+ 9 dBmV	2.8184 mV
+10 dBmV	3.1623 mV

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millivolts = $10^{(dBmV/20)}$
millivolts = $10^{(+6\ dBmV/20)}$
millivolts = $10^{(0.3)}$
millivolts = 1.995

Spare me further math and suffering

Using the formulas discussed so far, you can make yourself a handy dBmV-to-millivolts conversion table. I've created a small one (on page 26), including values from -10 dBmV to +10 dBmV.

As you look at the table, it should become obvious that the concept of dBmV is nothing more than ratios of various voltages to a defined reference. For example, 2.5119 millivolts (+8 dBmV) is 8 dB greater than 1 millivolt, 0.3981 millivolt (-8 dBmV) is 8 dB less than 1 millivolt, and so on. While dBmV technically is nothing more than a ratio, it provides an indirect but convenient way to express absolute signal levels using the decibel.

Still more examples

What about other examples where different references have been appended to the decibel? You've probably seen some of them: dBμV, dBm, and dBW are three that come to mind. These are abbreviations for decibel microvolt, decibel milliwatt, and decibel watt. The 0 dB references are 1 microvolt, 1 milliwatt, and 1 watt respectively. In each case, some signal level is being compared to the 0 dB reference, resulting in a ratio of that signal level to the defined reference. Here, too, the decibel provides an indirect way to express absolute signal levels. The formulas for these three are dBμV = 20log(level in microvolts/1 microvolt), dBm = 10log(level in milliwatts/1 milliwatt), and dBW = 10log(level in watts/1 watt). Note that the two direct expressions of power are 10log-based, while voltage is 20log.

Bottom line: The decibel by itself can be used to express gain and loss, but not absolute signal levels. You must append the decibel with a reference in order to be able to use it to express levels.

OK, time to put away the calculators and go get a fresh cup of coffee. Class dismissed! CT

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

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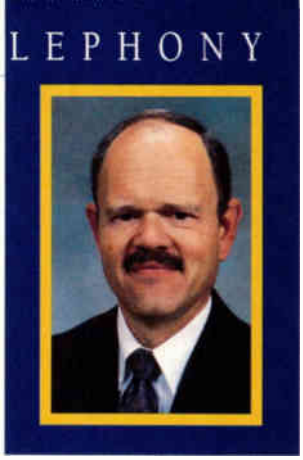
By Justin J. Junkus



Solving IP Telephony's Data Management Challenge

As many of us believe, Internet protocol (IP) telephony promises to be a cost-efficient way to leverage cable's broadband distribution system to deliver carrier-grade telephone service. This month, I want to touch on some of the data management issues that need to be addressed before that can happen, as well as the directory management technology that may be used to solve those issues.

First, let's think about what information needs to be managed in a telephony system. When asked this question, most people with some telephony background probably will immediately cite some form of customer data, such as billing, or a customer service database. Technical support personnel usually will point to operations systems that monitor system health and schedule various maintenance operations.

It's all about features

These are all good answers, but there is one more category of information that is more important—features. In a circuit-switched system, the telephony switch implements several hundred features. Although only subsets of them, such as caller ID, call waiting and call transfer, are actively marketed to residential subscribers, the others add tremendous value to a telephony system.

These others may be related to system maintenance or to making the telephony system perform tasks beyond residential call processing and routing, such as the automatic call distribution feature set used to build a customer service center.

The need for these features doesn't go away with a change of technology to packet- instead of circuit-switched. They still are necessary, and if the traditional time division multiplexed (TDM) circuit switch goes away, then obviously they need a place to reside. The exact place varies with vendor implementation, but in concept, it is in some type of server connected to the telephony network.

> "Cable will solve the problem of delivering features first because it has to be competitive with the incumbent phone company."

Server features, feature servers

Server is a data term, but remember that IP telephony is moving voice information that has been converted to the same packet structure as any other data. Packets, the building blocks of IP telephony information, have an administrative part called a header and an information part called the payload.

Both parts are collections of ones and zeros organized in a pertinent code. Certain payloads represent voice conversations, while others may be instructions or information used for control, record-keeping or maintenance. The server's job is to hold information and "serve" it to other parts of the system, called "clients," as needed and requested by the clients.

A voice circuit switch with a distributed processing architecture can be evolved to where part of that architecture takes on the role of "feature server." Circuit switches traditionally have been built to provide features as part of the call processing and routing of voice telephony. With each generation of digital circuit switching, feature definition software has become more independent of call processing software.

At some point in switch architecture evolution, the feature server can become completely independent of the routing and call processing part of the architecture. It, and all of the circuit switch features, can then also be used in a packet network architecture for IP telephony. This essentially is the philosophy Lucent Technologies is pursuing with its 7R/E telephony product.

Another way to reach the same end is to build from a data-routing, rather than a voice-routing, architecture with general links to applications servers. The servers and their software can be provided by third parties or by the network vendor. One of those applications servers can provide telephony features. Several vendors that traditionally have marketed data solutions, such as Cisco Systems, appear to be taking this route.

Whichever route is taken, feature information in the server needs to be correlated with other information, such as subscriber location, phone number and how many

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times a feature is used. The process of putting all of the information together is called directory management.

Directory = database

Directory is another data term. Simply put, directories are databases. Like any other database, they may contain user information, such as name and address, e-mail, and phone number. The power of a directory, however, is that it can hold a broader variety of information, possibly including the software definition of a feature, or security data, such as passwords and keys used for conditional access. My April 1999 column covered some of the ways directories interact with each other and policy servers to provide various classes of service to subscribers.

Obviously, many directories can exist in a company, and several of them will contain what should be the same information. The July 12, 1999, issue of *Information Week* stated that large companies support an average of 181 separate directories.

The information for any given field, such as "customer phone number" in any of the directories must be accessible by other directories and must correlate across directories. If not, producing meaningful results by combining information from multiple directories is impossible.

The likelihood of a problem drops if one vendor provides and maintains most of the pertinent directories (such as a feature server integrated into a circuit switch that also collects billing data), but it still can exist whenever there is an interaction with data built by another system. Most back office customer support is an example of this multivendor environment.

Solving that problem can be done in one of two ways: standardized directory communication protocols or master directories, called "metadirectories." Neither is a perfect solution.

Standardized directory protocols are slow in coming. The Lightweight Directory Access Protocol (LDAP) has been proposed as the standard for sharing directory information, but it has not been widely implemented. Even where vendors have created LDAP-compliant systems, the standard still has enough leeway to cause discrepancies between vendors.

This year, another standards effort was initiated by IBM, Oracle and others, but it does not include support by Microsoft, Netscape and Sun Microsystems. Even for the participating companies, practical agreement on a common standard will take time.

Metadirectories usually are proprietary products, which must provide translation between other vendor's directories. As such, they are inherently limited by the number of directory vendors included, as well as by the need to keep current with a vendor's product. While Microsoft and Novell both have announced plans to roll out metadirectory software, many information technology managers prefer to build their own metadirectory software, customized for the directories used by their companies.

So, what to do?

The need to communicate between directories thus leaves cable operators with some tough choices. They can stick with a single vendor solution for the majority of their IP telephony system and back office support. They thereby minimize the possibility of not being able to access a piece of required information, but the single-vendor choice locks them into that vendor's program for both pricing and technology.

Alternatively, they can attempt to merge multivendor systems together with a metadirectory, either from a third-party vendor or one developed by their own staff. Although a third-party solution allows using multiple system vendors, that alternative also locks the operator to the third party's software. (Do you really trust Microsoft that much?) On the other hand, internally developed metadirectories require substantial internal resources to develop and maintain.

What most likely will happen is that the systems for IP telephony in the field will develop slowly and partially. Cable will solve the problem of delivering features first because it has to be competitive with the incumbent phone company. Temporary solutions, possibly even manual file transfer between dual systems, will be used to share data until a cost-effective solution can be found to integrate everything. CT

Justin Junkus is president of KnowledgeLink, a consulting and training firm specializing in the cable telecommunications industry. To discuss this topic further, or to find out more about KnowledgeLink, you may e-mail him at jjunkus@aol.com.

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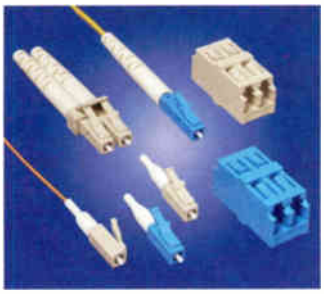

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Reader Service Number 25

By Jennifer Whalen

Headends: They've Come A Long Way, Baby

Consumer demand for digital video, data and telephony services is having a profound effect on today's cable headends. Not only are the equipment requirements greater to support the new services, but the very construction of the buildings also is being impacted. Today's engineers are designing digital headends with greater emphasis on reliability, power, fiber management, fire suppression, air conditioning and expandability.

I had the chance to tour two new digital headends—Cable TV Montgomery's (of Prime Communications lineage) headend in Rockville, Md., and MediaOne's Richmond, Va., facility. The engineers at both facilities are very proud of their state-of-the-art headends, and they have every right to be. Innovation and advance planning are evident everywhere you look.

When I say "new" headends, I mean new. Cable TV Montgomery had just turned up its first digital TV (DTV) customer the week before my visit. Roughly 1,100 fibers terminate in the headend, which serves 235,000 subscribers and delivers 81 analog channels and 115 digital channels, including 38 pay-per-view (PPV) and 40 music channels.

Like today's cable industry, nothing is simple anymore. The facility is really two headends in one, explained Rick Glover, headend manager for Cable TV Montgomery. The building houses the new 750 MHz headend for supplying both existing analog service and the new digital channels, as well as the old 500 MHz gear. "As we convert to 750 MHz, customers will come over to the new system. In two years, we will shut down the 500 MHz headend," Glover explained.

Takes a licking and keeps on ticking

Clearly, this headend is built to meet today's requirements for delivery of 24-hour, uninterrupted service. In the event of an electricity outage, two 50 kW uninterruptible power supplies (UPSs) deliver temporary backup power to the headend until the onsite diesel fuel generator kicks in, Glover reported. The 500 kW generator can supply power for 50 hours before needing refueling. "The generator also powers the whole building, so our customer service center can stay in operation," he added.

Can't take the heat

But it's not just power that ensures reliability. All that equipment generates a lot of heat. "We've installed a raised computer floor with air conditioning and electricity under the floor," Glover explained. Cool air comes up from the floor, which dissipates the heat generated by equipment more efficiently. State-of-the-art FM200 fire suppression systems also protect the headend in case of a fire.

Worried about vandals breaking in and damaging all that new, expensive equipment? Glover has that covered, too. From the outside, the headend looks like just any other office building, with tinted glass in front of drawn window shades. However, the glass is bulletproof, and the window shades are backed by solid steel, floor-to-ceiling plates.

When planning your headend, be sure to leave room for expansion to accommodate both the growth of existing services and to support new services.

MediaOne knows a lot about growth, as its Richmond facility serves 144,484 subscribers. In addition to analog and digital video equipment, the headend also houses servers and routers for its Road Runner cable modem service. And the facility is home to one of MediaOne's telephony hubs, explained Wesley Burton, technical engineering manager for the company.

Roof-top gardening

Delivering some 140 digital channels (including 36 PPV and 40 music channels) in addition to its 78 analog channels requires increased satellite capacity at the headend. With no space for satellite antennas in its parking lot, MediaOne had Scientific-Atlanta install its 12 earth stations on the roof—giving new meaning to the term "roof-top garden."

"It was cheaper than installing them at a remote site and running fiber. Now we just have to run coax," Burton explained. The earth stations and the 14-inch steel I-beam support structure that holds them are built to withstand 130 mph winds—the need for which is clearly evident with the current spate of hurricanes buffeting the East Coast.

Consumer demand for more programming is eating up the capacity of all those earth stations. MediaOne is in the process of extending the steel support structure on the roof so it can add two more 6-foot earth stations. "With the extension, we hope to have room for even more if needed," Burton added.

With the innovative thinking shown by these engineers, it's clear that today's headends will keep pace with the growing demands of subscribers. CT

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

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Reader Service Number 28

By David Devereaux-Weber

SCTE-List Turns Five

Every great idea starts with a small beginning. On Aug. 10, 1994, Jonathan Kramer sent the first message to the fledgling SCTE-List. Now, more than 1,500 people subscribe.

Here's how it all began:

From: Jonathan Kramer
Date: Wednesday, Aug. 10, 1994
This is a test message.
Ping.

Jonathan L. Kramer

From that relatively inauspicious beginning, a resource began to grow. Several other messages followed, mostly in the "let's get acquainted" vein, before we got into the technology of the day.

Of course, things have changed a bit since then. Now, the hot topics are the myriad technical details of open access, advanced services, standards, return path testing, system hardening, and exactly how to make all of them work.

The List was intended to be, and remains, a forum for solving problems—that certainly hasn't changed a whit. In the first month of the List's existence, we had 55 messages posted; today, we generally receive more than 20 daily.

Early days and origins

Many of the early subscribers are still with us. Those subscribers were technicians and engineers from operating cable companies; researchers and engineers from telecommunications laboratories (such as the Media Lab at MIT, CableLabs and Bell-Northern Research); the academic community, including telecom professors and institutional network operators; cable telecom regulators, both local and federal; consultants to cable operators and regulators; cable industry equipment manufacturers; and the trade press, initially including *MultiChannel News*, *Inter@ctive Week*, and *MacUser* Magazine.

In addition, computing companies, such as Apple Computer and Sun Microsystems, and manufacturers of networking gear, such as Cisco Systems, have been on the List since the beginning.

Among the topics we discussed in the first few months was digital TV (DTV)—for video conferencing—and cable modems, though not the Data Over Cable Service Interface Specification (DOCSIS) standard. At the time, CableLabs had been operating for six years, and analog fiber had been around for about the same time. Although fiber was being used in a few new systems, trunk-and-feeder plant still was the mainstay.

The World Wide Web was only just beginning. Almost none of the cable operators on the List had e-mail addresses with company domains—few companies even had domains at all. Hardly any cable operators or vendors had Web sites. Cable operators were not yet offering Internet services of any kind.

When the List started, I had been working at the University of Wisconsin-Madison for about a year in its information technology (IT) department. Although I had a fair amount of cable TV experience (as a consultant, I had helped to design one of the University's cable systems in the 1980s), I wanted to find out more about cable TV technology. As a "U" employee and network engineer, I had access to the Internet, where I looked around for cable TV information. Finding darned little, I decided to start a discussion list to help facilitate the sharing of information.

And so the List was born.

What it's become

Currently, the SCTE-List has more than 1,500 subscribers, and this number has stayed relatively stable over the last few years. Traffic on the List today definitely reflects the changing face of technology and its influence on our industry.

Now almost every cable operator has its own domain for e-mail. Many operators, vendors and industry trade publications have Web sites. Trunk-and-feeder has given way to hybrid fiber/coax (HFC) in new builds, and many old systems have been rebuilt to the new de facto industry standard. Many systems are offering DTV, Internet and high-speed data service using cable modems, and many are experimenting with cable telephony or Internet protocol (IP) telephony.

These new services and technologies are changing the way systems are designed and built—big time. Technicians have always wanted to build high-capacity, reliable systems, but now the business model demands it.

The need for ways to share information has continued and grown since 1994. The pressure is always on us to learn more, faster, and for less cost. The SCTE-List still is a good way to do that. CT

Dave Devereaux-Weber, P.E., is a network engineer at the University of Wisconsin-Madison. He is a senior member of the SCTE, and he can be reached via e-mail at djdevere@facstaff.wisc.edu.

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If you are Alfred E. Neuman of *Mad Magazine*, you would e-mail the command **subscribe scte-list Alfred E. Neuman** to the address: **listserver@relay.doit.wisc.edu**

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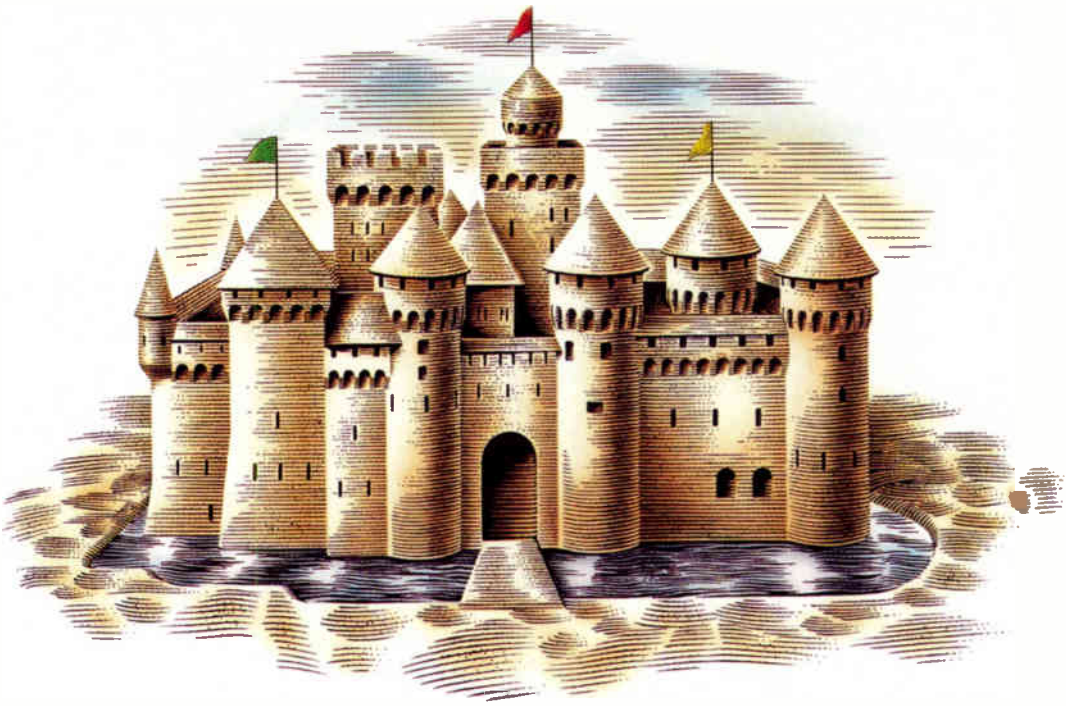

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Upgrades, Advanced Services Top Plans for 2000

By Jennifer Whalen

With little left of 1999, the cable industry's technology leaders are finalizing their plans for 2000. Completing network upgrades and aggressively launching advanced services top their "to-do" lists.

To provide you with a blueprint for the new year, *Communications Technology*'s editors have assembled a series of articles in our October and November issues on the most critical planning issues for 2000. For a look at what's hot, read on.

Relentless upgrade pace

With the industry consolidation underway comes the push to deliver new two-way services. Forrester Research predicts that combined cable subscription revenues from video, voice and data services will near $32 billion this year, climb to more than $34 billion in 2000 and skyrocket to $61 billion in 2005. Much of the new revenue comes from nontraditional services. (See the chart on page 44.) As a result, completing network upgrades to support the new services is critical.

"We are all very aggressively continuing to spend lots of dollars upgrading our cable systems to either 750 or 860 MHz, fiber down to between 500 to 1,000 home nodes, and activating the two-way portion of the plant. That's the baseline network you need in place to offer these new services," says Alex Best, executive vice president of engineering at Cox Communications.

Time Warner Cable is a leader when it comes to network upgrades and activating the return path of its 220,000 miles of plant. "By the end of this year, our upgrades will be 83-percent complete. The budgeting for next year will include the remainder of our upgrades," says Paul Gemme, vice president of plant engineering. "It's been a huge undertaking and a highly capital-intensive project. But we think it will pay off in spades."

Cox is right on TW's heels when it comes to upgrading its 106,000 miles of plant, although the company's buying spree has impacted its schedule. "Based on the recent acquisitions, we're now claiming that we'll be 78 percent upgraded at the end of 2000 (down from 90 percent prior to the purchases). At the end of this year, we'll be 65 percent complete," reports Best.

Chantilly, Va.-based Media General is one of those acquisitions impacting Cox's upgrade statistics. "We have a rather significant conversion facing us because of our unique architecture," says Christopher Young, senior vice president of technical operations and construction for Media General. "We are a dual 450 MHz system, and we have been supplying 120 channels of analog capacity since the early '80s."

Because of the dual system's 120-channel capacity, Media General hasn't felt the same competitive pressures to move to a fiber-rich, digital platform. However, with its acquisition by Cox, the operator intends to move to a single-cable system, which necessitates a hybrid fiber/coax (HFC) overlay and coaxial cable upgrade.

Chris Young, Media General

"While the dual-cable system has been a channel-rich system, it's been quirky and difficult to maintain," Young says.

Planning for construction

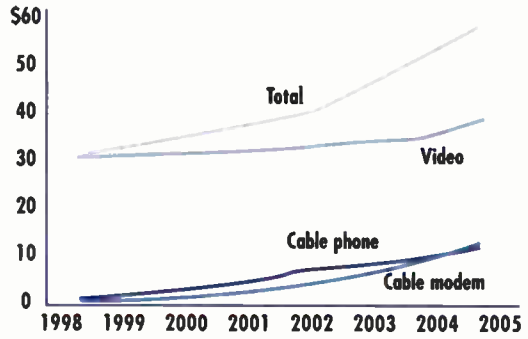
With the rush to upgrade networks, it's easy to forget that the codes governing construction of new builds and rebuilds may not be moving forward at the same speeds. Steve Johnson, director of engineering and technology at TW, advises you to keep tabs on the National Electric Code (NEC) when planning your upgrade.

The code recently has been revised to allow for 90 V down the drop to support new services. "As we were installing network interface devices powered from the cable system, we needed to power them at 90 V rather than 60 V," Johnson says.

Article 830 of the NEC now allows cable operators to use 90 V of power at 100 watts to support services for single-family homes and small apartment complexes, explains Johnson. But be careful—your municipality might still be operating under an older version of the NEC. If it is, you have to abide by whichever version the municipality uses.

The industry continues to work on

Subscription Revenue (billions) *Source: Forrester Research*



	1998	1999	2000	2001	2002	2003	2004	2005
Total	30.2	31.9	34.3	37.8	42.0	47.0	52.7	61.0
Video	29.9	30.8	31.7	32.3	32.7	34.2	35.1	38.3
Cable modem	0.3	1.0	2.0	3.8	6.1	7.5	9.6	11.0
Cable phone	<0.1	0.1	0.6	1.7	3.2	5.3	8.0	11.7

Steve Johnson, Time Warner

developing Article 831, which would allow operators to increase power to 2,250 watts to support advanced cable services for high-rise buildings.

Digital TV skyrockets

Digital TV (DTV) probably will see major growth next year, as many operators have launched the service and will spend 2000 aggressively deploying it. The Strategis Group forecasts that DTV revenues will more than double, climbing from $359 million in 1999 to $817 million in 2000.

Currently, about six of TW's divisions deliver DTV over Pioneer and Scientific-Atlanta set-tops. "During 2000, there will be probably 25 divisions that have full digital launches," reports Gemme. "The remainder will follow the next year. That may get bumped up depending on the success and our capital. If we had our druthers, we'd launch everywhere because we think it's going to be a huge success."

Scott Shelly, vice president of operations for Prime Communications' Cable TV Arlington and Cable TV Montgomery, launched DTV in August in Arlington County, Va., and service rolled out in Montgomery County, Md., in September. "It's going to be a big market driver for us," Shelly says. "Hopefully, by the end of the year, we'll have 10,000 digital set-top boxes in the home. Next year, we'll be heavily marketing that product."

Many planning issues still remain, especially when it comes to streamlining procedures, says Shelly. The storage capabilities of the new set-tops will require disconnect procedures different from those for analog boxes. "If I'm a customer and I disconnect service today, I could have ordered pay-per-view (PPV) events that are stored in the box .... You can't remove the account until you get the events out of the box," Shelly explains.

"We have some concerns about installation as well," Shelly adds. "With our data product, we found that over 65 percent of our installs were self-installs. From that experience, we're anticipating the same amount, if not more, digital self-installs." In light of that history, Shelly's team plans to assemble a self-installation package that includes the cables needed to hook up a General Instrument DCT 2000 digital set-top box, as well as a videotape.

Scott Shelley, Prime Communications

Adding digital service also requires more upfront planning in your headends, says Mike Smith, director of engineering for Adelphia's Virginia region. You'll need more space, equipment, power and air conditioning in your headends, depending on how many digital channels you launch.

"At minimum, you'll need two more racks if you're doing a 10- to 12-channel package. You've also got (uninterruptible power supplies) for the computer-driven stuff so you don't have to reset it every time you have a power glitch," says Smith. "As we deploy digital platforms, monitoring the headend for heat, fire and fire suppression becomes important because you are putting more dollars into those facilities." ➤

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Reader Service Number 32

Migration to DOCSIS

The availability of CableLabs-certified Data Over Cable Service Interface Specification (DOCSIS) modems also is impacting cable operators planning for data services. Operators are moving actively to the standards-compliant modems.

"Currently where we have one-way GI SURFboard cable modems, we want to get away from the telco return. So we are looking at the DOCSIS platforms," says Smith. "Even where we don't have the two-way plant up and working yet, we are switching over to a three-way modem (GI 2100 D), which has a telco return initially, but as soon as the reverse is activated, the modem auto-senses that and switches over."

Because of Time Warner's involvement with RoadRunner service, it has a bigger challenge than most operators in DOCSIS migration. The company has 15 to 20 systems with non-DOCSIS modems deployed, reports Gemme. "We will run two systems simultaneously, and all new modems will be DOCSIS. As time goes by, we may move some of those older modems back into three or four divisions until we get them off the books," he explains. ➤

BOTTOM • LINE

"To-Dos" for 2000

As cable engineers prepare for next year, it's clear that completing network upgrades and launching digital TV (DTV), high-speed data and telephony services top their "to-do" lists.

Combined cable subscription revenues from such services are expected to grow to more than $34 billion in 2000 and reach a whopping $61 billion by 2005, says Forrester Research. For cable operators to secure a piece of that action, they will need to complete their upgrades to 750 or 860 MHz and activate the return path.

Operators aren't content with simply the latest digital TV and data services. Broadband leaders like Time Warner Cable and Cox Communications also have interactive services such as video on demand and Internet over TV in the works. Telephony launches are expected to intensify next year as well.

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Reader Service Number 35

What about telephony?

While plans are in full swing for DTV and cable modem service, cable operators have been slower to dive into telephony. One multiple systems operator (MSO) not afraid to get its feet wet with telephony is Cox Communications. "To do telephony and do it right, you need the telephone switch, uninterruptible powering and all kinds of third-party agreements," says Best, adding that the company ended the second quarter with 60,000 residential voice customers.

Alex Best, Cox Communications

Cox also plans to tackle the business market. Already, the MSO has signed up 700 business customers in Omaha, Neb., for its voice product.

"Our intent is to put the manpower, resources and focus in place to go after the commercial market in a much bigger way," Best says.

Telephony is in the works at Time Warner as well. "We plan to continue our conversations with AT&T," says Gemme. "We will get a deal done with AT&T and launch telephony in 2000."

Other operators are more cautious when it comes to telephony. "We have constructed the plant, so we have the capabilities in fiber optics, but we're not really sold on wired-based telephony services," says Prime Communication's Shelly. "We're looking at what's going on with IP (Internet protocol) telephony, but we've no definite plans yet."

An interactive future

You'd think with all the upgrade activity and new rollouts that operators would have their hands full. But MSOs already have plans to add interactive services.

"As we move into 2000, the cable industry in general will move more into interactive services. One such service is Internet to the TV," says Cox's Best. Customers will be able to send and receive e-mail or access the Internet from TV sets rather than personal computers (PCs).

"We intend to trial Internet to the TV in our San Diego system some time after the first of the year," he added.

The Holy Grail of video services—VOD—also will reach prime time next year. Falling prices for digital set-tops and file servers for storage and video streaming will make VOD a reality, Best says, adding that Cox plans a VOD trial next year.

Time Warner has even more ambitious plans for VOD. "In the latter part of this year, we will launch video-on-demand in at least two divisions, and we will launch a number of other divisions next year. That's where a lot of our planning will be," reports Gemme. Time Warner will use VOD equipment from Concurrent Computer Corp. for its test in Tampa, Fla., and a system from SeaChange International for its test in Austin, Texas.

Finding people

People are key to making these plans come true. Training them for new services and retaining them can be difficult. "We've lost 21 employees in three months to the competition," says Shelly.

Cable TV Arlington and Cable TV Montgomery have impressive training programs (See *CT*, August 1999, page 90.) "We train the hell out of them, and they are so well-trained they are taken from us," he says. The company is testing referral, signing and staying bonuses to help recruit and retain talented employees. In addition to job fairs and Internet postings, Media General also looks to the military for skilled technicians.

Time Warner has decentralized its training approach. To make it easier for in-house personnel to receive training in new services, instructors now visit the local TW divisions rather than making personnel travel to a central facility.

Exciting times ahead

With the new year nearly upon us, it's imperative to refine your upgrade plans and engineering strategies for delivering advanced services. The articles that follow this month and next will provide you with a blueprint for staying ahead of this rapidly changing marketplace. CT

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

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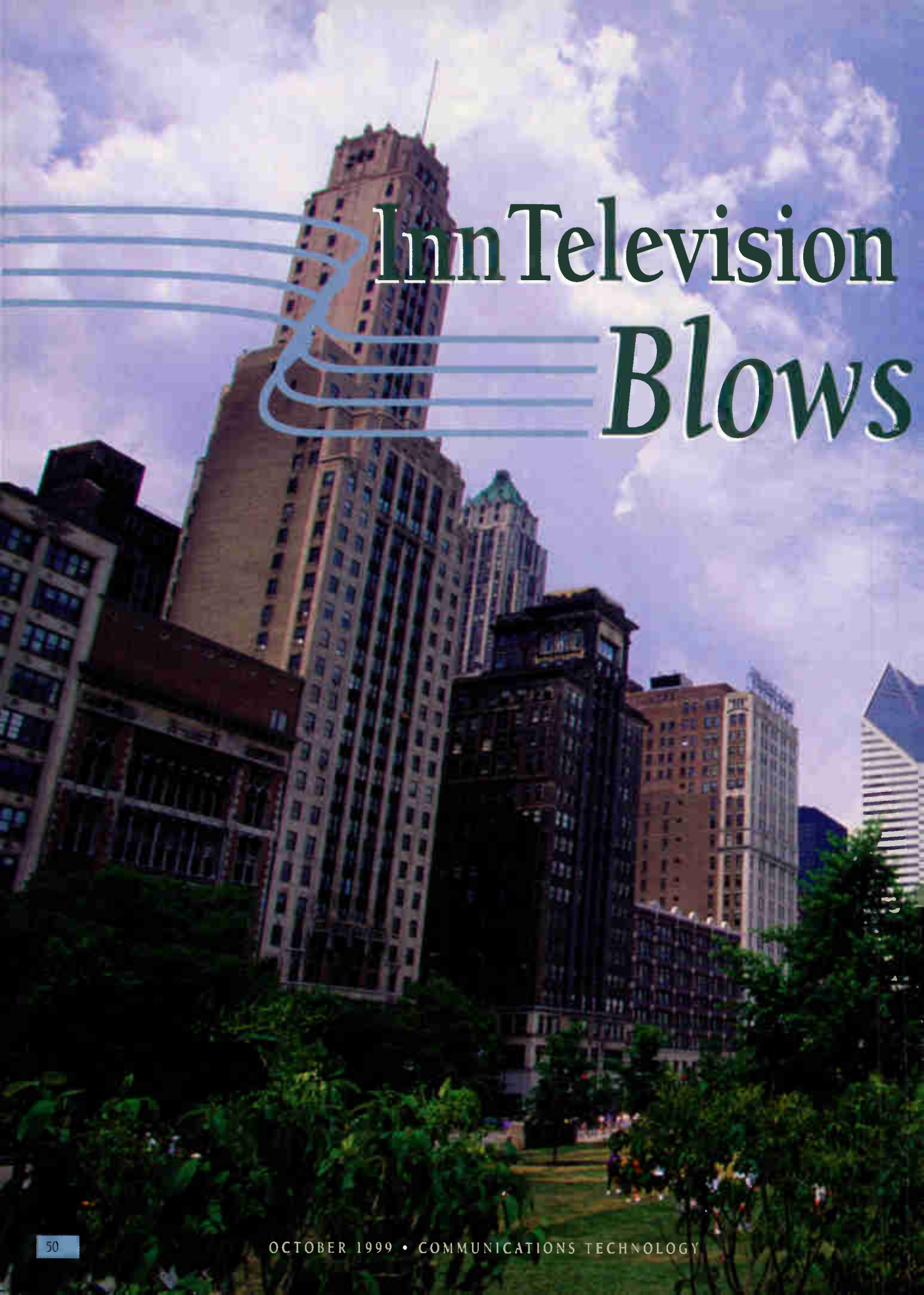

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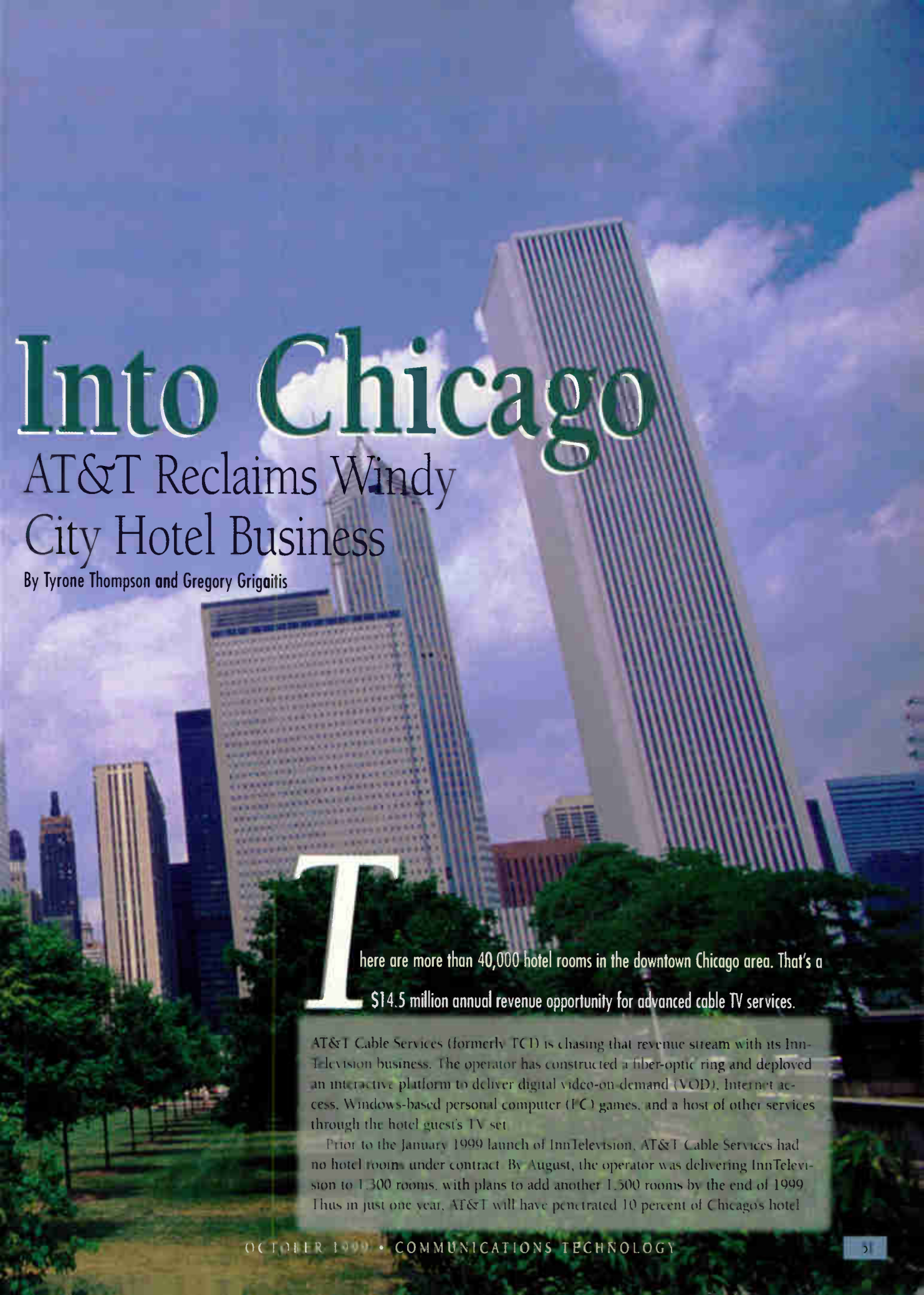


Into Chicago

AT&T Reclaims Windy City Hotel Business

By Tyrone Thompson and Gregory Grigaitis

There are more than 40,000 hotel rooms in the downtown Chicago area. That's a $14.5 million annual revenue opportunity for advanced cable TV services.

AT&T Cable Services (formerly TCI) is chasing that revenue stream with its InnTelevision business. The operator has constructed a fiber-optic ring and deployed an interactive platform to deliver digital video-on-demand (VOD), Internet access, Windows-based personal computer (PC) games, and a host of other services through the hotel guest's TV set.

Prior to the January 1999 launch of InnTelevision, AT&T Cable Services had no hotel rooms under contract. By August, the operator was delivering InnTelevision to 1,300 rooms, with plans to add another 1,500 rooms by the end of 1999. Thus in just one year, AT&T will have penetrated 10 percent of Chicago's hotel

> "At $30 per month, each hotel room looks like a residential cable subscriber."

rooms. Chicago is just one of the metropolitan areas where cable is unseating the traditional hotel service providers and tapping a new revenue stream.

Weighing the traditional option

Traditional hotel guest entertainment systems, from such companies as LodgeNet and On Command, require valuable hotel space to establish a mini-headend. That scenario demands the deployment of many racks of tape decks for movie playback, while a satellite dish and receivers gather traditional "free to guest" channels, such as CNN, ESPN and TBS. In addition, control computers are added to manage the system and interface with the hotel property management system (PMS) for billing purposes.

As with other high-intensity tape-based environments, tape decks can fail as jamming, head-failure and other problems occur, plus quality degradation of video home system (VHS) tapes as "play and rewind" cycles can repeat 24 hours a day, sometimes for up to 60 consecutive days.

In addition, there is a depth of copy limitation for a title. Specifically, if the number of hotel guests desiring to watch the same movie exceeds the number of tape decks loaded with that movie, some guests will be relegated to waiting—if they wait at all—for a deck with their movie selection.

Cable delivers

In Chicago, AT&T Cable Services envisioned the hotel services it would be able to provide with a fiber-based network throughout the city: interactive TV for the hospitality industry, as well as traditional cable today, and telephony and high-speed data services tomorrow. With the fiber in place, AT&T used SeaChange's GuestServe digital video server system to target the hospitality industry.

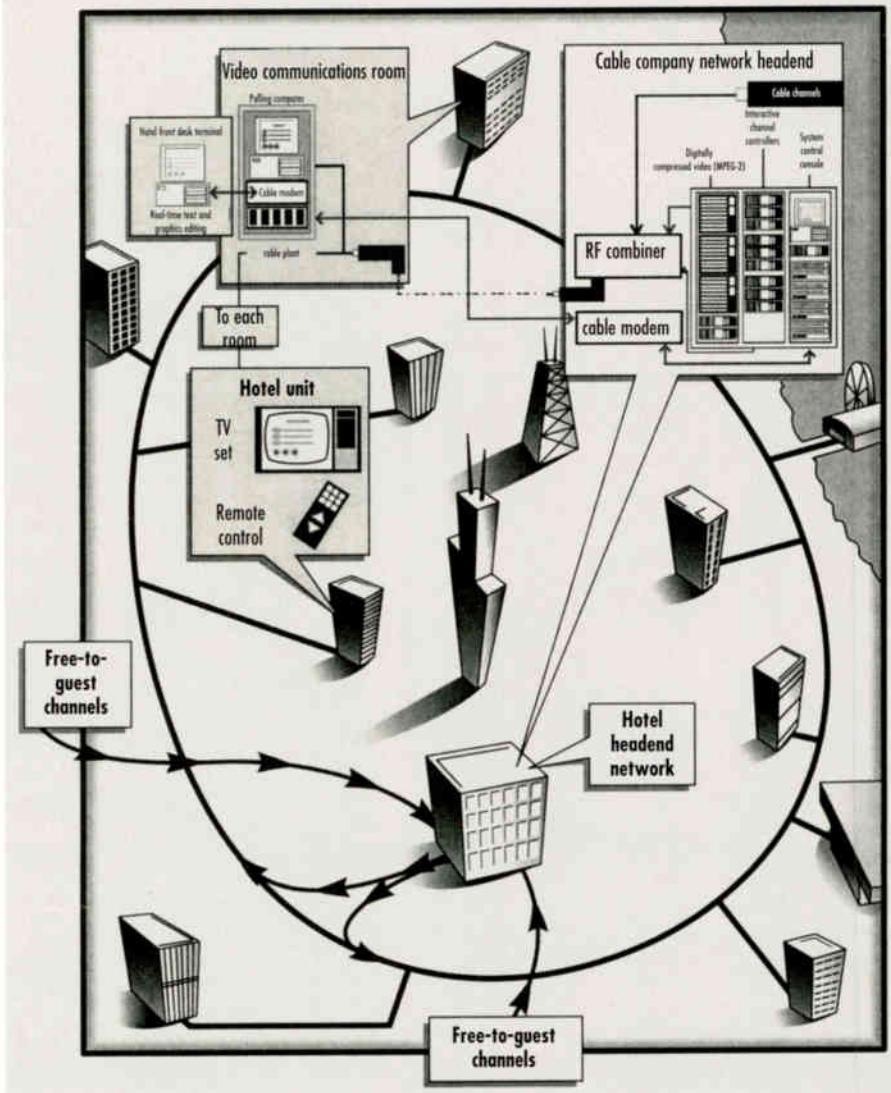
The scalable architecture allows Inn Television to pave the way for cable-based interactive TV service to all of Chicago's hotels. The system incorporates client/server technologies leveraged with AT&T's fiber ring around Chicago to locate the system assets at AT&T's downtown headend and share the resources with any hotel on the fiber ring. (See the accompanying figure.) There are lots of hotels within easy reach of the fiber ring.

The service encompasses content acquisition from major Hollywood studios, Moving Picture Experts Group (MPEG)-2 encoding, video server technology and in-hotel room set-tops. A hotel guest has access to first-run digital movies, Internet access through the TV set, 32-bit PC-based games, Folio Review, room service, interactive hotel tours, and multilanguage options (audible and on-screen text).

A welcome fixture

Hotel rooms on the service require simple components. The GuestServe set-top box has two-way capability. For most services (ordering a movie, selecting a free-to-guest channel, selecting room service), the guest utilizes a traditional TV remote control. For Internet access and PC gaming, the guest uses an infrared keyboard. ➤

AT&T Cable Services' InnTelevision fiber ring



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AT&T Cable Services has installed a five-node MediaCluster video server system to support its InnTelevision service. The system can store roughly 400 feature-length movies.

When the TV set is switched on, a menu of guest options appears. The customer interacts with the system by selecting menu options. The set-top communicates to the hotel headend (specifically, a computer called the Polling machine) over the hotel's master antenna TV (MATV) plant using a two-way RF modem. This modem allows communications at a data rate up to 152 kbps full duplex. The communications protocol operates at 49.8 MHz for the forward path to the set-top and at 9.8 MHz for the return path.

Hotel control

In the hotel is the video communications station, which includes a headend Polling machine with a two-way RF modem. The station manages all communications with set-tops and is connected to the headend through AT&T's fiber network. In addition to the video services provided to the hotel, the fiber network allows Internet protocol (IP) data communications between the InnTelevision headend and the Polling machine at the hotel through cable modems.

Interactive commands sent from the set-tops are interpreted by the Polling machine and are then translated into control semantics. From there, they're sent via IP through the cable modem over the fiber ring back to the central headend. In addition, a "front-desk computer" is included in the hotel video communications station. Through this computer, communications with the hotel's PMS occur, thereby

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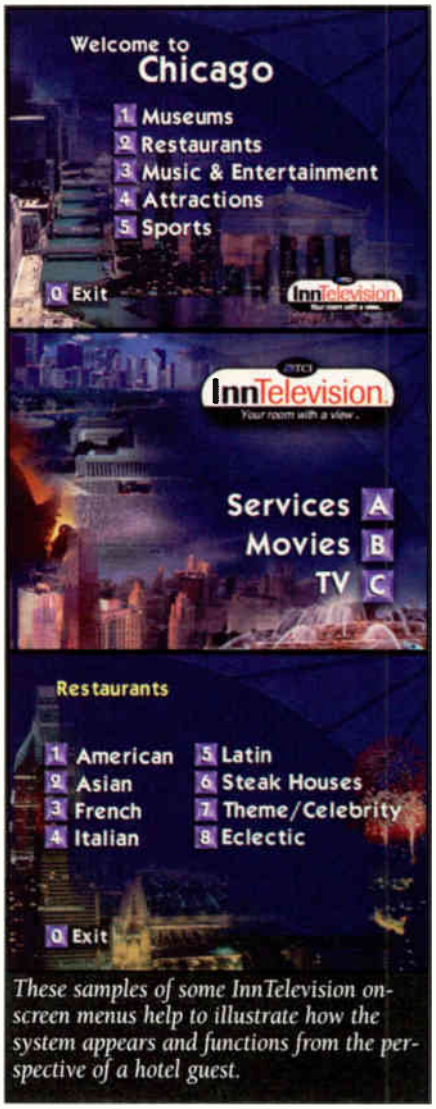
allowing for the posting of charges to customers' bills.

Meanwhile, back at the headend

AT&T's hotel-dedicated cable headend houses the majority of InnTelevision's infrastructure. Similar to traditional client/server models, a single group of assets can be used to serve multiple clients. In this case, that means multiple hotels, or multiple guests in multiple hotels. Unlike the traditional model where costly devices in a hotel sit idle during low usage periods, InnTelevision's resources are allocated as necessary to serve demand across the city.

AT&T's cable headend is home to the SeaChange MediaCluster (the video store or collection of video servers), a computer



These samples of some InnTelevision on-screen menus help to illustrate how the system appears and functions from the perspective of a hotel guest.

called the Console computer, interactive session management computers called Tree computers, and all the necessary modulation, networking, combining and cable modem equipment for delivering video and data services to the hotel.

When the Polling computer sees that a hotel guest has entered a request from either the remote control or keyboard, it translates the request and sends the data over the cable modem back to the headend and to the Console machine. If the guest has selected a movie, the Console machine issues a command to the MediaCluster to begin playing the movie. As the NTSC movie streams out, it feeds a frequency agile modulator. The Console machine assesses the RF spectrum in use, finds an available slot, and force-tunes the modulator to the appropriate channel. In addition, it sends a command to the Polling machine at the hotel, telling it to force-tune the specific set-top box to the same frequency—

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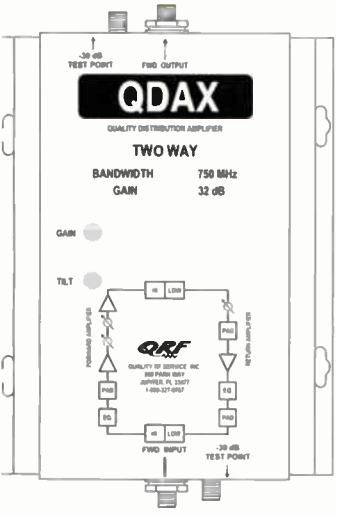

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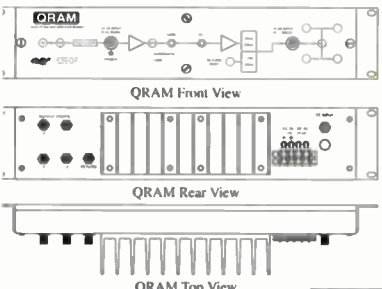

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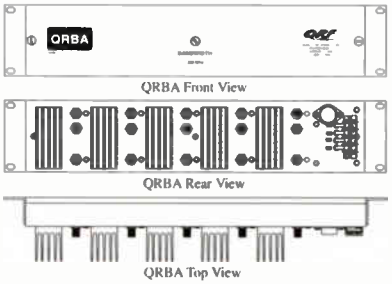

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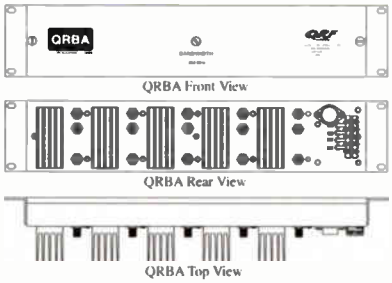

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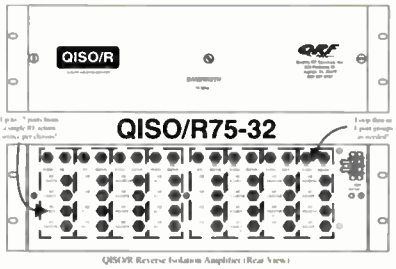

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Who's actually using the system? AT&T Cable Services intends to deliver InnTelevision service to 2,800 hotel rooms by the end of the year. The Best Western River North Hotel (left and center) and Hotel Allegro (right) are just two of the hotels providing the video, PC games, and Internet service to guests. Typical contract lengths are 5 years. Photos courtesy of Best Western River North Hotel and Hotel Allegro.

and then the customer receives the selected movie.

For Internet access or other interactive session activity, instead of the Console machine issuing commands to the MediaCluster, it issues commands to the Tree machines. They allow navigation through the menu system and provide games and Internet sessions. The output of the Tree machine is an NTSC signal that is force-modulated and mapped to a specific set-top box, similar to the manner in which the system handles movie requests. This interaction occurs for all services invoked by the hotel guest.

Ready to grow

The system currently is configured for 3,000 hotel rooms and can scale to serve every hotel room in downtown Chicago. The MediaCluster technology for delivering MPEG-2 video is a network of fast Ethernet-interconnected computers (each computer is known as a node) that perform as a single fault-tolerant video server system. Redundant array of independent discs (RAID) striping across drives within a node and across nodes allows it to deliver multiple simultaneous streams of a movie from only a single copy.

AT&T has a five-node MediaCluster, which is capable of storing more than 1.4 TB of video data—roughly 400 feature-length movies. Each node in the video server can have up to 48 MPEG-2 decoded video streams, for a total of 240 streams. The traditional subscription model, in a true VOD environment, demonstrates a 4-percent buy rate (one video stream is necessary to support 25 hotel rooms), so AT&T is prepared to serve as many as 6,000 hotel rooms.

King content

Hollywood sends SeaChange approximately 10 new titles for addition to the InnTelevision system each month. The movies arrive on D1 masters, and SeaChange encodes them into MPEG-2

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video. SeaChange then aggregates the content onto Digital Linear Tape and distributes it to AT&T for loading into the video servers. Hotel guests then have access to the movies.

By locating the equipment at the cable facilities, the amount of equipment needed at the hotel is minimized—a welcome relief from the racks and racks of failure-prone tape decks in the hotel basement. In addition, cable operators with their local presence provide an unparalleled level of service to the hotel.

The combination spells increased revenues for cable operators. CT

Tyrone Thompson is customer business manager at AT&T Cable Services. He may be reached via e-mail at thompson.tyrone@tci.com. Gregory Gregaitis is director of movie systems and GuestServe Network at SeaChange International, Inc. He may be reached via e-mail at gregoryg@schange.com.

BOTTOM • LINE

AT&T Chicago Taps Hotels

AT&T is committed to the hotel business: It has constructed a fiber-optic ring around Chicago to deliver services to the hospitality industry, including video-on-demand (VOD), traditional cable TV, Internet services and telephony.

Why is AT&T aggressive about this business? Because in the tumultuous world of cable system acquisitions, growth-oriented multiple system operators (MSOs) are paying upwards of $6,000 per subscriber. Remarkably, AT&T Chicago is acquiring cable subscribers for roughly one-tenth of that price—a true bargain at $600 to $700.

From a revenue equivalency perspective, at $30 per month, each hotel room looks like a residential cable subscriber. In the residential marketplace, you can't guarantee customer loyalty year to year, but AT&T is signing up hotels for five-year contracts and ensuring the long-term revenue stream. The InnTelevision system also provides a real, revenue-generating, living laboratory for the residential VOD business, positioning AT&T for yet another significant revenue opportunity.

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Plan for Network Manage

Get All Your Marbles in One Bag

By Fritz Rummery

Many startup cable operators build and maintain networks by purchasing a succession of products, each dedicated to addressing a specific need. While effective, such collections have drawbacks. They require technicians trained on each system. They incorporate multiple proprietary (or, at the very least, disparate) databases. And they generate a steady flow of system-specific data, difficult to leverage outside the scope of the product that generated or collected it.

These problems are easily solved by placing these stand-alones under the control of a network management system (NMS). Immediate benefits include standardization behind a single user interface, the simplified management of a centralized database, and the significant potential to extract additional performance from the system as an integrated whole (for example, with "smart" modules that correlate information from multiple layers, saving time and money).

Three rules provide the quickest, simplest route to a successful NMS implementation:

- Make system decisions that are both tactical and strategic.
- Invest in knowledge.
- Be prepared. Develop an NMS implementation plan as the first step in your overall network plan.

Plan for tomorrow

Operators must look beyond industry buzzwords and endless feature lists, evaluating prospective solutions for their abilities to meet both current and evolving requirements. By analyzing immediate (tactical) and long-term (strategic) goals with equal consideration, operators can make sensible investments in NMS systems that will remain in service for many years.

Gating qualifications

First and foremost, select a system that can maintain all types of elements—including power supplies, optical nodes, amps and end-of-line (EOL) equipment—and can easily integrate third-party element management systems (EMSs) for headend elements, regardless of the elements' manufacturer. Because most cable operators use a variety of products from different companies, this flexibility is crucial.

Protect your investment's technological viability by selecting a system that is scalable and extensible by design, one that can demonstrate its ability to support the changes you have planned. This will allow you to add users, applications and network elements as your network evolves. ➤

Look for network management systems with options that allow you to:

- Reduce alarm traffic at the central office, network operations centers (NOCs), and regional operations centers (ROCs) using advanced rules-based alarm filters. Such systems correlate information from multiple network locations, distilling multiple alarms into single, actionable, root-cause alarms. This speeds service and eliminates unnecessary truck rolls.
- Provide integrated signal analysis capabilities. In addition to monitoring signals leaving the headend, the system also should perform prescheduled signal measurements at selected EOLs within the cable plant. Integrated signal analysis capabilities qualify the plant's performance over time (days, weeks or times of day), assuring signal quality to customers while assisting with internal troubleshooting efforts.
- Manage the return path. With the proliferation of two-way services, a preferred NMS offers return path analysis solutions that integrate seamlessly into their NMS frameworks.

Invest in knowledge

The contributions of professionals with specific training and experience on the NMS products being installed are essential. Your NMS vendor must offer expert, on-site assistance during the early phases of your plant rollout. These services greatly assist a company's existing staff. There is no replacement for a vendor's intimate familiarity with its own product and no way to overstate the value of starting an NMS installation off on sound technological footing.

BOTTOM • LINE

Tie It All Together

Many cable operations consist of an odd succession of products, each dedicated to addressing a specific need. While effective, such collections easily can become nightmares of incompatibility.

Placing these stand-alones under the control of a network management system (NMS) is a good way to create a cohesive whole, rather than just a bunch of parts. Immediate benefits include standardization behind a single user interface, the simplified management of a centralized database, and the significant potential to extract additional performance from the system as an integrated whole, all of which can help save time, money and effort.

Three rules provide the quickest, simplest route to a successful NMS implementation:

- Make system decisions that are both tactical and strategic.
- Invest in knowledge.
- Be prepared. Develop an NMS implementation plan as the first step in your overall network plan.

Beyond the initial installation, these same professional service teams also can assist in ongoing operations. Remember, your solution provider needs to be a "partner" who clearly understands your company's objectives and has both the ability and the commitment to meet mutually agreed upon network goals in a timely fashion.

In-house expertise

Rapid change in the industry has sent network operators scrambling for experienced engineers knowledgeable in the latest technologies. These professionals also are vital to the success of an NMS implementation. Whether you appoint an NMS manager or distribute responsibilities among several employees, your on-site network management capabilities need to include:

- Significant experience with information systems: management, administration, configuration, training and support on various operating systems. Database knowledge is a plus.
- Working information technology (IT) knowledge: disk formatting and partitioning, network interface card (NIC) installation and configuration, scripting, databases, text editors, transmission control protocol/Internet protocol (TCP/IP) networks, and protocols (RS232, RS485, TCP/IP)
- Proven project management or project leadership experience
- Experience with integration and troubleshooting of hardware and software products
- Comprehension of problem analysis
- Ability to communicate effectively, verbally and in writing, as implementing and operating an NMS requires cross-departmental support

Rules-based alarm filtering pinpoints problems and eliminates unnecessary truck rolls.

Educating your existing staff is another important step to proactively managing your NMS equipment. Most NMS vendors offer formal training programs.

The implementation plan

Successful implementations don't just happen. They are the products of research and careful planning, with close coordination between a network operator's own staff and its NMS vendor's regional and corporate field engineering departments, help desk technicians, and sales/account management personnel.

As part of an overall system build plan, it is essential to begin with an NMS implementation plan. This plan must be a "living document," designed to be modified as a project unfolds. Be sure that your NMS implementation plan includes:

- Status summary section: A tracking mechanism to assess project progress from implementation, including issues, shipments and deliveries through qualification of node
- Statement of work to be accomplished: An overview of the various phases of the NMS rollout, including readiness assessment, planning and deployment phases
- Program schedule: A critical component charting tasks and milestones, showing the sequence of various components and their interdependencies
- NMS vendor's system installation, operation and maintenance overview, including the vendor's documents on installing, operating and maintaining its products

A good network management system is key to coordinating all your stand-alone elements. Photo courtesy of Cheetah.

- Cable operator's system design: A graphical representation of the network operation's infrastructure, including headend/hub architectures, return combiners, forward combiners and data network plans
- Resource plan: An outline of resources that will be required for both NMS vendor and cable operator
- Training plan: An off-site and on-the-job program as well as adjunct (such as operating system or database) classes

Combine for success

The implementation of an NMS is a huge, positive step for your operation, one that marks its entry into a new level of performance and efficiency. Like any technologically complex undertaking, an NMS can be implemented with resounding success if the proper groundwork is in place.

You must have a clear picture of your network's future in order to select a system that will meet its current and evolving requirements. You must acquire professionals with the skill and experience needed at each phase of the implementation, from installation through start-up to maintenance. And you must create and follow an accurate, detailed implementation plan.

Combined, these components assure the initial and ongoing performance of your investment in network management technology. CT

Fritz Rummery is director of applications engineering for Cheetah Technologies. He can be reached via e-mail at fritz.rummery@cheetahtech.com.

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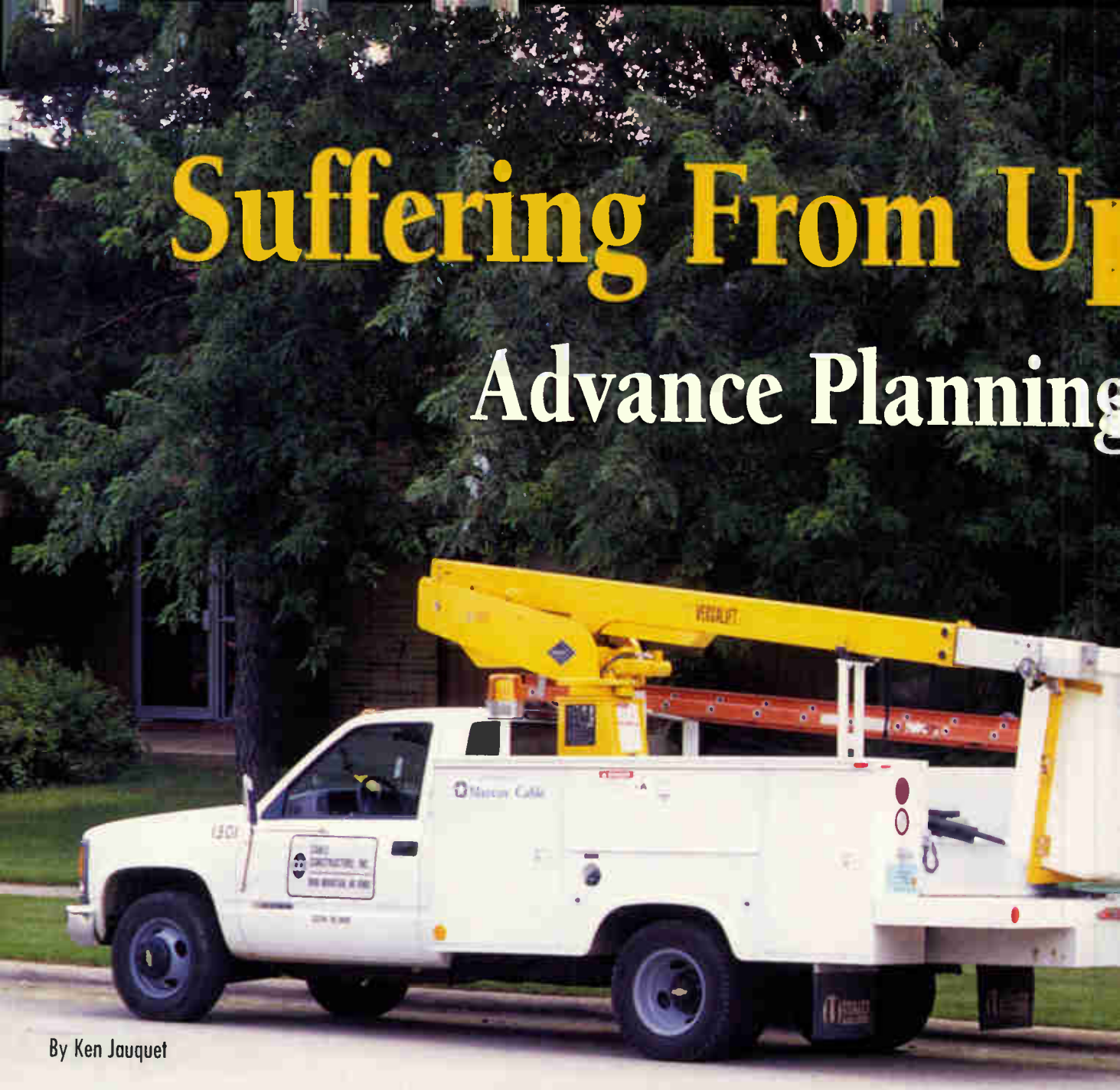


By Ken Jauquet

With any system upgrade, the chances of success are best if you start with a solid foundation. In this case, the foundation is a sound plan, which details your mapping, design and construction strategy.

A sound upgrade plan is basically a paper version of the project that you build ahead of time. It will document the current state of your network, where you want to be when finished, and everything in between. That said, let's get into details.

Update your maps

First off, you'll need accurate "as-built" maps of your system. Without accurate as-built maps, the upgrade is destined to fail. We have war stories about customers who send us "accurate" as-built maps that basically are untouched maps we gave them when we finished their last design upgrade—four years ago.

In all honesty, this is the most important part of an upgrade, but it's often given the least attention. You don't want to discover that your maps are outdated when construction begins.

The level of information collected during the walkout process depends on the services you plan to offer over your upgraded network. If you are going to build a 750 MHz system with active reverse and offer additional services such as Internet access and telephony, then you'll need to carefully examine the drops during the walkout. Underground areas often need

-grade Headaches?

Provides the Cure

much attention during this phase, and the only way to be sure of the routing is to have the cables located to verify it.

Pick a design partner

Once you are confident you have accurate maps, you can work on getting a design partner and picking a vendor for construction materials such as electronics, coax, fiber and the like. A lot of research is necessary when choosing a design partner to ensure the most economical use of the signal.

With the multitude of system architectures to choose from, an experienced design firm can help you form a plan to make your investment feasible for years to come. Things such as node size, scalability, redundancy and fibers per node are critical decisions, and a solid partner can help you make an informed choice.

At this point in the project, interaction between you and the designer is critical. Node and power supply locations will have to be picked and verified so the permitting process can start. I have been involved in projects that were held up for six months because someone neglected to apply for power supply permits.

Your designer also needs to provide you with an estimated bill of materials so you can place a preliminary order for construction supplies. With the lead times from the manufacturers extending all the time, be sure to place this order as early as possible. Decide now whether to allocate additional fibers for school and municipal use, and pick any locations where spare fibers will be necessary.

You are at the point now where the

BOTTOM • LINE

Plan Your Upgrade

Advance planning is essential to the success of any system upgrade. When developing your plan, be sure to:

- Create or otherwise obtain accurate "as-built" maps of your present system—without them, you're in for real trouble.
- Select a design partner and a vendor for the construction materials.
- Develop a strategy for bidding and awarding the construction contract. Allow ample time, and have a thorough review of the construction standards as well as billing, as-built, quality control and inspection procedures.
- Notify customers early about expected outages through TV, newspaper and radio advertisements. Prepare your customer call center to accommodate increased call levels.
- Keep materials flowing at the right pace for the project.
- Update your maps upon project completion to give you an accurate representation of your newly upgraded system.

mapping is complete, design is being shipped to you for review and you can start planning the construction phase.

Bidding woes

One of the most time-consuming aspects of the whole upgrade project is bidding and awarding the construction contract. If your company is large enough to have a standard request for proposal (RFP) process in place, then some of your workload is reduced; still, you have much to do. There are no guarantees that you will have successful response to any RFP, but some steps can increase the quality of bids.

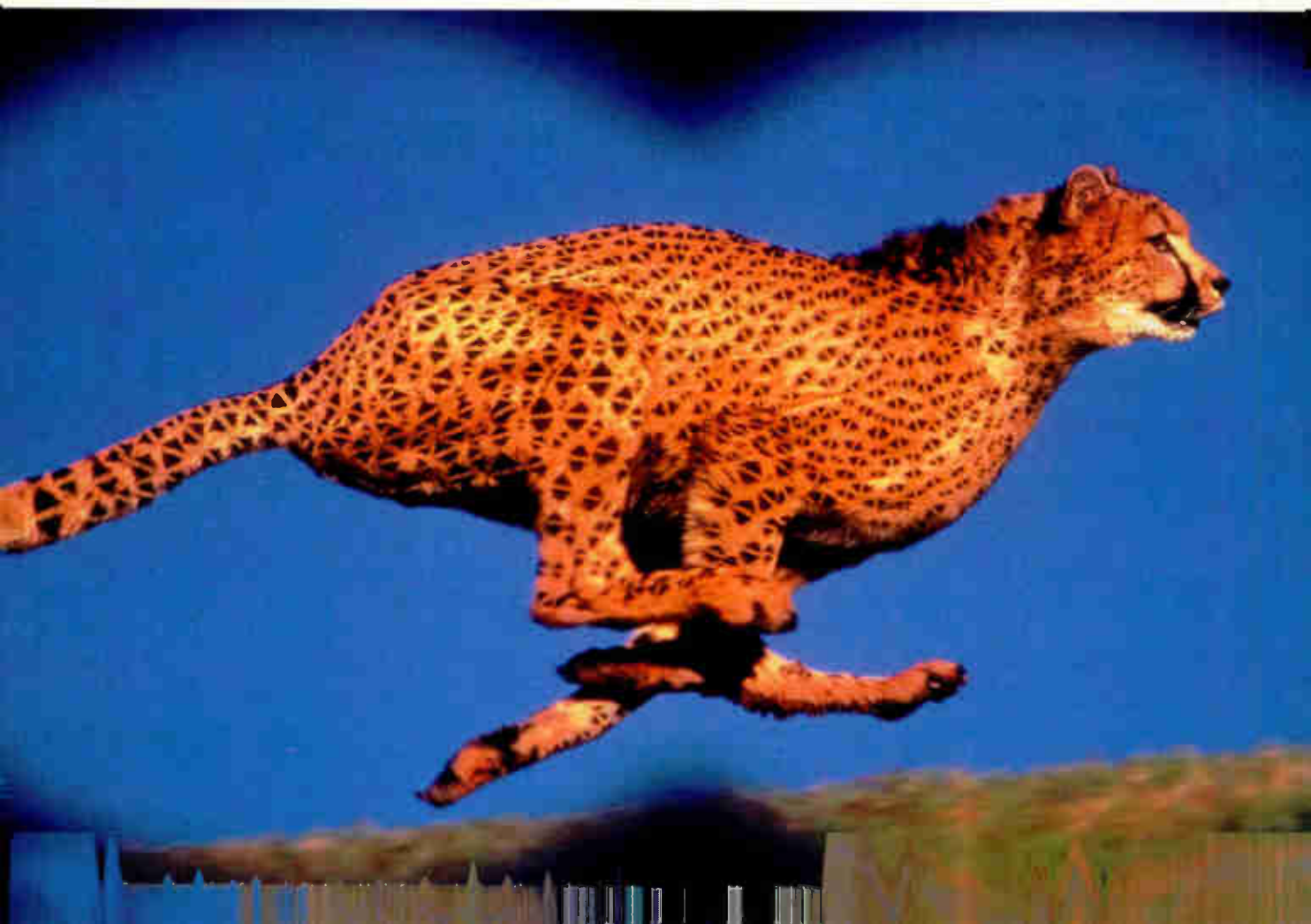
First, be sure to allow ample time before the bid is due. In most cases, the respondents will have to travel quite a distance to look at the project. Second, it is best to have a formal prebid meeting where all respondents have a chance to meet with you and discuss the project. It is a good forum to pass information to the prospective contractors, and it also lets you know if companies are interested in your bid.

Lastly, do not tie yourself down to a strict award date. Invariably, you will have a very difficult time coming up with an apples-to-apples comparison because every contractor has a different way of bidding projects.

Kick it off

To kick off the construction phase of the upgrade, a preconstruction meeting is mandatory to get all parties off on the right foot. Thoroughly review construction standards as well as billing, as-built, quality control (QC) and inspection procedures.

Be sure to have a preliminary walkout



shortly after construction starts so all the bugs can be identified early. All too often in an upgrade project, construction gets underway, and the owners never look at the plant until too many miles are built, at which point they want something done a little differently. Then we have to go back over many miles of plant. This can cause major delays and hard feelings.

One frequently overlooked problem is the volume of customer calls. During a typical day, you can have 1,000 to 1,500 customers without their entertainment. Although early customer notification through TV, newspaper and radio advertisements will help, you still can expect your customer call center to be loaded. Knowing and preparing for this up front will help mitigate a potential source of frustration.

Supplies and quality

With construction running, you'll have to watch material flow closely. On a large project, the volume of material necessary to keep things on track is mind-blowing.

Where are we? Having accurate "as built" maps of your system is critical to a successful upgrade, so make sure your maps are up to date, reflecting any and all changes made since the last system upgrade.

If, for example, your project is going along at 50 miles of upgrade splicing per week, you will need to supply roughly 12 nodes, 100 trunk amps, 200 line extenders, 400 splitters, 500 splice connectors, 1,800 taps, 3,500 pin connectors, 2,600

feet of heat-shrink, plus scads of straps, spacers, F-connectors and grounding material a week. The result is that once the construction machine is under way, it takes a lot of fuel to keep it going.

It is usually at this point that you will be tempted to get behind in the QC and walk off. "People power" is stretched thin, and it seems easy to let QC slip, but the work involved in getting caught up again is not worth letting it slip in the first place. Besides, if we as contractors allow you to get behind, we are not doing our job.

Most successful construction projects have a common theme: a close working relationship between the construction supervisor and your construction manager. Mandatory weekly meetings and daily contact are essential for a smooth project.

> "Don't underestimate the time and energy it will take to properly plan for your upgrade."

The last few things

Upon completion of the construction project, accurately update your maps to get a final set of construction as-built prints. Equally important will be your updated fiber splice book. This book is tremendously valuable when it becomes necessary to restore your network. Often times, relatively few fibers need to be respliced to restore service to customers. The remaining splicing can be done as time permits.

Don't underestimate the time and energy it will take to properly plan for your upgrade. Often, you have to accomplish this feat with no additional staff and not enough information to make the best decisions. That is why it is so important to form working partnerships with your mapping, design and construction companies. If everyone is working toward a common goal, the chance of success is greatly increased. CT

Ken Jauquet is project manager for Cable Constructors. He can be reached via e-mail at jauquetk@cableconstructors.com.

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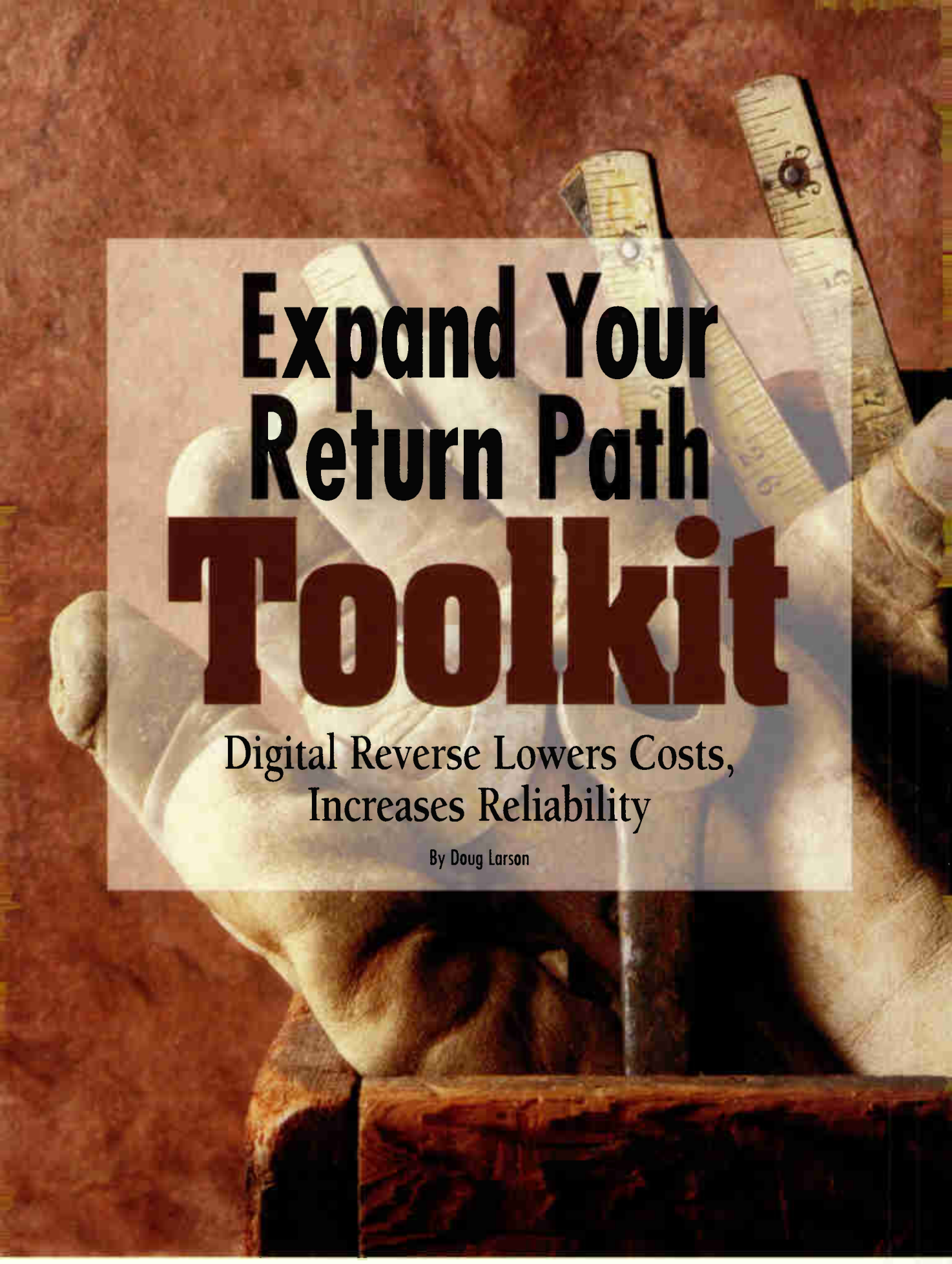


Expand Your Return Path Toolkit

Digital Reverse Lowers Costs, Increases Reliability

By Doug Larson

Until recently, operators were limited in their choice of upstream traffic solutions. Their return path toolkit consisted of reverse dense wavelength division multiplexing (DWDM), RF combining and block conversion—viable yet costly solutions in deep-fiber, high-traffic networks.

Riding the rapidly dropping optical cost curves, engineers at Scientific-Atlanta and General Instrument now have added another tool to the assortment: baseband digital reverse. But it's not just another option. For some operators and some architectures, it promises to revolutionize the way we handle the ever increasing number of return path packets from interactive services.

Return path conundrum

As penetration for interactive digital services starts to soar, revenue floodgates are opening. Also opening, however, are the floodgates of upstream traffic from cable modems, telephony and other interactive content, creating a Catch-22 for operators.

On the one hand, increasing traffic volume, longer distances between headends and homes, and resulting analog ingress potential are forcing operators to push nodes and headend equipment closer to the home. On the other, maintenance and capital costs are pushing nodes and headend equipment away from homes. Finding a compromise solution has left many engineers wracking their brains.

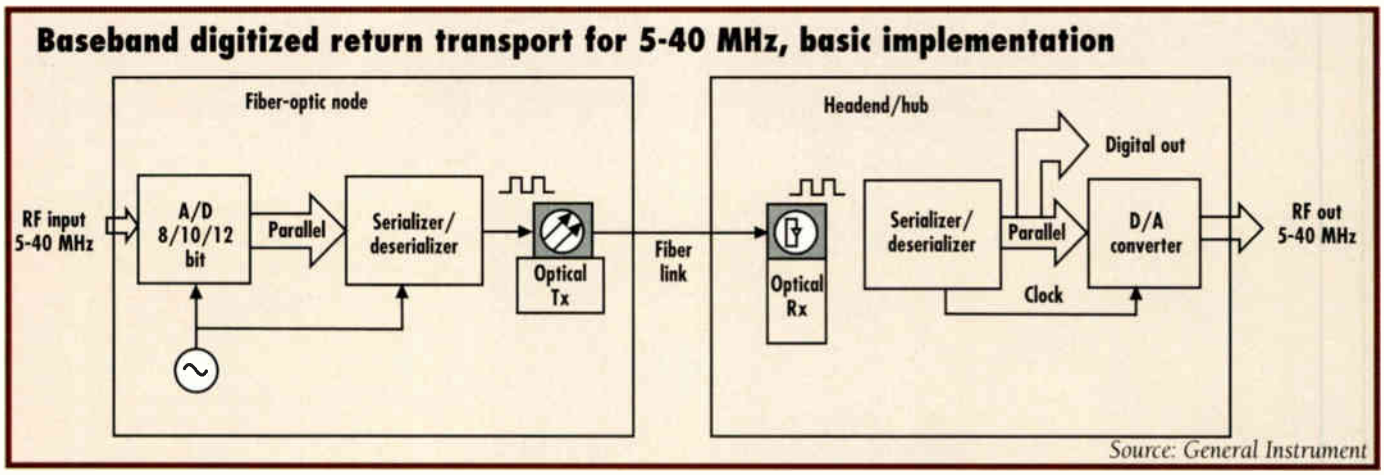
Enter baseband digital return technology. The benefits of a baseband digital reverse path to operators are compelling: scalability, more reliable performance over longer distances, more bandwidth capability and simplified network management through digital signal processing (DSP) functions.

Perhaps even more compelling are the cost benefits. With a complete baseband digital reverse solution from node to headend, hubs can go passive, and demodulators and routers can be moved upstream or eliminated altogether because of the better signal qualities inherent in the digital stream. As an added benefit, multiplexing multiple signals onto one fiber via time division multiplexing (TDM) can reduce fiber counts.

That's great, but what is it?

Now that we've talked about the problems digital baseband reverse solves and some of the cost benefits, let's get into the nuts and bolts of the system architecture itself. While there are subtle differences between the General Instrument and Scientific-Atlanta baseband digital reverse products, the core product is the same.

In its simplest terms, baseband digital reverse takes the entire 5-40 MHz reverse spectrum and digitizes it at the node (or hub)



and then transports it to the headend via fiber as a digital signal. The reverse spectrum is digitized using high-speed analog-to-digital (A/D) converters, which currently can sample 10 to 12 bits at 100 or more MHz samples per second (MSPS), and then returned to the original 5-40 MHz spectrum at the headend using a digital-to-analog converter (D/A). (See the accompanying figure.) Time division multiplexers can be employed at the node to combine several digitized return spectra onto one fiber.

A cost-effective solution

According to Paul Connolly, Scientific-Atlanta's vice president of marketing and network architectures for its Transmission Network Systems group, his company has had a formal mission for the past 18 months to solve the problem of building a carrier-class network capable of handling high-volume traffic for varying kinds of information.

Connolly says the company has conducted "what if" modeling with more than 100 customer networks. These network models have addressed issues such as analog vs. digital performance, 1,310 nm vs. 1,550 nm, optimal node sizes, ideal fiber redundancy levels and so on. The company's recently announced baseband digital reverse technology emerges as the much-touted product of a great deal of this research.

"When we started looking at the business models through all of the network modeling that we had been doing of what happens when your VOD (video-on-demand) penetration is rising, and your data traffic increases, and you want to roll out telephony, we started breaking the capacity model," says Connolly. "So a lot of operators will say: 'Hey, if I get to 750 MHz, 500-homes-passed nodes, I'm finished. I've got enough capacity for all of the services.' We found that definitely wasn't true."

Connolly says his company struggled to find solutions using analog technologies.

"We started realizing that there were different ways to solve that problem. If you don't have enough bandwidth at 500 homes, you can take the fiber deeper or you can split the node and have separate coax feeds coming in," explains Connolly. "If you do that, you have to figure out how to mux all of those analog signals, so we looked at block conversion and shifting frequencies around. Every time we tried to get better with the analog tools available, we found it difficult to do. It's hard to multiplex analog signals, hard to transmit them—you have distance limitations, you have to worry about second or third order distortions—it's just a hard medium to work with."

These analog impairments led S-A to explore the possibility of digitizing the 5-40 MHz return spectrum. Key to success in this approach would be the A/D converter, which at the time could not sample quickly enough to convert the 35-MHz bandwidth spectrum.

"The initial enabling technology became A/D. We have A/D circuits now where we actually sample this thing at 10 bits, 100 MHz per sample, so we're producing a Gigabit of information," he says, "so each node that can be serving anywhere from 500 down to 50 subscribers is going to produce a Gigabit worth of data. When we finally put it together, we realized that if you just take the simplest connection between the node and hub, we can actually A/D it, transmit it digitally, D/A it at the other end and receive it cheaper than the analog system that it replaces."

While node costs increase in this scenario, Connolly says these costs are

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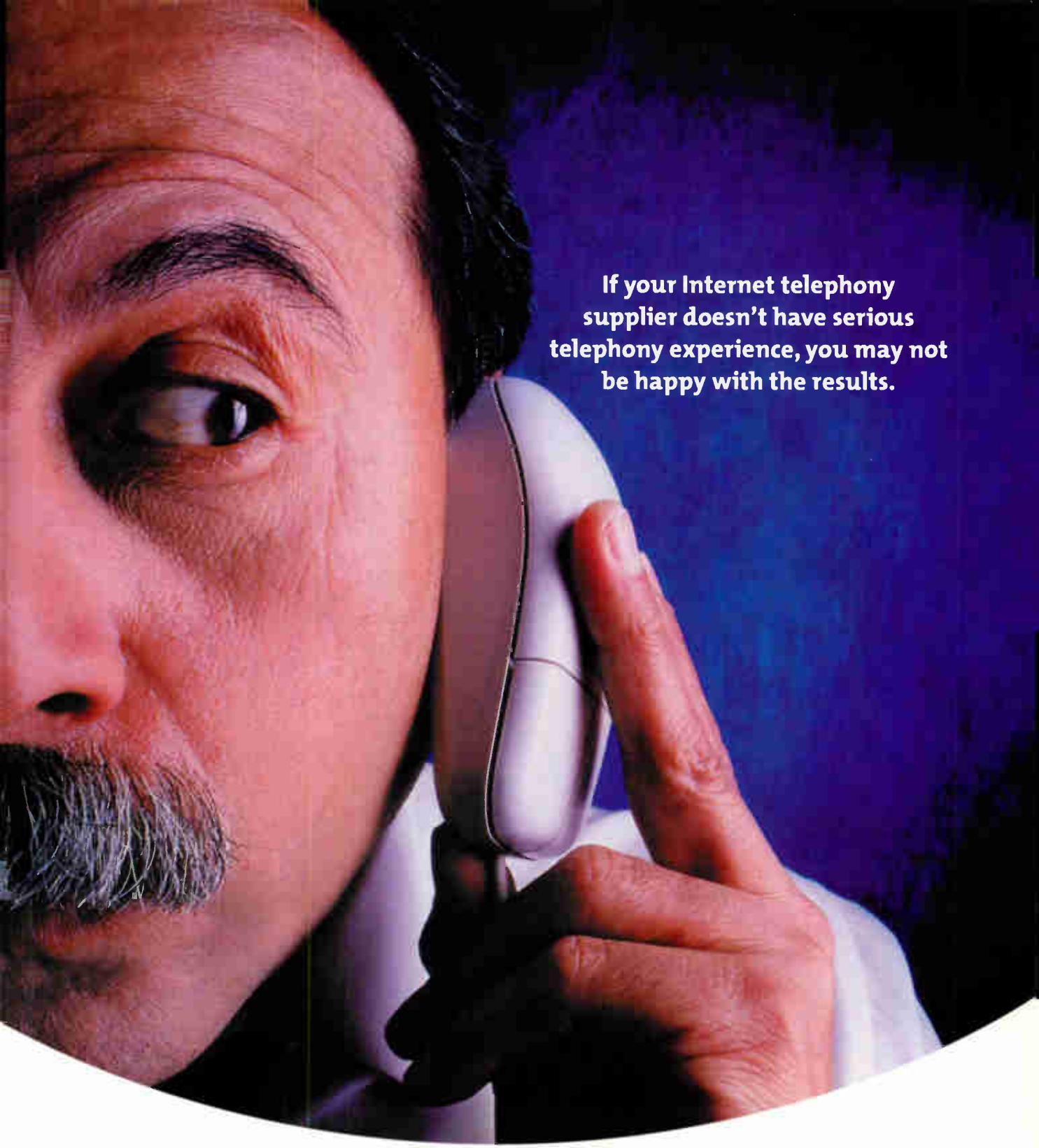
Digital Goes Upstream

As penetration numbers for cable's advanced service offerings soar, operators are confronted with two competing forces.

On the one hand, increasing traffic volume, longer distances between headends and homes, and resulting analog ingress potential are forcing operators to push nodes and headend equipment closer to the home. On the other hand, maintenance and capital costs are pushing nodes and headend equipment away from homes. Finding a compromise solution has left many engineers befuddled.

Until recently, the return path toolkit for solving these problems consisted of reverse dense wavelength division multiplexing (DWDM), RF combining and block conversion. With the rapidly falling cost of optical components, a new tool has come on the scene: baseband digital reverse.

Courtesy of Scientific-Atlanta and General Instrument, baseband digital reverse takes the 5-40 MHz reverse spectrum and digitizes it at the node or hub using high-speed analog-to-digital (A/D) converters and then transports it to the headend via fiber as a digital signal. At the headend, the signal is returned to its original form using digital-to-analog converters (D/As).



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more than offset by the simplified configuration at hub sites, which no longer require receivers, transmitters or amplifiers, and related processing equipment—no matter how deep you push your fiber.

Connolly cites the flexibility of the platform as one of its key selling points.

"What digital reverse allows us to do for that simple link of node to hub is effectively engineer the performance that we want. By deciding how many bits we want to sample, how quickly we want to sample them and how many bits per sample, we can basically engineer that performance," says Connolly.

At the Society of Cable Telecommunications Engineers' Cable-Tec Expo and the National Cable Television Association's Cable '99 shows earlier this year, Scientific-Atlanta demonstrated the carriage of 256-QAM (quadrature amplitude modulation) over 80 km of fiber with 30 db of loss, an engineering feat not possible with existing analog technology.

Implement now, reap benefits later

General Instrument also has announced a baseband digital reverse product, but is not touting it as a slam-dunk winner over other available return path solutions.

"It's promising because it offers the lure of low-cost optical devices, but it does add a certain amount of complexity into the node for the A/D converter, the high-speed digital components, etc.," says Dave Grubb, vice president of marketing for GI's Transmission Network Systems group.

> "It offers a cost-effective implementation for small nodes by allowing an operator to efficiently multiplex upstream digital payloads and eloquently process them at secondary hub sites."
>
> —Tony Werner, AT&T

Robert Howald, director of GI's Transmission Network Systems Engineering group, says his company's preliminary cost studies show no significant advantages to baseband digital reverse over existing analog technologies, but notes that dropping optical costs make the cost benefits clear.

"A lot of the really powerful advantages are down the road a little bit, but the shorter term advantages are that you basically get the performance of DFB (distributed feedback)-type of analog optics for the price of FP (Fabry Perot)-type of optics, added robustness and further reach," says Howald. He adds that A/D development could lead to improvements in second order distortion.

When it comes to performance, Howald

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says A/D development is reaching the point where digital reverse will surpass analog performance in the theoretical sense.

"Basically, now you can just about exceed good DFB performance for longer link lengths," says Howald, "but when you get to the point where you can have 12-bit A/Ds—the data rates that you need to support return path applications—you'll have effective performance that exceeds any theoretical performance that you can get from the analog pieces that are there today, with longer reach and with the lower cost."

GI and S-A both use Norwood, Mass.-based Analog Devices A/D converters in their current baseband reverse products.

General Instrument initially is focusing its efforts on digital reverse applications at the node, but sees strong potential at the headend as well as in systems using sophisticated digital application receivers.

"We would see the possibility of taking your parallel digital words that come upstream and handing them directly off in digital to these receivers, and thereby bypassing the analog reconstruction, the tuners on the front end of these demods, and getting rid of that entire analog headend impairment, in which case you've really limited all of the impairment in the link to just what happens up to the node," says Howald. "There's a big performance advantage there.

Is it right for you?

Despite the potential for significant cost savings and increased robustness, General Instrument and Scientific-Atlanta are quick to point out that this technology is not ideal for all operators or all systems. S-A is targeting its product to operators that have yet to build expensive hub sites.

"If you've already got a bunch of hub buildings built, then that's OK because you have the space—you've already paid for it," says Connolly. "You still have all of the complexity of maintaining and servicing all of that stuff, but it's viable for somebody who's already got a hub-based, upgraded HFC (hybrid fiber/coax) network. Most of our customers don't have that capability."

Connolly cites TCI, on the other hand, as a prime candidate for its digital reverse product and points to the operator's Fremont, Calif., system as an ideal application environment. Using DWDM for the reverse path, TCI combined 1,200-homes-passed nodes to create logical node sizes (number of people sharing upstream bandwidth) of 4,800 homes passed.

When TCI's business case began to change under AT&T ownership, which is pushing high-volume, high-penetration voice and data services, the system became burdened. As upstream traffic volume increased because of its telephony and cable modem services, AT&T B&IS decided to cut each node in half and put two transmitters in each node, taking the logical node size down to 600 homes.

This approach required two separate fibers from each node and essentially equated to eight times as much reverse traffic. As its business case continues to develop and voice and data penetration

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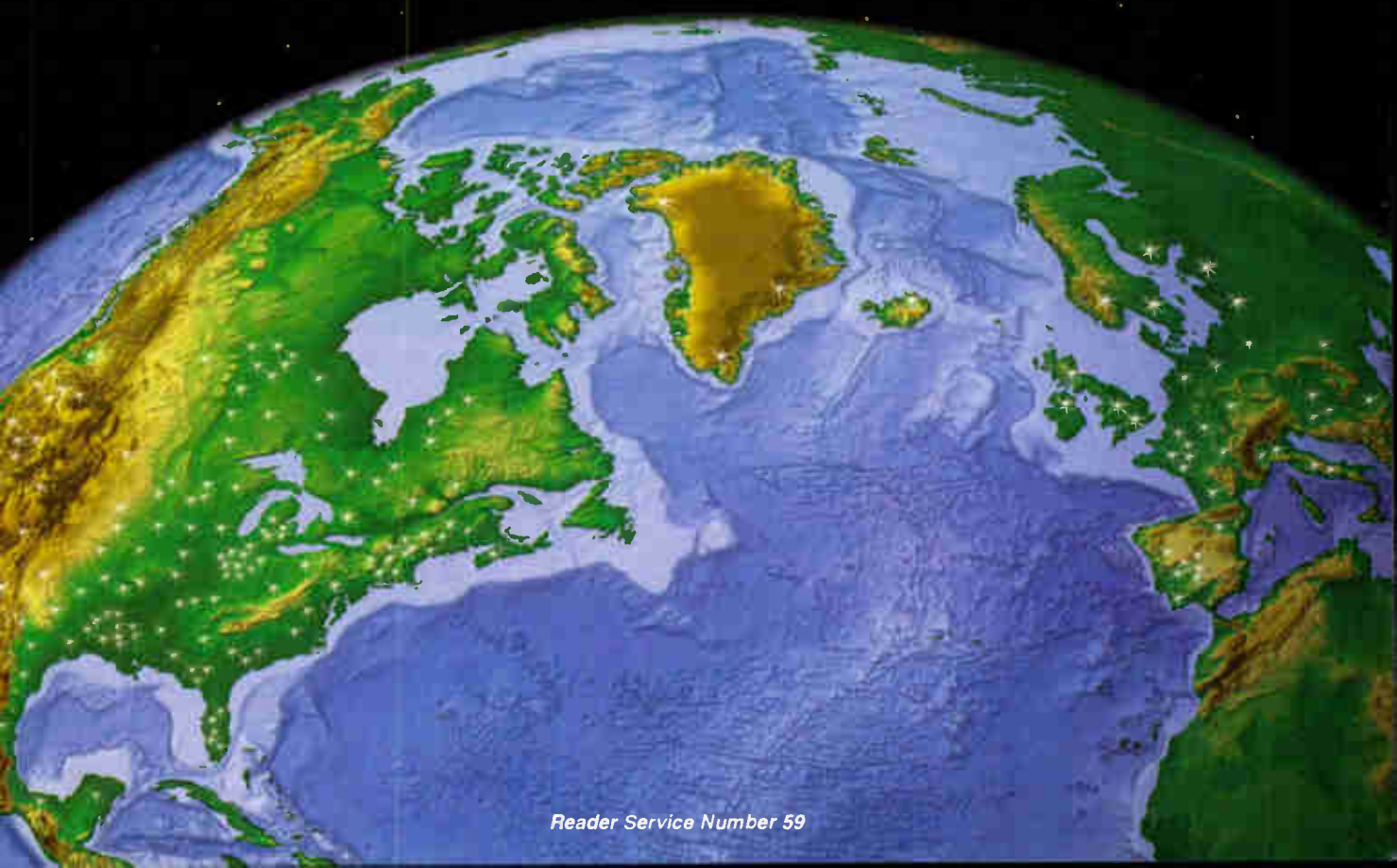

Reader Service Number 59

numbers increase, the system will need more upstream capacity and more cable modem termination systems (CMTSs), telephony and other equipment at hubs.

By using baseband digital reverse instead, TCI could achieve the same logical node split with one transmitter and combine the two signals onto one fiber, instead of two, using TDM. Moreover, with the increased loop reach, the CMTS and telephony could be pushed further upstream, eliminating the need, and cost, of putting this equipment in multiple hub sites, which now would require only passive multiplexers to handle upstream signals.

While most operators face the challenge of getting large numbers of return packets back from nodes to centralized processing centers, Grubb says two-hop architectures with a master headend feeding a hub or optical transition node (OTN) and a second hop from there to a fiber node will benefit most from his company's product.

"At that OTN, you want to efficiently gather up all of the return traffic. If that OTN serves 30 nodes, you don't just want to run 30 fibers from that OTN back to the headend to carry all the return traffic," says Grubb. "You want to get it onto a small number of fibers, through WDM, frequency stacking, digitizing and using TDM, or combinations of these."

Operators actively involved in system clustering also stand to profit from the technology. "You pick up 20,000 homes here and 20,000 homes there, and you need to aggregate again that return traffic and bring it back to a processing center—those are definitely candidates for this technology," says Grubb.

You don't have to start from scratch

To make digital reverse more compelling for operators, both companies have engineered their products to be backward compatible with nodes already in the field. GI, for example, says the transition is virtually seamless to the operator that already has installed its SG Optical Nodes.

"Our nodes are able to be opened and segmented and operated so that there's a little bit of flexibility to them, depending on how many ports you want, how much redundancy you want, etc.," says Howald. "Our digital return design is going to be made such that you can remove an analog laser module and plug in a digital return module, and it'll be transparent.

"The size is really not a problem compared to what we have there today," he explains. "To an operator, there's no difference doing (digital reverse) to what they're doing today. We don't want to make them have to buy a new node, obviously."

While focusing on nodes now, GI will be targeting hubs sites and headends later and plans to eliminate the D/A converter at the headend altogether, which Howald dubs an "impairment addition." Reaching this point will require discussions with CableLabs regarding Data Over Cable Service Interface Specification (DOCSIS) interfaces for modems with analog inputs.

What others are saying

Digital baseband reverse has received a lot of attention. Among those eyeing the technology is AT&T B&IS Vice President of Engineering Tony Werner.

"I believe that digital reverse technology is the next logical evolution for upstream transmission," says Werner. "It offers a cost-effective implementation for small nodes by allowing an operator to efficiently multiplex upstream digital payloads and eloquently process them at secondary hub sites."

Availability

At press time, S-A had completed numerous field trials of the technology and had received a commercial order from AT&T. GI was working to launch a field trial with a system in Philadelphia and expected availability for its product by year-end 1999 or early 2000. CT

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

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Reader Service Number 61

What Happens When

New Services Will Impact Your Plant's Power Structure

By Arthur Cole

It's no secret that the more digital goodies you put in your network and customers' hands, the more power you will have to supply to your system. And unlike days of yore when power outages simply meant missing out on HBO or C-Span for a while, your future customers are going to expect smooth, continuous service while they chat, shop, surf or what have you.

That's why planning for adequate power is one of the most crucial steps when it comes to hybrid fiber/coax (HFC) upgrades. Whatever you're providing now, you'll need to provide more of it in the future with no, repeat no, interruptions. If you don't take powering seriously, you can bet the phone company in your area does.

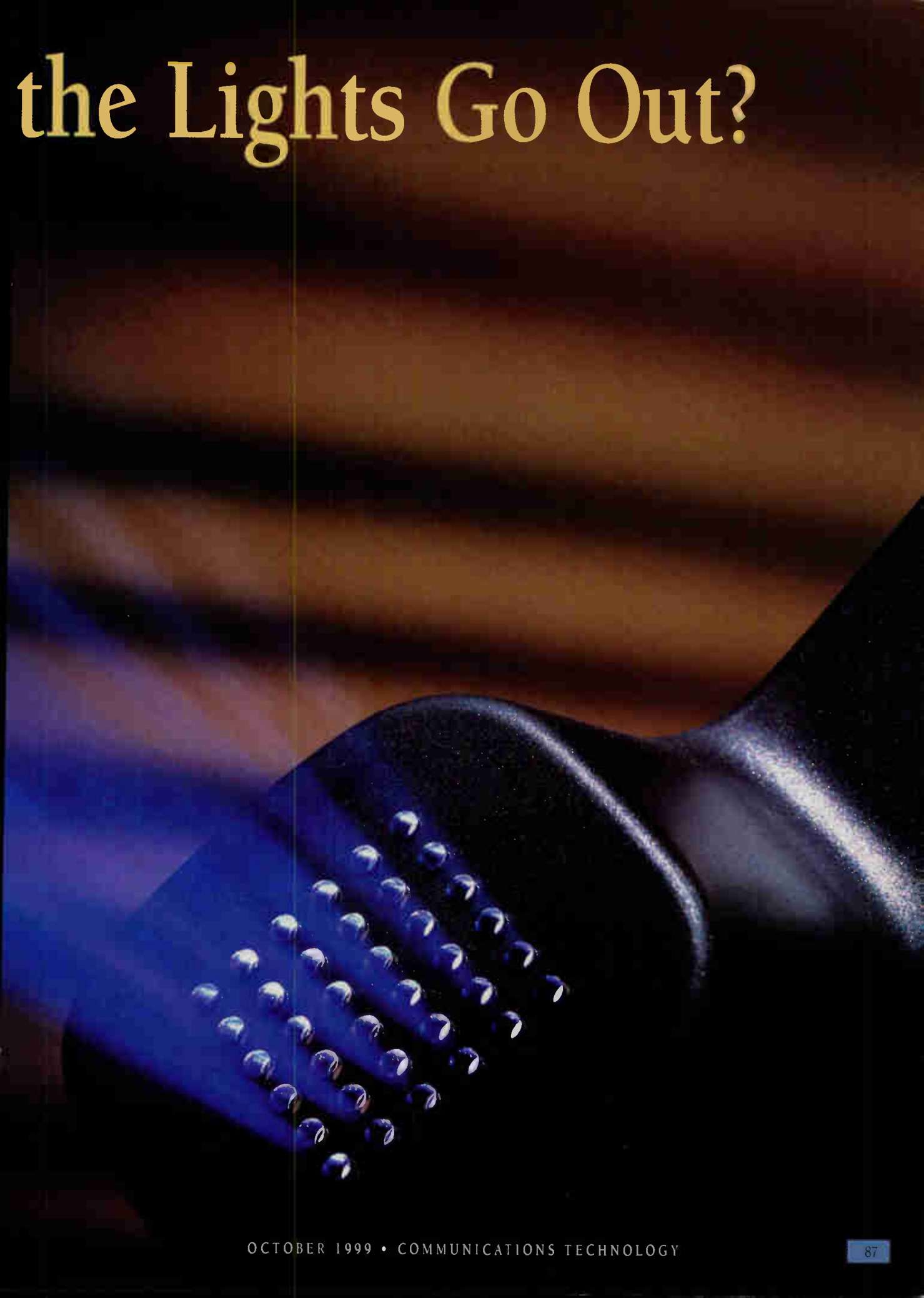
Expanded run time

"Customers are paying for services that they expect to be reliable," says Michael Wearsch, president of Antec Digital Systems. "The first time you screw up and lose customers, it's hard to get them back."

For day-to-day power requirements of future HFC systems, it will be pretty much business as usual. Power drawn from the local utility will have to be conditioned and monitored just as you've been doing, except now you're drawing more power.

The real changes are going to hit your backup systems. Not only will you have to generate more power from your

the Lights Go Out?



plant, but you also will need longer run times in case of a major outage.

"The cable industry has typically focused on one to two hours of backup time," says Eric Wentz, director of marketing at Alpha Technologies. "What we're seeing is that as the revenue-generating potential of the service has increased, one to two hours for some pay-per-view events or telephone service is not nearly enough. We're seeing a number of customers with eight or more hours of backup."

The most important thing to remember when upgrading backup power systems is to get it right the first time. Increasing the size and number of powering enclosures is expensive and requires a fair amount of local bureaucratic red tape, so you only want to go through it once every decade or so.

The best way to ensure a long enclosure life is to have an upgrade plan in place, so you can add new batteries and power modules as your needs grow.

"Start with a module that supports 60 V today and make sure the same unit, with an adjustment to the transformer, can provide 75 or 90 V when needed," Wentz says. "Make sure you can take out a 12- or 15-amp power supply and slip in a 22.5-amp module of the same size."

It's also a good idea to provide extra space for a second or third string of batteries or a generator.

Have a plan

All of this means you need a clear idea of how much power you need to maintain now and in the future and what type of backup you intend to use. Calculating your own plant's power requirements should be fairly easy once you have a good idea of the number of transmitters, amps, muxes and other hardware to be installed. The guesswork starts once you get into carrying Internet protocol (IP) data and telephony.

There's no way to know precisely how many telephony and modem customers you'll draw in a given year, but with strong market research, you can make a pretty good guess.

"It all depends on how many phone lines we sell," says Hugh McCarley, director of engineering at Cox. "A typical NIU (network interface unit) draws about 5 watts."

Local power

Some operators, however, have elimi-

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Power Rules

You have to add more services to stay competitive, and you have to pump more power through your plant to add more services. That paradigm is driving the brisk market for network powering equipment in the cable industry.

But before you go on a spending spree, it's wise to have a concrete plan of attack to get the most mileage out of your new gear.

The first rule of thumb is, "Only add new enclosures or increase the size of existing ones when you have to." It's an expensive process, so make sure the power supplies you're putting in have enough headroom for new batteries or generators you might want to add later.

The second rule is, "Have a good idea what your power requirements are going to be." Make a detailed study of your own network needs, and gain as much market research as you can about adoption rates for Internet protocol (IP) telephony and data devices that you may have to power.

The third rule is, "Invest in the kind of backup power supplies that best fit your needs." Urban and suburban areas probably want to consider gas-fed centralized distribution, while more rural operations would probably do best with battery-powered distribution setups.

New technologies such as flywheels and fuel cells are out there, but at this point they are too new to be considered reliable.

nated the guesswork surrounding customer demand by going to local power and backup—that is, powering the NIU from the customer's home and placing backup batteries in the NIU.

But there are disadvantages to this type of system. There is a chance the customer could disconnect or tamper with the backup battery. Disposal also could become a problem if customers are not educated about the hazardous nature of the batteries. Anyone caught tossing them in with the regular garbage could be in for a hefty fine.

"This is a big issue," says Mark Kettler, founder of MK Batteries of Anaheim, Calif. "We have the infrastructure in place to recycle, but if we can't get people to care about this, it will affect everyone eventually."

Local power also makes monitoring backup battery condition a little trickier because information is coming in from multiple locations throughout the plant, rather than one central location or a few distributed ones. The same goes for servicing or replacing the batteries, which will require housecalls to each telephony subscriber.

Distributed power

Antec's Wearsch argues that local power will be cost-effective only during the initial startup of telephony service.

"Depending on your penetration rate and the amount of backup you want to provide, there is a crossover point," he says. "If you have a 20- to 25-percent penetration rate, you might want to switch over to centralized or distributed power."

Battery-powered universal power supplies,such as this 50 kW unit, provide temporary electricity to Cable TV Mongtomery's headend until the onsite generator turns on.

It's all about flexibility and scalability: Because of the potential costs—in time, money and hassle—involved in having to rebuild or add new powering elements to the network, it's wise to go with equipment that can be scaled and expanded to fit the changing needs of your system. Photos (above and above left) courtesy of Alpha Technologies.

That question of central or distributed power has been the subject of debate for several years now. For most of its history, the cable industry has relied on distributed power supplies throughout the plant, which were inexpensive, easy to maintain and didn't have too great an impact on surrounding areas. But in the past few years or so, the movement to centralized power systems grew out of the development of fiber optics and the ability to do longer runs without amplification. Although larger and more complex than distributed supplies, the centralized version provides a single station from which to control an entire region's power supply.

Fortunately, this does not have to be an either/or choice for most cable operators.

"We're finding some customers going to a semi-centralized approach," says Alpha's Wentz. "Instead of consolidating four or five power sites into one, they are consolidating them to two or three."

Large multiple systems operators (MSOs), of course, are likely to back a mix of approaches based on each system's circumstances.

"(Centralized power) makes sense in medium and high density locations," says Joe Wetzel, vice president of technology at MediaOne. "In some concrete jungles, even with the best demographics and subscriber density, you can't find a place for multiple enclosures."

Other backup methods

New ways of generating backup power also are emerging. Batteries continue to be the method of choice for most operators, although we are now seeing such things as natural gas and new flywheel and fuel cell technologies.

Cox Communications probably is the

leader in natural gas backup. McCarley says the company is hoping to use natural gas wherever it's available because it is a limitless energy source and in the long run costs less than batteries, which have to be maintained and replaced every so often. However, the drawback is that gas lines are not available everywhere, and it is more expensive initially than batteries.

"The biggest problem up front is getting the local permits and approvals," McCarley says. "Once it's installed, it works great."

There are few magic-bullet solutions to powering.

Keep in mind, though, that a natural gas generator will need a few moments to sync up, so a small battery-based crossover system will be needed for an uninterruptible power supply (UPS).

"In the digital world, even a few milliseconds of transfer time is no longer acceptable," says Alpha's Wentz.

Other technologies such as flywheels are showing good results in a few installations around the world, but the long-term viability of these units is unproven.

"In the early days, they had a tendency to fly apart," says Ralph Brodd, a cable industry consultant based in Nevada. "That problem appears to have been solved with newer materials. Look for high sprung steel for lower speed units and plastic/graphite for higher speeds."

Wrap-up

There are few magic-bullet solutions to the many issues surrounding modern cable design, and powering is no exception. Fortunately, as long as cable operators are clear in their desire to see new revenues from advanced digital solutions, there are enough innovative solutions to help you get from here to there. CT

Art Cole is a contributing editor to "Communications Technology."

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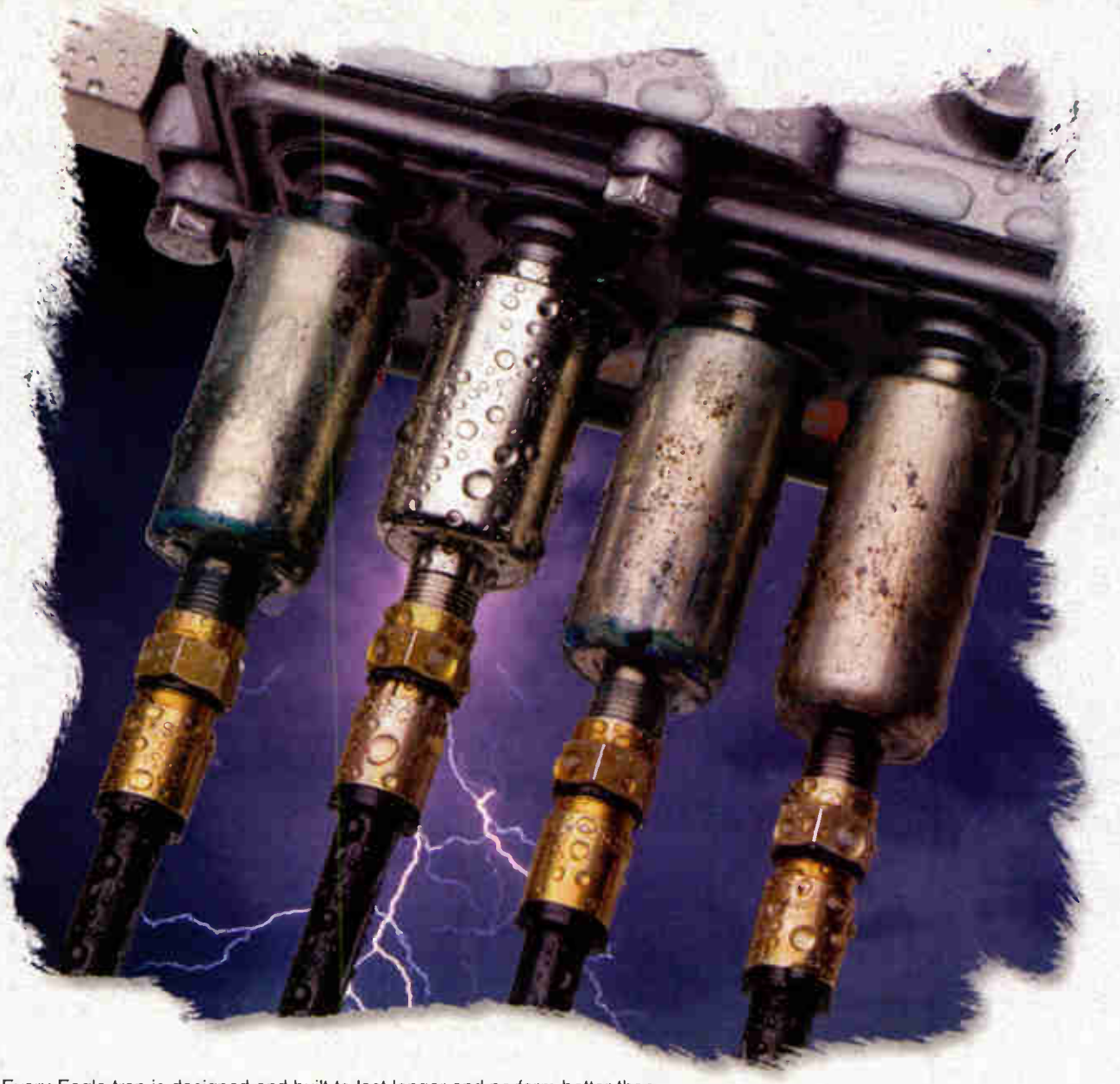

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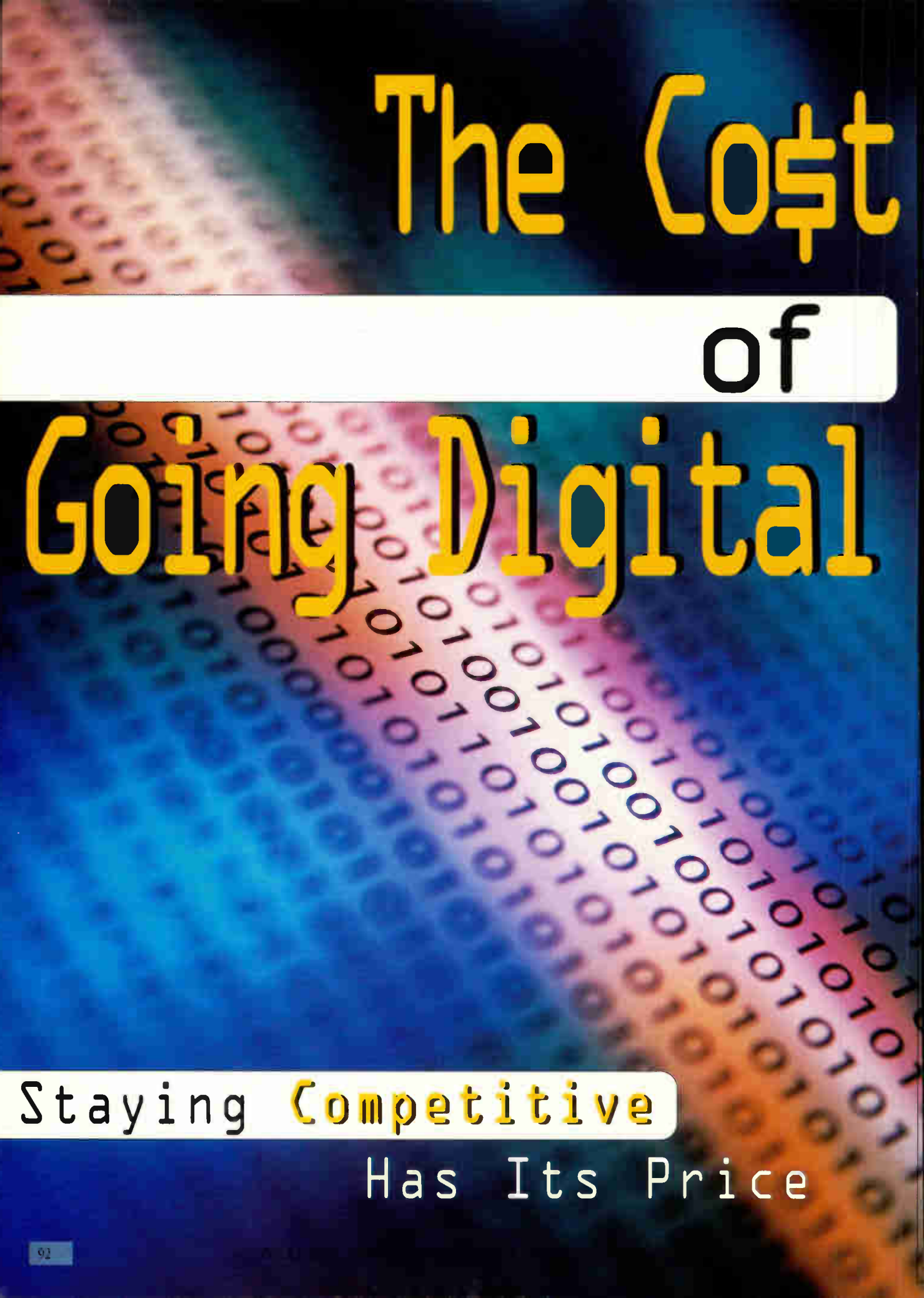
The Co$t
of
Going Digital
Staying Competitive
Has Its Price

oing digital will not be cheap. Yet the day is approaching when your company will have to offer digital services to remain competitive. Here's a look at some cost scenarios that can be adapted to fit your company's needs.

or months now, you've been considering ploying some sort of digital service, and recommendation to upper management imminent. But the boss is still waiting r you to create a pro forma budget. What's it going to cost?" you ask.

Well, it depends.

"I was afraid you'd say something like at," you sigh. "Can you at least give me me idea?"

OK, let me ask you a question. Can you more specific about the type of digital rvice you're contemplating?

You pause a moment, then continue. How about digital video? Direct broadst satellite (DBS) is a rious threat, and digil video may help us to more competitive."

Well, it still depends. et's look at a couple otions and make a few sumptions along the ay. I'll provide some camples, including osts based on my own cperience, as well as formation provided y operators and vendors. Keep in mind these are very general uidelines, and your actual costs may vary onsiderably.

There are two primary methods you can se to provide digital video services to able subscribers, along with a possible ird option.

atellite delivery

The first, and arguably most common, a satellite pass-through compressed digil video service, such as Headend In The ky (HITS). As I outline this option, let's ssume that you decide to use a HITS-type ervice.

The first thing you probably will need is new satellite antenna to receive the digital signals. The antenna's size and cost will be closely related to your specific location in relation to the satellite's footprint and which satellite you receive the signals from. If your headend has limited outside space available, you may have to resort to a pier-mount installation or maybe even a rooftop installation. A worst-case scenario would require locating the satellite antenna at some remote site and transporting the low noise block downconverter (LNB) output back to the headend via fiber or microwave.

Let's assume you do have space available, and the antenna, foundation, LNB, interconnecting cables and the labor to install all of these things are within reason. That new satellite antenna might cost somewhere around $10,000.

The next thing you'll need is electronic equipment inside the headend to receive and process the satellite signals. In most cases, digital video will be transmitted via satellite in a format other than what you will carry on your cable network. One common digital modulation format for satellite signals is quadrature phase shift keying (QPSK), which will have to be converted to 64-QAM (quadrature amplitude modulation) for cable transmission. This is done with a device known as a transcoder, which often is part of the satellite receiver—hence, the name integrated receiver transcoder, or IRT.

One IRT will be necessary to receive the signals from one satellite transponder, each of which may carry from four to 10 or more digitally compressed video channels. Let's say you intend to carry signals from six of the satellite's transponders, and each transponder has eight compressed channels. That will provide you with the equivalent of 48 new channels! After transcoding and upconversion to the desired cable network frequencies, those 48 channels will occupy the same amount of spectrum as just six analog TV channels.

> "Satellite pass-through compressed digital video service is the most economical way of providing digital video."

The equipment that does this includes the previously mentioned IRTs, an upconverter (or stand-alone QAM modulators), an out-of-band (OOB) modulator to transmit control data to the subscribers' digital set-tops, a data collector (telephony or RF return), critical spares (generally one IRT and possibly also an OOB modulator), a few other odds and ends, and a computer to control all of these pieces. It's highly recommended that you also add an uninterruptible power supply (UPS) to provide voltage regulation and backup power. All of this equipment will require a minimum of one to two racks inside the headend and can be expected to cost from $70,000 to $100,000 or more. ➤

By Ron Hranac

What About Cable Modems?

Now that you've decided to take the digital plunge, why not jump in head first and tackle cable modem service, too? Again, equipment costs will depend on your particular situation.

First, I'll assume that your company doesn't have its own cable modem operation and that you will have to set up a stand-alone operation. You can either install and operate the system yourself, or you can partner with a third-party company that takes care of capital costs, installation and operation, and splits the revenue with you.

Second, I'll assume you've upgraded your cable network to a hybrid-fiber-coax (HFC) architecture and are in the process of activating the return path. This allows you the option of telephone return from the cable modems in areas where two-way has not yet been activated, and RF return in areas where two-way is operational.

Once again, you need space in your headend. Unlike digital video, if subscriber demand for your cable modem service increases substantially over time, you will need additional equipment and the space to support it. But for a basic installation—one that will handle up to about 8,000 or so modem customers—you will need space for at least two racks of equipment.

Those racks will include such things as a channel service unit/digital service unit (CSU/DSU), network router, 100BaseT Ethernet switch, cable modem termination system (CMTS), application servers, caching engines, remote access servers, local loop access hardware and other equipment. Figure $100,000 to $200,000 here.

You'll also need a connection to the Internet. If you start with a modest T1 or equivalent circuit, that may cost from as little as $1,000 per month to as much as $3,000 or more, depending on what your local telephone provider charges for those services. If you have telephone return, don't forget the cost of multiple standard telephone lines.

Before I get too far ahead of myself, let's look briefly at some of the equipment I just mentioned. Assuming you already have your outside telco circuit to the Internet, you might want to have a CSU/DSU connected between that outside circuit and your network router. The CSU/DSU can best be thought of as remote access test equipment to determine potential problems in your headend or in the telco circuit link to the Internet.

The network router is a gateway device that essentially translates the data packets going between your system's cable modems and the Internet at large. The router is installed between the CSU/DSU and the Ethernet switch.

The Ethernet switch links all of the headend equipment. In addition to being connected to the router, the switch is connected to various application servers. These include e-mail servers, Web servers, authentication and administration servers and so forth. A caching engine, which also is a server, is connected to the Ethernet switch and caches regularly updated popular Web sites that get heavy subscriber use. This helps reduce traffic through your actual Internet connection and speeds up performance.

Remote access servers, sometimes called high-density dialup modems, are used for Internet access backup and telephone access for customers in areas not connected to your two-way cable network. Somewhere in all of this, you'll find the local loop access platform, too.

The CMTS forms the link between your headend equipment and the cable system. One side is connected to the Ethernet switch and the other to your reverse path RF combiners and forward path transmission equipment. A recommended configuration is four to six nodes per CMTS receive card.

Backing all of this up should be an appropriately sized UPS. Digital equipment simply doesn't get along well with poor-quality electrical power.

And of course, the cable modems themselves cost about $300 each.

In addition, you'll have costs for back-office functions, customer service support, 24 by 7 network monitoring, and installation and training expenses. *—RH* ➤

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Reader Service Number 67

from a few hundred thousand to several million dollars. All told, a good multichannel local programming operation could cost millions of dollars, in addition to the stand-alone digital compression equipment.

On top of all this, you still need digital set-tops at the previously mentioned $300 to $500 per unit cost, plus installation. While I don't want to discourage you from considering a stand-alone option, especially if it's your only practical choice, you need to be aware that it can become quite expensive rather quickly.

A hybrid option

A third possibility sometimes is called

Dollars for Digital

Satellite antenna:	$10,000
Headend equipment:	$70,000-$100,000
CA control system:	$100,000
Set-tops w/installation:	$350-$550

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Although the cost of going digital doubtless will be high, it's a cost we'll have to absorb if we want to remain competitive with digital broadcast satellite (DBS). The good news is that some options are relatively affordable in comparison to others.

There are two primary methods you can use to provide digital video services to cable subscribers, with a possible third option.

The most common option is a satellite pass-through compressed digital video service, such as Headend In The Sky (HITS). You could add 48 new channels at a budgeted cost of about $110,000 to $210,000, assuming you have the space, electrical, and air conditioning capacity available for the equipment, plus $300 to $500 each for digital set-tops and $50 or more for installation.

Option No. 2 is stand-alone digital video service, whose cost is nearly prohibitive. Digital video compression equipment for 48 channels can be expected to average as much as $50,000 per channel, or about $2.4 million. You still need programming sources, which may include satellite signals and locally created programming, which easily could cost millions of dollars. Then tack on $350 to $600 per sub for set-tops and installation.

A third possibility is hybrid cable/satellite, which requires the availability of DBS, plus your existing cable network. Traditional cable programming would be delivered by the cable system, and enhanced satellite services would be provided by a DBS antenna at each subscriber's home. The set-top would need a satellite receiver and digital decompression circuitry in addition to cable converter/descrambler functions, which easily could cost from $500 to $1,000 or more per set-top, plus installation.

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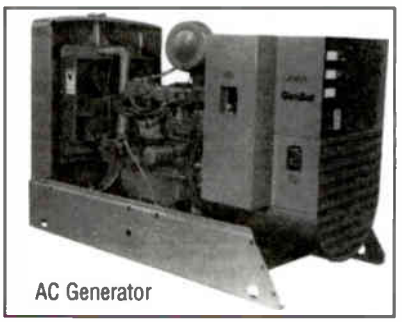

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(MDUs), it may not be practical to install a satellite antenna in every apartment or unit. This would require a roof-top antenna installation and in-building satellite signal distribution.

For all of these digital video options, don't forget about the cost of interfacing the operation to your billing system.

> *"Digital services, such as digital video and cable modems, are potential revenue sources that hold substantial promise."*

The next step

Remember, the costs and other information discussed here are rather general in nature. If digital services are in your system's future, I suggest that you contact the major equipment providers and get specific details. Actual costs and deployment issues will vary from system to system.

Getting your budget approved is only the beginning. There are a variety of technical and operational issues to handle when launching digital services. I'll cover those in next month's issue of *Communications Technology*.

While analog entertainment delivery will be our mainstay for the foreseeable future, competition is here now, mandating alternative revenue sources. Digital services, such as digital video and cable modems, are potential revenue sources that hold substantial promise.

This article originally appeared in the April 1999 issue of sister publication "International Cable." CT

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

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Expanding Possibilities

Reader Service Number 75

THE Build

Training and Construction Strategies for Evolving Broadband Networks

ClearWorks Lights up Vegas

By Reed Miller

While carriers have just started getting their act together on fiber-to-the-home (FTTH) this summer, developing a specification that will be used as a blueprint for equipment, one company already has 7,000 FTTH subscribers. ClearWorks.net has been successfully selling its service to Houston-area residents and now is opening an office in Las Vegas.

"ClearWorks has been around for two years," said John Diaz, president of ClearWorks Structured Wiring. "We are a publicly traded company and are leaders in the area of developing fiber-to-the-home."

ClearWorks has 7,000 subscribers in Houston and expects to be at 21,000 by the end of next year. The company also has plans to expand to San Antonio and Austin by the end of this year.

ClearWorks is aggressively pursuing contracts with land developers in Las Vegas. The company hopes to capture 100,000 subscribers in Las Vegas by the end of 2000.

"We have structured our business so that we can install fiber-to-the-home as quickly and effectively as possible," Diaz said.

ClearWorks.net is divided into four units. The first, ClearWorks.net, manages the other three divisions and works with shareholders. The second, ClearWorks Communications, serves as a media content provider for the FTTH service. The third, ClearWorks Structured Wiring, does all of the cabling and maintenance of the fiber-optic plant. And the last division, ClearWorks Integration, installs local and wide area networks.

Negotiating with land developers is a key for ClearWorks. Its business model currently is built on deploying fiber to new homes as they are being constructed. Consequently, the company must pitch fiber as a communications solution to land developers.

ClearWorks has contracts with the developers of five communities in Houston. The company is paid an average of $65 million per contract to install and maintain the fiber, with an average contract length of 20 years.

ClearWorks also must maintain good relations with home builders and learn how best to work with them. The company currently has dealings with Centex, Pulte, Royce Homes, Kaufman and Broad, Legacy Homes, Michael Thomas, and Village Builders.

However, "The projected number of subscribers ClearWorks has made for Vegas is way out of control," said Brad Bradshaw, director of energy and communications at Yankee Group, a high-tech consultancy in Boston. "ClearWorks could not do that in a year. They have a lot of competitors doing overbuilds of hybrid fiber/coax (HFC) in Vegas. Sprint is the local phone company, and they are providing DSL (digital subscriber line technology). There will be too much competition to reach 100,000."

Nonetheless, ClearWorks is making a significant contribution to FTTH technology. The 7,000 subscribers in Houston probably is the largest group of FTTH subscribers held by any one company in the nation. TB

Reed Miller is editor of sister publication "Fiber Optics News." He can be reached via e-mail at rmiller@phillips.com.

[Table of Contents]

WINTERIZING QUIZ

Are You Ready for the Icy Onslaught?

By John Bisset

Sometimes it can be hard to convince people that preventive maintenance can help save time, effort and money. It is usually after a significant failure, when some critical areas were ignored, that the importance of regular maintenance becomes crystal clear.

Avoiding those catastrophic problems in the first place is the mindset these days, and with that in mind, we present our Winterizing Quiz to help make sure you've got all the bases covered. Thanks to David Hanzel, lead headend tech at Media General Cable of Fairfax, Va., for assisting with preparing the quiz.

As you read each question, realize that there may be more than one correct answer. Some questions may require you to select the best all-inclusive answer. The answer key begins on page 110. ➤

Don't let a beat-up dish ruin your winter. Replace defective panels now.

Keep track of battery replacement by labeling equipment with the date the battery was installed.

Keep a rubber squeegee on a long handled pole for clearing dishes of snow and ice.

Let the games begin

1. Select the two best inspection areas from the answers below that will keep your headend running trouble-free this winter.

a) Building gutters and tower both clean
b) Serviced air conditioning and heating systems and freshly charged batteries
c) Building water turned off and interior lighting properly functioning
d) Backup computer disks on hand and floors free of clutter

2. Amplitude modulated link (AML) receivers typically perform better in the cooler winter months. However, after a summer of heat and temperature extremes, what is the most likely component to fail?

a) Wiring
b) Waveguide junctions
c) Fuses
d) Pressurization equipment

3. Before the cold weather hits, it's a good idea to have your tower climbed and inspected by a reputable tower firm. Most cable entities are shifting this responsibility to outside contractors because of the liability. When they climb, select the items that should be inspected.

a) Ice shield and ice bridge supports and bolt assemblies
b) Condition of transmission line—look for nicks or deformities
c) Feedhorn nitrogen system
d) Paint and general condition of the tower
e) All of the above

4. Keeping lines pressurized will prevent moisture buildup and the potential for flashover or high voltage standing wave ratio (VSWR) that can degrade signals or damage amplifiers and other equipment. Monitoring the frequency of dehydrator operation can signal a leak in the line. But a dehydrator with sodden crystals protects nothing. In a crystal-type dehydrator, which condition of operation is the best?

a) All crystals in the canister pink in color
b) No crystals in the canister
c) All crystals blue in color
d) Half of the crystals pink, the other half blue
e) Dehydrator hasn't worked in months

5. Fall is a good time to get your ambient sweeps done, setting up your amplifiers and line extenders. If the first 10 amps out are properly aligned, the rest should track closely. As you know, the amps will key on two frequencies, called pilots. If they are out of range, what are the typical indications?

a) A sharp picture
b) Poor picture quality and customer calls
c) RF interference
d) Noise problems
e) Both b and d

6. Power supplies are critical for all equipment, but they won't work unless there is backup power. Backup power in the form of batteries requires regular intervention. Select the answer(s) that outline the best battery maintenance procedure.

a) Trickle-charge batteries, and ensure the charger is working.
b) If one battery in a group of three is replaced, the other two will be fine.
c) Know what the battery kickoff point is—how long the battery will back up its associated equipment before its charge is depleted.
d) Keep a log or label to indicate when batteries have been replaced.
e) All of the above

7. Federal Communications Commission measurements are performed a minimum of twice a year—typically during the coldest and hottest months. What is obtained from comparing these two measurements?

a) That frequencies are stable
b) That automatic gain control (AGC) circuits are tracking ambient temperatures correctly
c) That amplifiers are not breaking down
d) That lines have not stretched

8. If you haven't adopted a leakage program, which automatically measures and tracks leakage as your service trucks drive through your service area, then making the measurements manually using a dipole is necessary. What is a good starting point for making these measurements?

a) Driving in a 10-mile radius around each hub site searching for ingress/leakage

b) Walking in a spiral from the hub center to 25 miles out, taking measurements each mile
c) Measuring only along azimuths that don't intersect any cables or amplifiers
d) There is no good starting point; just wait until complaints are called in.

9. Instituting a monitoring package to provide details on power supplies and amplifiers using the return network will help in spotting which of the following?
a) Power supply voltage fluctuations
b) Battery condition
c) Signal levels
d) Amplifier conditions
e) None of the above

10. A visual inspection of dishes also is in order. Select the most important inspection items from the answers below.
a) Check for missing or deformed panels.
b) Check for missing hardware, especially on support structures.
c) Clear bees' nests and cover the feed horn opening to deter infestation.
d) Check that all RF connections are waterproofed and tight.
e) All of the above

11. It's important to seal cables and cable entries. At the same time, cables should be inspected for damage caused by abrasion, rodents or the elements. There are two additional inspection points listed below. Please identify them.
a) Cracked cable jacket, permitting water to damage both the cable and connector
b) Adequate ventilation around high-power cable feeds
c) A weep hole on pressurized cables, to give moisture an "out"
d) Corroded connectors, which should be replaced

12. Dishes most likely will fill with snow and ice this winter. What's one solution to this problem?
a) A hose connected to a hot water tank, to melt the ice as it builds up
b) A rubber mallet to crack ice buildup, by smacking the back of the dish
c) A rubber squeegee or broom connected to an extendable pole to clear snow and ice from the dish
d) 2' x 4' supports mounted at the bottom lip of the dish to prevent distortion from the weight of the snow

13. While the weather is good, what's the best measurement you can make on your dishes to use as a diagnostic tool when winter arrives?
a) A compass glued to the dish support structure
b) A carrier-to-noise ratio (C/N) measurement
c) A frequency measurement of each transponder
d) A phase measurement of the low-noise block (LNB)

14. As your technicians drive around their service areas, what is the most important thing for them to watch for?
a) Open or unlocked doors on pedestals and power supplies
b) Broken lashing wire
c) Too much sag on cable spans or drops that are too low
d) Tree limbs that overhang or rub against cables
e) All of the above

15. What is the best procedure to adopt to ensure your trucks will be ready for the challenges of winter?
a) Chains fitted for each truck
b) Batteries maintained—terminals checked for corrosion, battery maintains charge
c) A set of flares, cones and container of sand on each truck
d) Sharpened shovels and clean tools on each vehicle
e) An efficient and diligent truck maintenance department

Extra Credit: Winter is the best time for which of the following programs?
a) Vacation relief
b) Cross-training
c) Organizing equipment catalogs
d) New underground construction projects

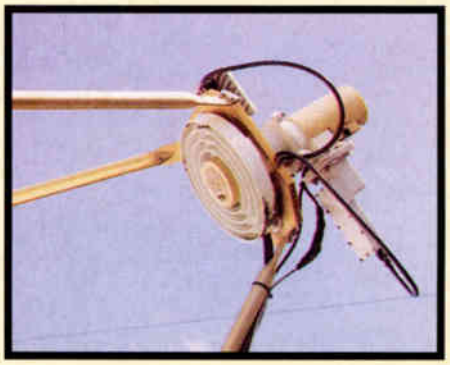
Check your work

See, that wasn't so bad, was it? To find the correct answers, along with useful explanations of them, turn the page. Then tally up your totals and check your results against the scale on page 114 to see what to address next. ➤

Tower inspection includes checking feedhorn covers and ice shields, not to mention the antenna mounts.

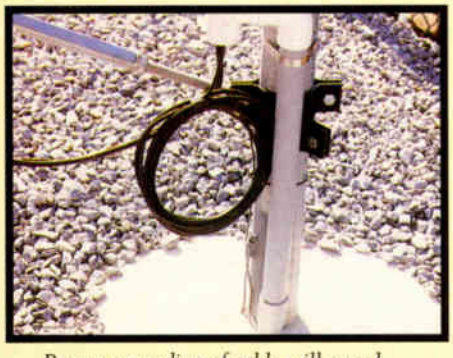
A nitrogen manifold not only gives an individual level of pressure for each line, but the individual line valves permit quick isolation of any leaks.

Make sure your dehydrator crystals are blue—indicating that the line gas is dry. Even a canister with half blue and half pink crystals is better than no moisture absorption at all.



Even a small hole as seen in the lower part of this feedhorn screen can cause maintenance headaches. Carefully inspect the entire satellite dish for damage.

Make sure all cable entries are sealed to keep weather, insects and animals out of your site.



Proper grounding of cable will guard against lightning surges next summer.

Don't forget alternative power sources, such as generators. Inspect cables and hoses for wear and tear.

A well-maintained truck fleet is key to getting the winter problems solved quickly. Keep each truck well stocked, so there is no wasted time looking for supplies.

Answers

1. The correct answer is b). The two best inspection areas to keep your hub running trouble-free this winter are to keep your air conditioning and heating systems properly serviced and ensure that batteries are freshly charged. Keep in mind that if only one in a series of, say, four batteries is replaced, an imbalance can occur, which can cause future battery failure.

2. The correct answer is c). After a summer of heat and temperature extremes, AML receivers' fuses are the components most likely to fail. The stress that storm surges and voltage spikes and sags place on fuses usually means they are the first point of failure. Check your fuses, replacing any that are suspect.

3. The best answer is e), all of the above. Before the cold weather hits, it's a good idea to have a reputable tower firm check your tower's ice shield, ice bridge supports and bolt assemblies; condition of transmission line, especially nicks or deformities; feedhorn nitrogen system; and paint and general condition. Have your contractors also check feedhorn covers for tears and concrete base pillars for cracks or breaks.

4. The correct answer is c). In a crystal-type dehydrator, the best condition would be all blue crystals, signaling no moisture in the canister. Of the available answers, and also in the real world, half pink and half blue crystals is most likely. If your dehydrator hasn't worked in months, get it repaired!

5. The correct answer is e). If pilot frequencies are out of range, the typical indications are poor picture quality and customer calls and noise problems. When the amplifier linearity changes, you can expect poor picture quality and customer calls.

6. The best answers are a), c) and d). The best battery maintenance procedure is to trickle-charge batteries and ensure the charger is working, know what the battery kickoff point is—how long the battery will back up its associated equipment before its charge is depleted, and keep a log or label to indicate when batteries have been replaced. Remember, if you replace only one battery in a group, the others may suffer and soon fail, too.

7. The correct answer is b). Checking your system twice a year shows that your amplifier AGC circuits are tracking ambient temperatures correctly from hot to cold weather.

8. The best answer is a). A good starting point for making manual dipole leakage measurements is driving in a 10-mile radius around each hub site searching for ingress/leakage, though I've known techs I've wanted to have walk that spiral to 25 miles out. If you really don't care, you're already getting the complaint calls listed in answer d).

9. The correct answers are a), b), c) and d). Instituting a monitoring package for power supplies and amplifiers using the return network will help in spotting problems with power supply voltage fluctuations, battery condition, signal levels and amplifier conditions.

The cost of a monitoring package is quickly offset by the ability to spot problems before they occur.

10. The best answer is e). The most important dish inspection items are to check for missing or deformed panels; check for missing hardware, especially on support structures; clear bees' nests and cover the feed horn opening to deter infestation; and check that all RF connections are waterproofed and tight.

Because dishes really are the lifeblood of a cable system, make sure you've devoted the time to carefully inspect each part.

11. The best answers are a) and d). In addition to inspecting cables for damage caused by abrasion, rodents or the elements, two additional inspection points are to check for cracked cable jacket, permitting water damage to the cable and connector, and corroded connectors, which should be replaced.

Cracked jackets will allow water to quickly attenuate the signal or short out conductors. Corroded connectors can cause intermittents and signal attenuation. Although a weep hole can be drilled in an emergency to drain water from an air

Gotta get a Gator

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As a manufacturer of cable installation tools, Ben Hughes/Cable Prep was approached by technicians and linemen throughout the industry to produce a center conductor cleaner. The prevailing factor was the need to eliminate cleaning the bonded dielectric from center conductors with knives or other scraping methods without causing installation problems. By listening carefully to the comments and suggestions offered, Cable Prep has responded with the Cable Gator.

There is a beveler that performs the pyramid cut to remove the burrs. If the center conductor burrs aren't removed, damage to the seizing mechanism of the connector can occur. Scoring of the copper-clad coating on the center conductor results in signal loss. In two easy steps the Gator bevels the center conductor and removes the bonded dielectric, leaving the cable perfectly prepared and ready for the connector. A perfect prep means no signal loss and no down time.

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dielectric line, it's not standard operating practice and must be repaired later.

12. The correct answer is c). Use a rubber squeegee or broom to pull snow out of the dish. I've seen techs use the rubber mallet and end up with a dish as seen in the top photo on page 108—not pretty.

13. The correct answer is b). Taking a C/N measurement while the weather is good can be used as a diagnostic tool when winter arrives.

Having a record of the C/N measurements of each dish will be a good starting point in determining why a satellite signal has failed.

14. The correct answer is e). As your technicians drive around their service areas, they should watch out for open or unlocked pedestals and power supply doors, broken lashing wire, too much sag on cable spans or drops that are too low, and tree limbs that overhang or rub against cables.

Training your field staff to look for potential problems helps avert emergencies later. Remember, snow and ice buildup may make securing pedestals and doors impossible.

Not only can broken lashing wire and excessive sag on cable spans, anchor cables or drops cause you technical headaches, but they also may cause accidents. When a tree limb is allowed to grow around a cable, it can rub the outer conductor and damage the cable.

Trying to find these kinds of problems in the middle of an ice storm can tax anyone's patience.

"If you have a good cross-training program, you are miles ahead of potential maintenance headaches."

15. The best answer is e). The best way to ensure your trucks will be ready for the winter is to have a good truck maintenance department to make sure there are chains for each vehicle; batteries are properly maintained; safety devices such as flares, cones and sand are on board; and each truck has a full set of tools—clean and sharpened.

Extra Credit: The best answer here is b). Winter is the best time for cross-training staff members on other jobs. This not only improves and expands their skills, but it also ensures that staff can assist in other areas if required. ➤

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How did you do?

Each question is worth 7 points. The extra credit question is worth 10 points—5 if you got it right, and another 5 if you actually have implemented a cross-training program. If you have a good cross-training program, you are miles ahead of potential maintenance headaches. The next step is to add up your points and check the sum against the following scale.

115: You got every question right! Take a bow, and tell your boss. The engineering department usually gets the rap for always spending money, but you've demonstrated your ability to save the company money by properly maintaining the equipment. Congratulations!

114-90: Your plant is in great shape, ready for the bad weather. Take your maintenance chief out for coffee and a bagel (or a doughnut, depending on his preference). Get feedback from him on how systems can be improved.

80-89: Your have your finger firmly planted on most of the maintenance "hot buttons," but there's room for improvement. Meet with your staff to discuss the test, and come up with an action plan for improving your facility. Make sure your boss knows the steps you are taking to improve the company's investment.

65-79: Talk about making it "by the skin of your teeth"—it's time to develop a plan, get everyone signed on board, and execute it. Cover the major areas of maintenance first, and then take care of the little things. There is still time before winter actually arrives, so acting now will help keep you from getting kicked around.

Below 65: All is not lost! Bone up on some of the back issues of *Communications Technology*. Talk to manufacturers about applications notes, in-house training and developing effective maintenance procedures. With that information in hand, you'll have a good start on a plan.

> "It can be hard to convince people that preventive maintenance can help save time, effort and money."

Wrap-up

Now that you've got a clearer picture of where you stand in terms of winter readiness, it's time to take the knowledge that you've gained and act upon it. You've still got time, and upgrading your readiness now will save you innumerable headaches later on down winter's icy roads. TB

John Bisset is a district sales manager for Harris Broadcast. He can be reached via e-mail at jbisset@harris.com.

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THE Build

BRING IT HOME

The ugly face of ingress: If a sub's pictures look like this one, you can bet that return path activation on this drop will be a challenge. Photo courtesy of the NCTI

Testing the Return Path

By Steve Holmes

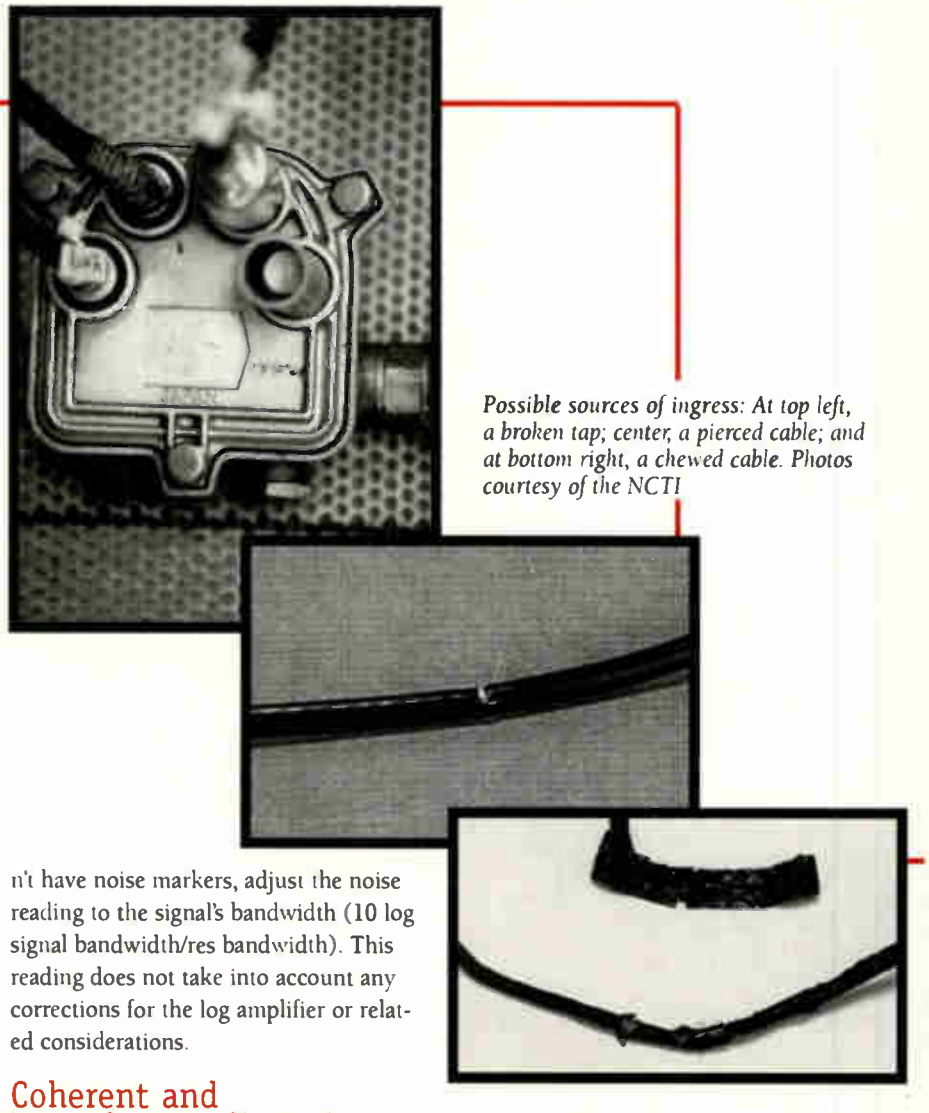
Today's digital-ready cable networks are placing more demand on the return path. The importance of a reliable return path is essential when implementing cable modem services, telephony and the like. Therefore, it is important to maintain and monitor the return path's performance.

Testing return carriers differs from testing forward carriers in that each carrier has its own set of distortions. Composite second order (CSO) and composite triple beat (CTB) both are caused when some aspect of the forward amplification becomes nonlinear. Carrier signals will beat and cause second and third order products. Most beat products in the return band will fall out of band (OOB) at various locations within the return band, most of which aren't normal CTB and CSO spots. When two or three carriers beat, they will fall outside the passband, or at odd locations in the return band.

Carrier-to-noise ratio (C/N) in the return band differs as well. C/N is based on occupied bandwidth, so an adjustment or correction must be made based on the bandwidth of the data signal. Most of the signals are not 4 MHz wide, as is the noise-power bandwidth used for forward path analog TV channel C/N measurements, so the corrections applied to the forward path are not appropriate. It's useful to have an RF analyzer that has noise markers that can be placed on top of the data and at the noise floor close to the data carrier. The analyzer provides an adjustment for the bandwidth of the data you are measuring and provides an accurate C/N.

You must keep coherent and noncoherent distortions (caused by beats or ingress) at or below acceptable levels for the type of modulation being used at that section of the band. The numbers will change, depending upon the types of modulation and the bandwidth in use.

Peak hold must be used for most return data signals. This is because of the "bursty" nature of the signal and the need for enough data (signal points) to build the modulation stack. With peak hold on, and a sufficient amount of data collected, put the analyzer marker on the average



Possible sources of ingress: At top left, a broken tap; center, a pierced cable; and at bottom right, a chewed cable. Photos courtesy of the NCTI

level of the data signal. This will give you a close approximation of the received level. *Editor's note: One downside to using peak hold for upstream data carrier amplitude measurements is that a "hot" modem or other device will cause a much higher indicated level than properly operating equipment will.*

To read the noise power, use the noise markers and set their bandwidth to the signal's bandwidth. If your analyzer doesn't have noise markers, adjust the noise reading to the signal's bandwidth (10 log signal bandwidth/res bandwidth). This reading does not take into account any corrections for the log amplifier or related considerations.

Coherent and Noncoherent distortions

It's advisable to keep the total coherent and noncoherent distortions to an acceptable level throughout the return, not just where you have data carriers. Note that distortions may vary at different parts of the return band. Closer to the low end of the return spectrum, the noise floor typically has a small rise. This may make it necessary to have different noise requirements for different parts of the return band. Thus, you'd place slower, narrower data carriers at the lower end of the return band and wider, higher-speed data carriers at the upper end of the return band.

The new data service providers are allocating more of the return-band spectrum for digital carriers, used for new services such as telephony, cable modems and digital interactive services. Figure 1 (on page 120) shows a good, clean return path with data carriers present.

With cable modem services, interference can cause sessions to end abruptly, without the user's knowledge. Interference also can increase the time it takes to establish communications because of data retransmission when bit errors occur.

With digital interactive services, interference will prevent the customer from establishing communication between the server and the set-top box, causing transmit error messages to be displayed on the TV screen.

Most of the problems that occur in the return path result from three major types of interference:

- Ingress
- Common path distortion (CPD)
- Impulse noise

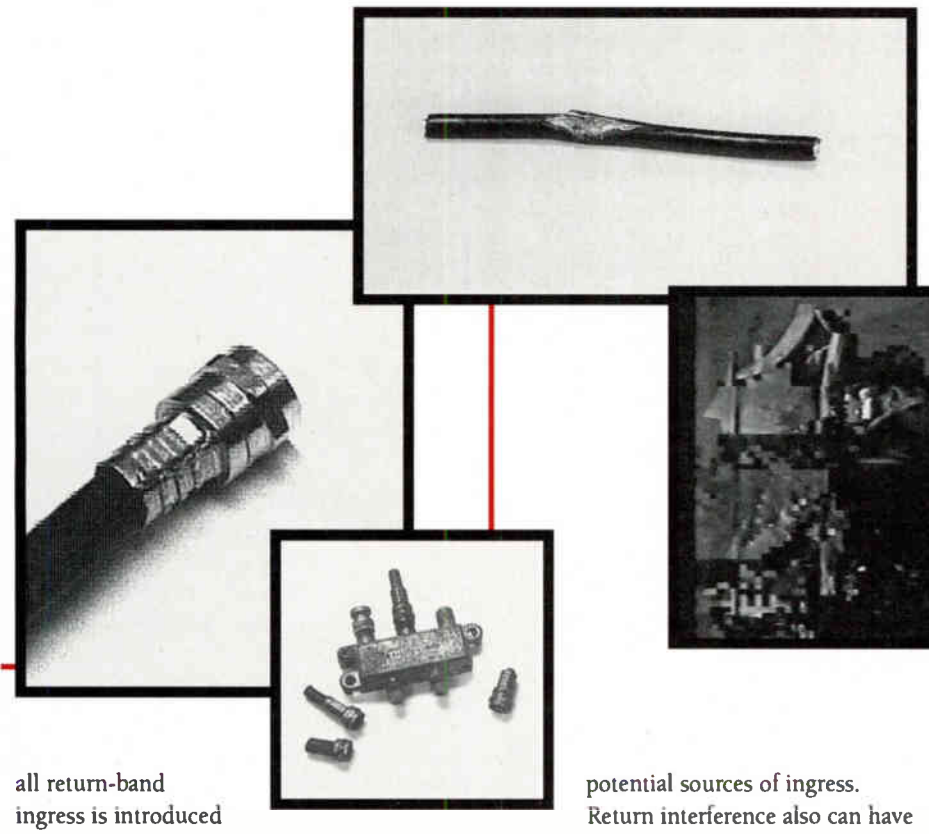
Ingress sources

The most common sources of ingress are the many known over-the-air radio frequencies that share the same spectrum with any given system. Ninety percent of

The Bottom Line

Testing the Return

With today's new two-way cable services, maintaining the return path can be quite a challenge. Services such as cable modems, interactive set-top boxes and telephony are placing increasingly higher demands on the return path. This makes keeping customers happy (while keeping distortions, noise, ingress and the like at manageable levels) a full-time job. Problems in the return path differ from those in the forward path. We need to understand how to test, and what to look for, in the return path. If we do this, we will be able to provide the quality and types of services that our customers deserve.



Still more possible sources of ingress and its results: Clockwise from bottom left, corroded connectors, a cracked crimp ring, severely scraped cable, and a distorted image. Photos courtesy of the NCTI

all return-band ingress is introduced in the subscriber drop. Loose F-connectors, poorly shielded drop cable and unshielded TV sets are all contributors.

A common solution is to put high-pass filters in the drops of all one-way customers. These traps keep any subscriber drop problems from getting into the rest of the plant. This works fine until the customer wants a service that requires the return path. For that, the subscriber's wiring will have to be cleaned up. (See Figure 2 on page 120.)

The trunk and feeder plant accounts for less than 10 percent of the ingress detected in a system. The root cause of most problems is loose or improperly installed line connectors or damaged trunk or feeder cables. Good plant maintenance will help prevent these problems from becoming critical.

Tri-shield and quad-shield drop cable effectively shield against over-the-air interference as long as the fittings are properly installed and tightened. The return is like a funnel; all subscribers at one node are potential sources of ingress. Return interference also can have a significant effect on the laser diode inside the optical transmitter. As interference is transmitted from more than one trunk leg, carriers at the same frequency can combine, increasing carrier power.

"With cable modem services, interference can cause sessions to end abruptly, without the user's knowledge."

The noise floor also will significantly increase. These combined carriers can cause the laser diode at the node to begin clipping. Rather than affecting only one digital carrier, clipping (also called cross-compression) affects the entire return band for the node in question.

Common path distortion

CPD, another cause of return path interference, is in most cases caused by dissimilar metals interfaces, corrosion and poor connections. CPD is tough to troubleshoot because it comes and goes. A small amount of oxidation in the signal path can be the electrical equivalent of a diode that, in turn, will cause the forward signals to beat (heterodyne) down to the return spectrum. For instance, some have found that loose backing nuts on 90° connectors also can cause CPD problems. When you touch the amp housing to take a reading, the 90° connector has a good ground, temporarily, and the CPD temporarily disappears.

Average detection mode weeds out the spurious noise products and allows you to see better the signals of interest. When combined with max hold, this can help detect the elusive CPD that hides in the noise floor. To identify such CPD, decrease the dB per division from 10 dB to 5 dB or 2 dB, and you will begin to see distinct characteristics of CPD. (See Figure 3 on page 120.)

Figures 1-3: Spectrum analyzer readouts

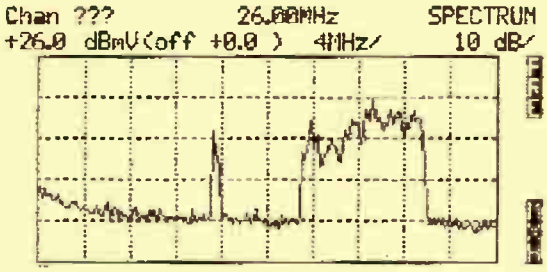
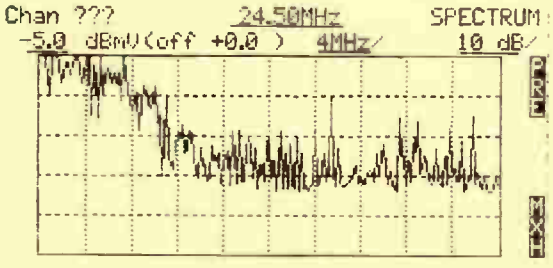
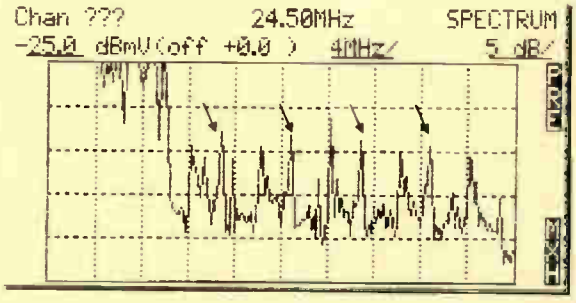


Figure 1, at top left, indicates a "clean" data return path.

Figure 2, at bottom left, indicates a "dirty" subscriber drop.

Figure 3, at bottom right, indicates common path distortion (CPD). The beats are spaced every 6 MHz (8 MHz for a phase alteration line, or PAL, system).





Impulse noise

Impulse noise is a special case of ingress, caused by over-the-air electromagnetic interference (EMI), and is best described as bursts of random noise. Impulse noise can originate from household appliances, such as hair dryers, blenders, drills and microwave ovens. These signals enter the coax through the same ways conventional RF ingress does. Dirty power-line insulators and fluorescent lights can cause additional disturbances in both the forward and return bands. (See Figure 2.)

To differentiate these interference signals, it's useful to have an RF analyzer that has AM/FM demodulators with speaker, max hold, average detection mode and relative field strength. In the relative field strength mode, you connect an antenna to the analyzer and tune the instrument to the desired frequency. In this mode, you can do one-person triangulation to find the offending RF signal. Usually, any place where signals leak out of a plant, signals can enter as well.

The point

Following these steps will help you keep your return path reliable for cable modem services, telephony and the like. Without a clean return, you can look forward to endless headaches, annoyed customers and lost revenue, all of which can combine to make you question why you ever went two-way in the first place. TB

Steve Holmes is an application engineer for video/CATV at Tektronix. He may be reached at steven.r.holmes@tek.com.

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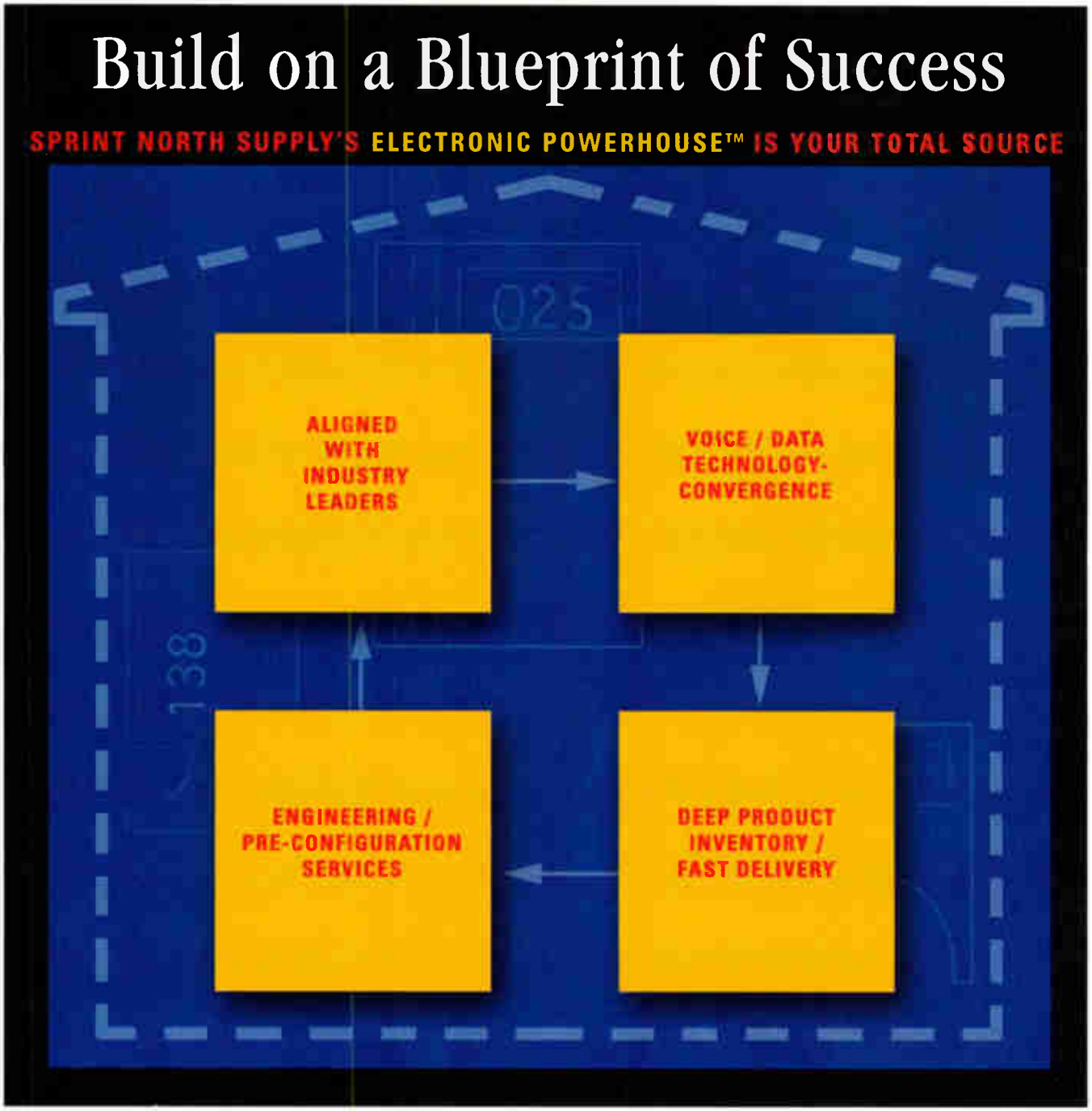

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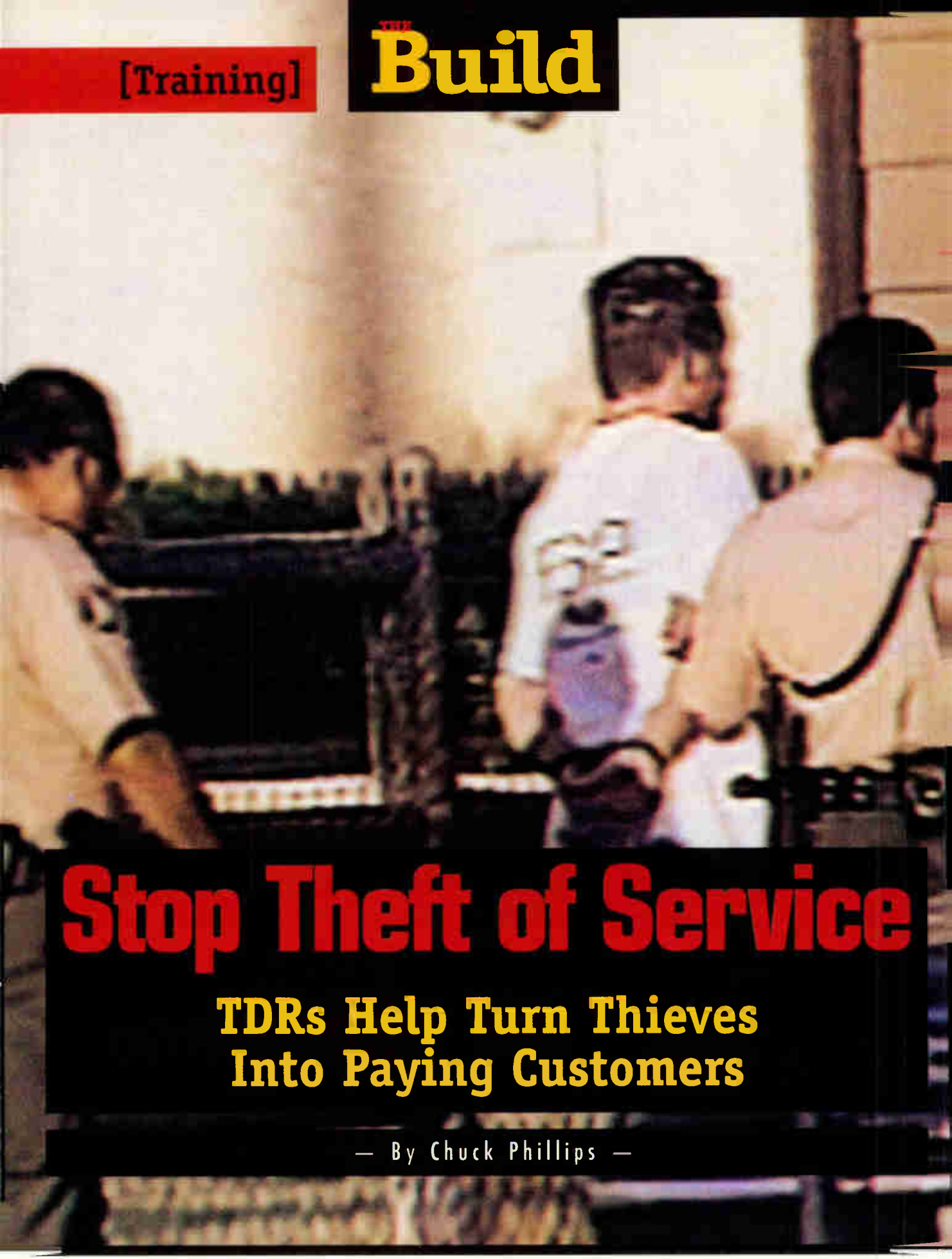


Stop Theft of Service

TDRs Help Turn Thieves Into Paying Customers

— By Chuck Phillips —

Caught on video: Working with the Moreno Valley Police Department, MediaOne orchestrates raids on the homes of three individuals suspected of selling millions of dollars' worth of illegal cable piracy equipment. Each year, theft of service is estimated to cost the cable industry $5.8 billion in lost revenues.

Photo courtesy of MediaOne

With competition breathing down the necks of today's cable operators, it's essential you make every subscriber's dollar count. One way to reap new dollars fast is to crack down on service theft.

Today's state-of-the-art time domain reflectometers (TDRs), a staple in your tool chest, can help you sniff out the thieves. In fact, a TDR can pay for itself in a short time by helping you to detect illegal cable hookups.

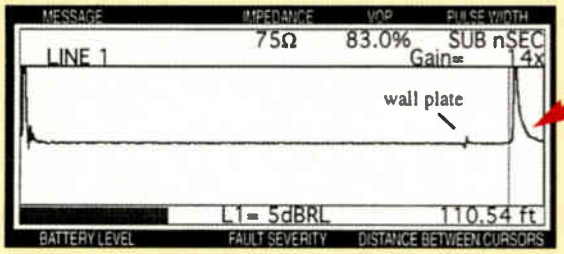
> "The primary goal in detecting illegal service is to convert the thief into a paying customer."

Today, many cable companies are making a concentrated effort to curb the theft of their cable TV service. By employing teams of technicians, investigators and lawyers, cable systems are having a significant impact on this widespread problem.

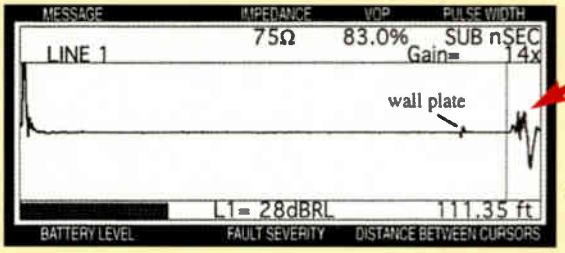
The primary goal in detecting illegal service is to convert the thief into a paying customer. Some systems even give bonuses for the number of suspected thieves that ultimately are converted. If a customer refuses to pay and continually is caught stealing service, you may need to prosecute. If this is the case, a TDR can provide useful evidence to back your claim.

Although it may be blatantly obvious if someone is connected illegally, thieves may still claim they were not using the service. Theoretically, this could be true if the cable were just lying on the floor inside the residence and not connected to

Waveforms of unconnected cable vs. possible theft



End of cable (complete open indicating no theft of service)



This reflection, which looks very different from an open, indicates a device at the end of the cable.

The top waveform shows a substantial upward reflection, which indicates a complete open (nothing reflected on the cable). This would indicate that the cable is not connected to a device such as a TV set or VCR. The bottom waveform is dissimilar from the first in that it indicates that a device is connected to the cable and that service theft could be occurring.

any device. However, if you can prove that there is a device connected inside the residence, most courts will prosecute.

A TDR is an excellent tool for detecting whether a device, such as a TV set, videocassette recorder (VCR), or converter box, is connected to the end of a drop cable inside a residence. A TDR test of a cable with an open end (no device connected) has a very defined signature (waveform), which is easily recognizable. The waveform would display an upward reflection, or open, indicating that there are no devices connected and most likely no provable theft of service. A reflection other than open would indicate some type of device is connected to the cable, thereby indicating theft of service. You may not be able to tell exactly what type of device is connected, but you'll know that something is connected. (See the accompanying figure.)

Spotting the theft

There are several simple methods your personnel can use to help locate illegal taps, including the following:

- Performing visual inspections. By regularly driving through the neighborhood, you'll be able to spot unauthorized connections at pedestals, aerial tap plates or at the residence.
- Running leakage tests. Some illegal taps are found because of excessive leakage caused by improper wiring. Consider involving your security department when testing high leakage problems.
- Checking on work order cancellations: Have your security department follow up on all cancellations of new work orders with a visit to the site. It's possible that someone moving into a new residence may call for service hookup. But, if the previous service was never turned off, the new occupant may say, "Never mind," when the installer shows up or simply calls to cancel the hookup.
- Setting up a cable theft hotline. Some cable systems have a telephone number that allows people to turn in others who are suspected of stealing service. For this to work, the system's paying customers need to realize that thieves don't just prey on the cable company—they prey on paying customers, too.

Make certain that all employees understand how theft of service affects the company. When the company experiences growth, everybody wins. Cable theft takes away from the bottom line. ➤

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Photo courtesy of MediaOne

In the early morning raid, police seize more than $1 million worth of "black boxes" as well as modules for converting set-tops into illegal descrambling devices.

Actions to take

Once an illegal tap is located or reported, many companies follow steps similar to these outlined here:

- Disconnect service. A technician will disconnect the illegal tap from service, document the time and date, and possibly confiscate the exterior drop wiring.
- Test with TDR. When you see an illegal tap, use a TDR to test and store the waveform of the cable connected to the house. If the TDR has a store feature, using it allows the information to be recalled and studied at leisure. Note: If testing a multiple dwelling unit (MDU), it is a good idea to use at least two different pulse widths. Use the smallest pulse width available on the TDR, plus the next larger pulse width to give more distance readability.
- Notify the resident. Leave a note on the dwelling's door explaining what you found and how the occupant can call to get service installed. If the problem crops up again, it may be necessary to inform the suspected thief that legal action could be taken against him or her. Gather as much documentation as possible, such as photographs, affidavits, and any physical evidence of homemade connections and printouts of waveforms from a TDR. ➤

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Reader Service Number 87

If a cable is illegally connected and running directly to a dwelling, the resident still could claim neither knowledge nor use of the service. Many systems have found that if they can confirm that the cable is connected to a device inside the residence, this provides proof that the service is being used.

Storing the waveform in the TDR allows the technician to gather evidence for that particular cable drop. The waveform will show if the cable has been connected to a device or not. If it is connected to a TV set, VCR or converter, the waveform will reflect a lowering of impedance characteristic (downward reflection) and somewhat of a "rippling" effect. If the cable is not connected to a device, it will display a complete open, or upward reflection, on the TDR's screen.

Because of the numerous types of TV sets, VCRs and converters, the waveform signature displayed sometimes can vary greatly. However, stored waveforms can be used for analysis or can be printed out later for use as evidence.

Though TDRs are only one part of the process, all of the foregoing amply illustrates that they do make useful tools in your fight against theft of service. CT

Chuck Phillips is national sales manager, of CATV/broadband systems for Riser-Bond Instruments. He may be reached at (402) 466-0933, (800) 688-TDRS or via e-mail at cphillips@riserbond.com.

The Bottom Line

Check Theft With TDRs

Almost any time domain reflectometer (TDR) can be used to test for theft of service. However, today's TDRs hold some advantages over their predecessors, both for fault location and for the documentation of cable theft.

The latest TDRs have very small pulse widths and can locate previously undetected or unsuspected faults that occur only at high frequencies. A smaller pulse width (and the resulting smaller blind spot) also is advantageous while inspecting the cable for illegally connected devices.

Another advantage of some of the newer test equipment is its ability to store waveform traces. The waveform will show if the cable has been connected to a device or not. If it is connected to a TV set, VCR or converter, the waveform will reflect a lowering of characteristic impedance (downward reflection) and somewhat of a "rippling" effect. If the cable is not connected to a device, it will display a complete open, or upward reflection, on-screen. Being able to produce a waveform that shows the cable is connected to a device will help thwart claims that the resident had no knowledge that the cable service was being stolen.

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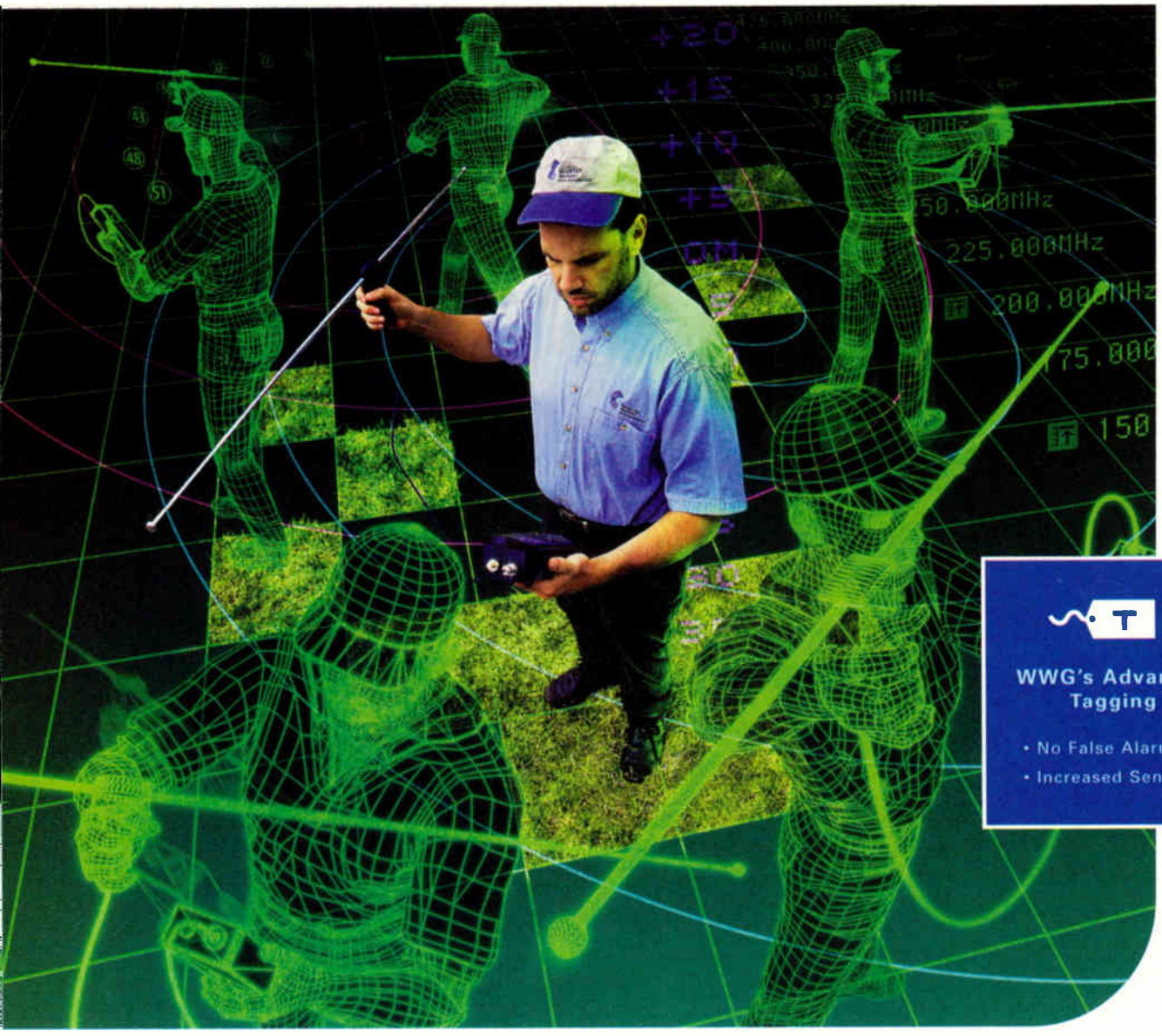

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Reader Service Number 90

Detecting Signal Leakage, Part 3

This month's installment continues a series on detecting signal leakage in the drop system. The material is adapted from a lesson in NCTI's Installer Technician Course. © NCTI.

Isolating leakage at the drop and tap

When multiple drops are connected to the tap, eliminate the possibility that other drops are causing the signal leakage by disconnecting each drop individually while monitoring the leakage detector or signal level meter (SLM). (See Figure 1.)

If the leak is still present with all but the one drop connected, and the service drop is suspected as the leakage source, remove the RF signal from the customer's service drop. To do this, disconnect the drop cable from the tap port and install an F-81 barrel connector and 75-ohm terminator on the drop cable as shown in Figure 1. Next, connect an SLM to the opposite end of the service drop cable (after disconnecting the service drop from the ground block) and tune the SLM to a local over-the-air TV or FM signal. (See Figure 2.)

If the SLM shows the presence of the tuned signal, replace or repair the drop cable according to your system procedures. If no over-the-air signal is measured, the service drop is not the cause of the signal leakage. Reconnect the drop to the tap and at the ground block, and then check the rest of the drop system using the same method.

Isolating leakage at individual drop outlets

For each individual drop outlet, verify that no signal leakage is coming from damaged cable, loose F-connectors or poorly shielded passive devices. You can verify that each drop cable leading to an individual outlet has no signal leakage when the RF signal is removed and the drop cable (with one end terminated) is tested with an SLM for the presence of a local over-the-air TV or FM signal.

To do this, first disconnect the suspected drop outlet cable from the ground block or grounded splitter output and connect an F-81 barrel connector and a 75-ohm terminator. (See Figure 3.) Next, after verifying proper F-connector installation at the input to the wall plate, connect an SLM to the wall plate output and tune your SLM to a local over-the-air TV or FM signal. (See Figure 4.) The presence of a tuned signal indicates that signal leakage (egress) is coming from the individual outlet drop cable.

Rather than trying to isolate the precise signal leakage location along the cable, replace the individual drop cable per your system's policies and procedures. After this replacement, recheck the F-connectors and passive devices for tightness of fit. To verify the fix, recheck the individual drop cable for over-the-air signals with the same procedure used to detect the signal leakage. TB

Next month's installment will continue with a systematic approach for isolating signal leakage sources in the drop system.

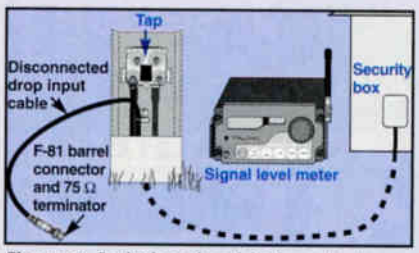

Figure 1: Isolating signal leakage to tap by disconnecting service drop from tap

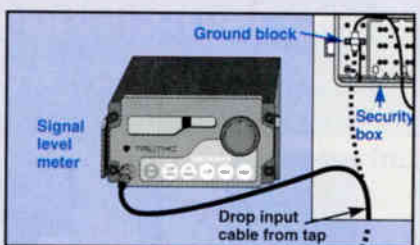

Figure 2: Isolating signal leakage at service drop by disconnecting from ground block

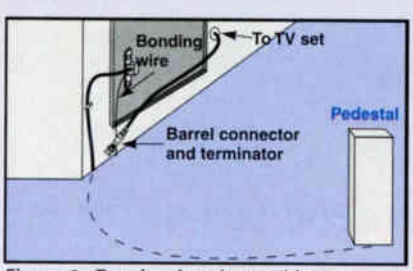

Figure 3: Terminating drop cable at ground block

Figure 4: SLM tuned to over-the-air TV or FM signal

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CALENDAR

October

5-7: Hybrid Management Sub-Layer Subcommittee Interoperability Workshop, Society of Cable Telecommunications Engineers headquarters, Exton, Pa. 9 a.m.—5 p.m. Chair: Esteban Sandino. Contact Dr. Ted Woo at (610) 363-6888.

6: Cascade Range SCTE Chapter testing session, Kelso. Wash. Broadband Communications Technician/Engineer (BCT/E) certification examinations to be administered. Contact Chris Johnson at (503) 245-0603, Johnson.Chris@tci.com or member.aol.com/cascte/.

9: Llano Estacado SCTE Chapter Cable-Tec games and vendor show, Cox Communications, Lubbock, Texas. Contact David Fielder at (806) 793-7475.

12-14: Atlantic Cable Show, Baltimore Convention Center, Baltimore. Call (609) 848-1000.

12-14: Mid-America Cable Show, Overland, Kan. Call (785) 841-9241.

14: SCTE Satellite Tele-Seminar Program, Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Topic: "Engineering Management and Professionalism." Contact SCTE headquarters, Janene Martin, at (610) 363-6888, ext. 226, or jmartin@scte.org.

15: Oklahoma SCTE Chapter testing session, Multimedia Cablevision registration office, Edmond, Okla. BCT/E certification examinations to be administered. Contact Steve Johnson at (405) 422-2346 or sjohnson@cvvt.org.

18-20: 22nd Annual Newport Conference on Fiber Optics Markets, Newport, R.I. Contact Kristin Engdahl at (401) 849-6771.

19-21: Desert, San Diego and Southern California SCTE Chapters vendor show and golf tournament, Norwalk, Calif. Contact Gary Adams at (714) 586-3196.

21: Cascade Range SCTE Chapter testing session. BCT/E certification examinations to be administered. Contact Chris Johnson at (503) 245-0603, Johnson.Chris@tci.com or visit member.aol.com/cascte/.

24-28: National ComForum '99, Hyatt Regency O'Hare, Chicago. Call (312) 559-4600 or go to www.iec.org. CT

Planning Ahead

Nov. 10-11: OSP Expo '99, Fort Worth Convention Center, Fort Worth, Texas. Call (847) 639-2200.

Nov. 16-19: Color Imaging Conference, SunBurst Resort, Scottsdale, Ariz. Call (703) 642-9090.

Dec. 14-17: Western Cable Show, Los Angeles. Call (510) 428-2225 or go to www.cct-assn.org.

Jan. 11-13: SCTE Conference on Emerging Technologies 2000, Anaheim, Calif. Call (610) 363-6888.

Feb. 23-25: 40th Anniversary Texas Show, San Antonio Convention Center, San Antonio. Call (512) 474-2082.

VENDOR CONNECTION

Vendor Connection is *Communications Technology's* resource for up-to-date information on the industry's leading technology suppliers. These vendors have advertised in this issue. Check their ads for products and services that will improve your cable system's reliability, efficiency and capacity.

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Sally Thiel, Manager, Corporate Communications
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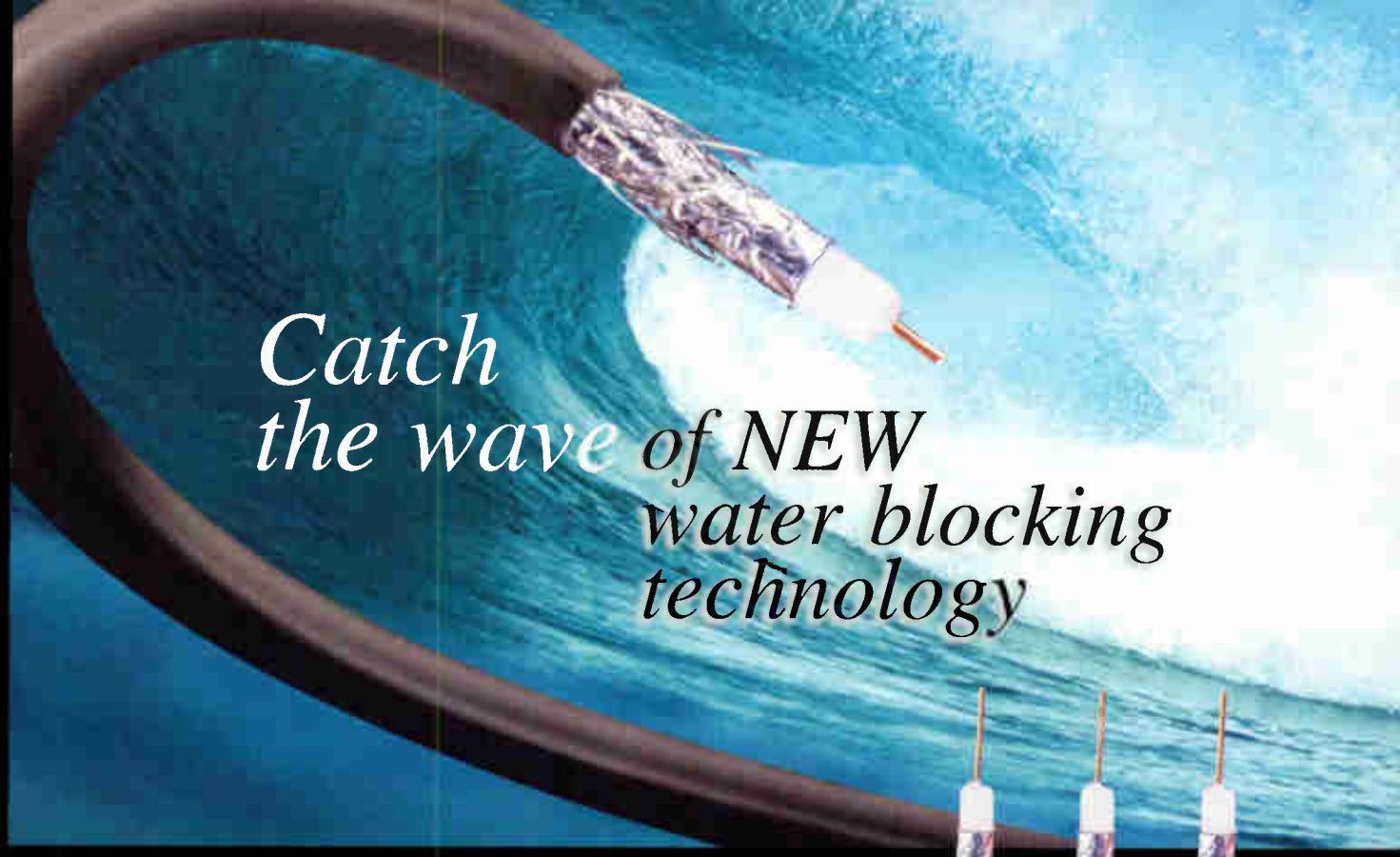

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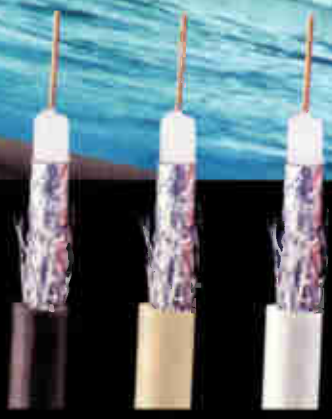

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- ☐ 36. Antennas
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- ☐ 55. Power Supplies. (Batteries, etc.)
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F. What is your annual cable equipment expenditure?
- ☐ 57. up to $50,000
- ☐ 58. $50,001 to $100,000
- ☐ 59. $100,001 to $250,000
- ☐ 60. over $250,000

G. In the next 12 months, what fiber-optic equipment do you plan to buy?
- ☐ 61. Fiber-Optic Amplifiers
- ☐ 62. Fiber-Optic Connectors
- ☐ 63. Fiber-Optic Couplers/Splitters
- ☐ 64. Fiber-Optic Splicers
- ☐ 66. Fiber-Optic Patchcords/Pigtails
- ☐ 68. Fiber-Optic Cable

H. What is your annual fiber-optic equipment expenditure?
- ☐ 70. up to $50,000
- ☐ 71. $50,001 to $100,000
- ☐ 72. $100,001 to $250,000
- ☐ 73. over $250,000

I. In the next 12 months, what cable test & measurement services do you plan to buy?
- ☐ 74. Audio Test Equipment
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- ☐ 76. Fiber Optics Test Equipment
- ☐ 77. Leakage Detection
- ☐ 78. OTDRs
- ☐ 79. Power Meters
- ☐ 80. Signal Level Meters
- ☐ 81. Spectrum Analyzers
- ☐ 82. Status Monitoring
- ☐ 83. TDRs

J. What is your annual cable test and measurement expenditure?
- ☐ 84. up to $50,000
- ☐ 85. $50,001 to $100,000
- ☐ 86. $100,001 to $250,000
- ☐ 87. over $250,000

002740

L. What is your annual cable services expenditure?
- ☐ 91. up to $50,000
- ☐ 92. $50,001 to $100,000
- ☐ 93. $100,001 to $250,000
- ☐ 94. over $250,000

M. Do you plan to rebuild/upgrade your system in:
- ☐ 95. 1 year
- ☐ 96. more than 2 years

N. How many miles of plant are you upgrading/rebuilding?
- ☐ 97. up to10 miles
- ☐ 98. 11-30 miles
- ☐ 99. 31 miles or more

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Corporate Management
31. CEO
32. President
33. Owner
34. Vice President
35. Partner

Operations Management
36. General Manager
37. Business Manager
38. Operations Manager
39. Product Manager
40. Purchasing Manager

Engineering Management
41. Engineering VP
42. Engineering Manager
43. Director of Engineering
44. Engineering Supervisor
45. Corporate Engineer
46. Senior Engineer
47. Regional Engineer
48. Divisional Engineer
49. Plant Manager
50. Installation Manager
51. Network Manager
52. Construction Manager
53. Field Services Manager
54. Technical Manager Engineering
55. Engineer
56. Headend Engineer
57. Const. Engineer
58. OSP Engineer Technical
59. Headend Technician
60. Line Technician
61. Bench Technician
62. Sweep Technician
63. Other Technical Title (Please specify)

Installation
64. Installer
65. CSR
66. Other Installation Title (Please specify)

E. In the next 12 months, what cable equipment do you plan to buy?
35. Amplifiers
36. Antennas
37. CATV Passive Equipment including Coaxial Cable
38. Cable Tools
39. CAD Software, Mapping
41. Compression/Digital Equip.
43. Connectors/Splitters
45. Headend Equipment
46. Tranmission/Switching Equipment
47. Networking Equipment
48. Vaults/Pedestals
49. MMDS Tranmission Equipment
51. Receivers and Modulators
52. Cable Modems
53. Subscriber/Addressable Security Equipment/ Converters/Remotes
54. Telephone/PCS Equipment
55. Power Supplies. (Batteries, etc.)
56. Video Servers

F. What is your annual cable equipment expenditure?
57. up to $50,000
58. $50,001 to $100,000
59. $100,001 to $250,000
60. over $250,000

G. In the next 12 months, what fiber-optic equipment do you plan to buy?
61. Fiber-Optic Amplifiers
62. Fiber-Optic Connectors
63. Fiber-Optic Couplers/Splitters
64. Fiber-Optic Splicers
66. Fiber-Optic Patchcords/Pigtails
68. Fiber-Optic Cable

H. What is your annual fiber-optic equipment expenditure?
70. up to $50,000
71. $50,001 to $100,000
72. $100,001 to $250,000
73. over $250,000

I. In the next 12 months, what cable test & measurement services do you plan to buy?
74. Audio Test Equipment
75. Cable Fault Locators
76. Fiber Optics Test Equipment
77. Leakage Detection
78. OTDRs
79. Power Meters
80. Signal Level Meters
81. Spectrum Analyzers
82. Status Monitoring
83. TDRs

J. What is your annual cable test and measurement expenditure?
84. up to $50,000
85. $50,001 to $100,000
86. $100,001 to $250,000
87. over $250,000

002740

L. What is your annual cable services expenditure?
91. up to $50,000
92. $50,001 to $100,000
93. $100,001 to $250,000
94. over $250,000

M. Do you plan to rebuild/upgrade your system in:
95. 1 year
96. more than 2 years

N. How many miles of plant are you upgrading/rebuilding?
97. up to10 miles
98. 11-30 miles
99. 31 miles or more

Circle Numbers for Free Information

1	25	49	73	97	121	145	169	193	217	241	265	289
2	26	50	74	98	122	146	170	194	218	242	266	290
3	27	51	75	99	123	147	171	195	219	243	267	291
4	28	52	76	100	124	148	172	196	220	244	268	292
5	29	53	77	101	125	149	173	197	221	245	269	293
6	30	54	78	102	126	150	174	198	222	246	270	294
7	31	55	79	103	127	151	175	199	223	247	271	295
8	32	56	80	104	128	152	176	200	224	248	272	296
9	33	57	81	105	129	153	177	201	225	249	273	927
10	34	58	82	106	130	154	178	202	226	250	274	298
11	35	59	83	107	131	155	179	203	227	251	275	299
12	36	60	84	108	132	156	180	204	228	252	276	300
13	37	61	85	109	133	157	181	205	229	253	277	301
14	38	62	86	110	134	158	182	206	230	254	278	302
15	39	63	87	111	135	159	183	207	231	255	279	303
16	40	64	88	112	136	160	184	208	232	256	280	304
17	41	65	89	113	137	161	185	209	233	257	281	305
18	42	66	90	114	138	162	186	210	234	258	282	306
19	43	67	91	115	139	163	187	211	235	259	283	307
20	44	68	92	116	140	164	188	212	236	260	284	308
21	45	69	93	117	141	165	189	213	237	261	285	309
22	46	70	94	118	142	166	190	214	238	262	286	310
23	47	71	95	119	143	167	191	125	239	263	287	311
24	48	72	96	120	144	168	192	216	240	264	288	312

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BUSINESS DIRECTORY

By John Clark

Get Results in 2000 with SCTE

Planning for the training needs of your organization can present many budget dilemmas. As the new millennium approaches, the vision of what systems and training personnel will need is crucial. How can you be sure that you've made provision for the training and resources your staff will require in the new era? The Society of Cable Telecommunications Engineers offers many training options to fit the needs of a vast array of system budgets.

SCTE's mission of "training, certification and standards" can provide the basics to get your employees trained or help them stay abreast of changing technology. By taking advantage of these resources, even a modest investment can add up to increased individual skills and improved system service.

Training

Cable TV is in an era of increasing capital investments and operating expenses. Many people see training as an expense; visionaries see it as an investment in people. The challenge is finding the right training to improve performance or teach new skills with a reasonable investment of your training dollars.

Consideration of how the training will be delivered is the first step. Supervisors and managers can be very effective trainers if they have the time and can concentrate on delivery rather than the development of training materials and programs. In-house dedicated trainers probably are the best solution, but most small to mid-sized systems can't afford that luxury.

Another consideration is determining the actual material. Do you want to spend the time and money developing training yourself, or can you buy something "off the shelf?" Can you easily modify the "off the shelf" program to address specific company or local issues? It is lengthy and costly to develop good training.

SCTE already has invested the development time to create programs that are well-designed and flexible. Most Knowledge Avenue brand products such as student workbooks can be used for self-study for students who like to learn in that mode. The materials also include review questions and activities that help the manager or supervisor check to make sure the training can be applied to the job. Leader guides are available that provide trainers, supervisors or others with the tools to deliver training in a classroom environment. Finally, the programs can be modified easily to insert local or company-specific policies, procedures or information.

Another aspect unique to SCTE training is that the cost per student actually decreases as more people are trained. There is a small fixed cost per student for each participant, but the leader guides are long-term investments that can be spread over the total number of students—resulting in lower costs as you train more people.

Certification

SCTE offers certification programs that not only provide professional designations but also serve as comprehensive training programs in the specific areas of engineer, technician, installer, service technician and telephony. This results in your staff's increased knowledge and skill.

Standards

SCTE's standards subcommittees generate industry specifications and test procedures in the areas of data-over-cable, digital video transmission, in-home cabling and the physical layer, just to name a few. These standards are available through the Society's Bookstore, and each of the seven subcommittees meets approximately four times a year.

Other SCTE offerings

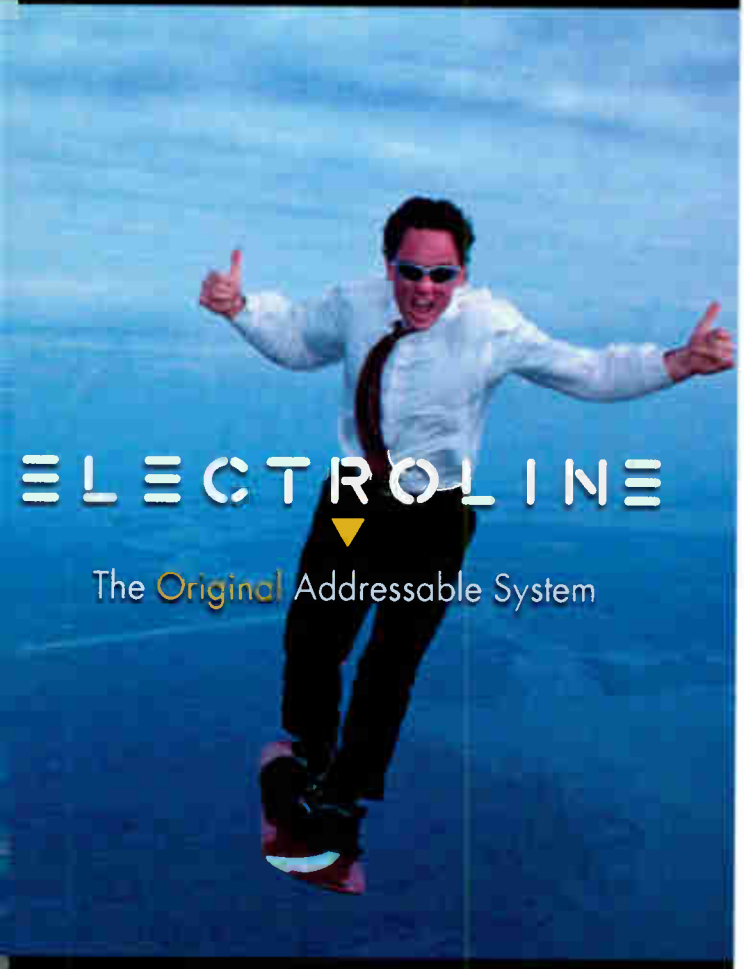
SCTE offers two annual conferences. The first is the Conference on Emerging Technologies, which addresses the latest issues facing the industry. Presentations by industry leaders focus on educating you about new technologies. Next year's conference will be held Jan. 11-13 in Anheim, Calif. In June, SCTE's Cable-Tec Expo 2000 will feature exhibits of all types of products, supplies, services and equipment used in the various facets of broadband telecommunications systems. Learning opportunities are expanded through technical workshops and the Annual Engineering Conference. Expo 200(will be held June 5-8 in Las Vegas.

You can receive training in your area through local chapter meetings and vendor shows. These shows are the cornerstone of the execution of the SCTE mission and offer attendees hands-on learning experiences through hardware demonstrations. Technical seminars sponsored by SCTE's local chapters and meeting groups also provide more in-depth education.

Budget payoffs

SCTE's many training programs, materials and services can be incorporated easily into any budget, no matter what its size. Investing in training translates into a more highly skilled staff and successful system. This in turn increases the level of customer satisfaction, a financial payoff enjoyed and understood by all. CT

John Clark is president of the Society of Cable Telecommunications Engineers.



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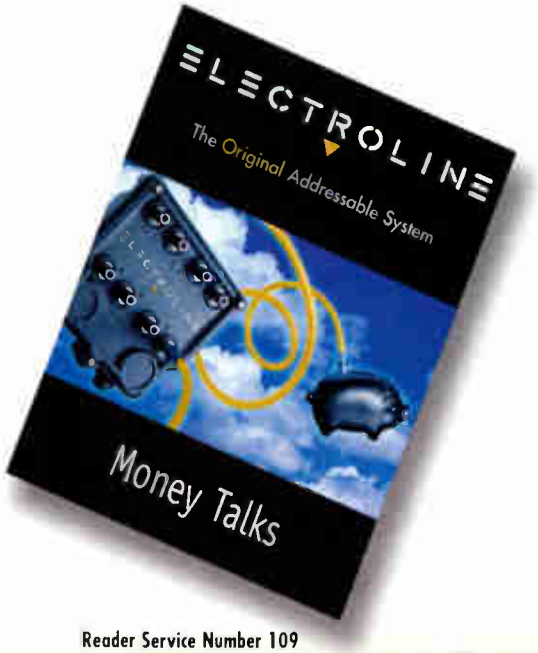

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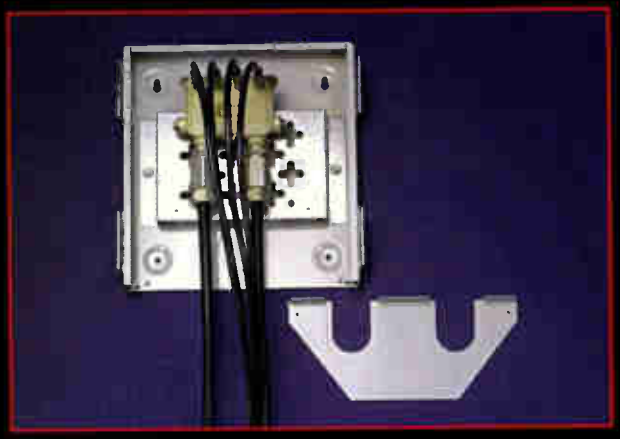

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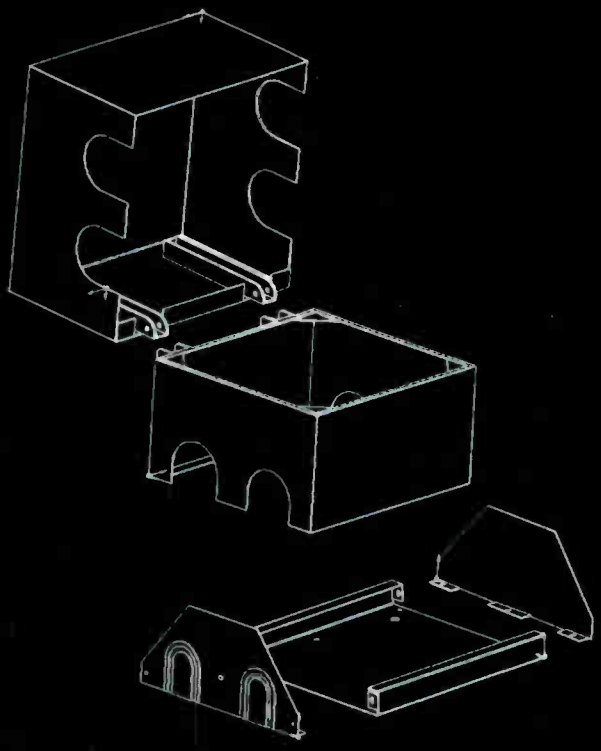

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