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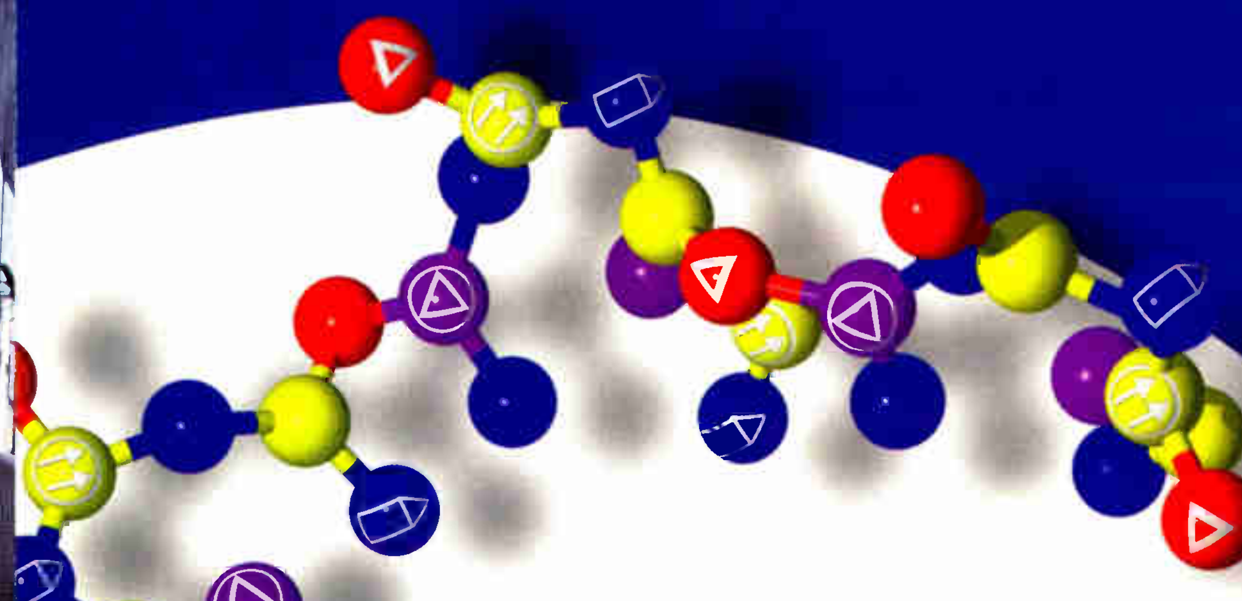

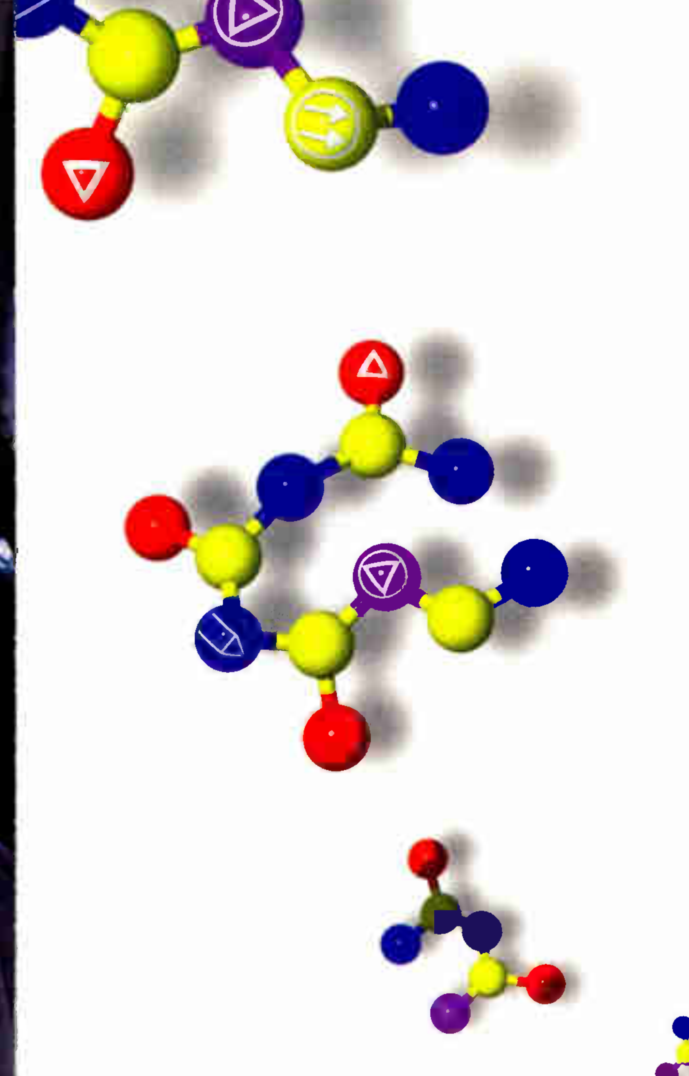

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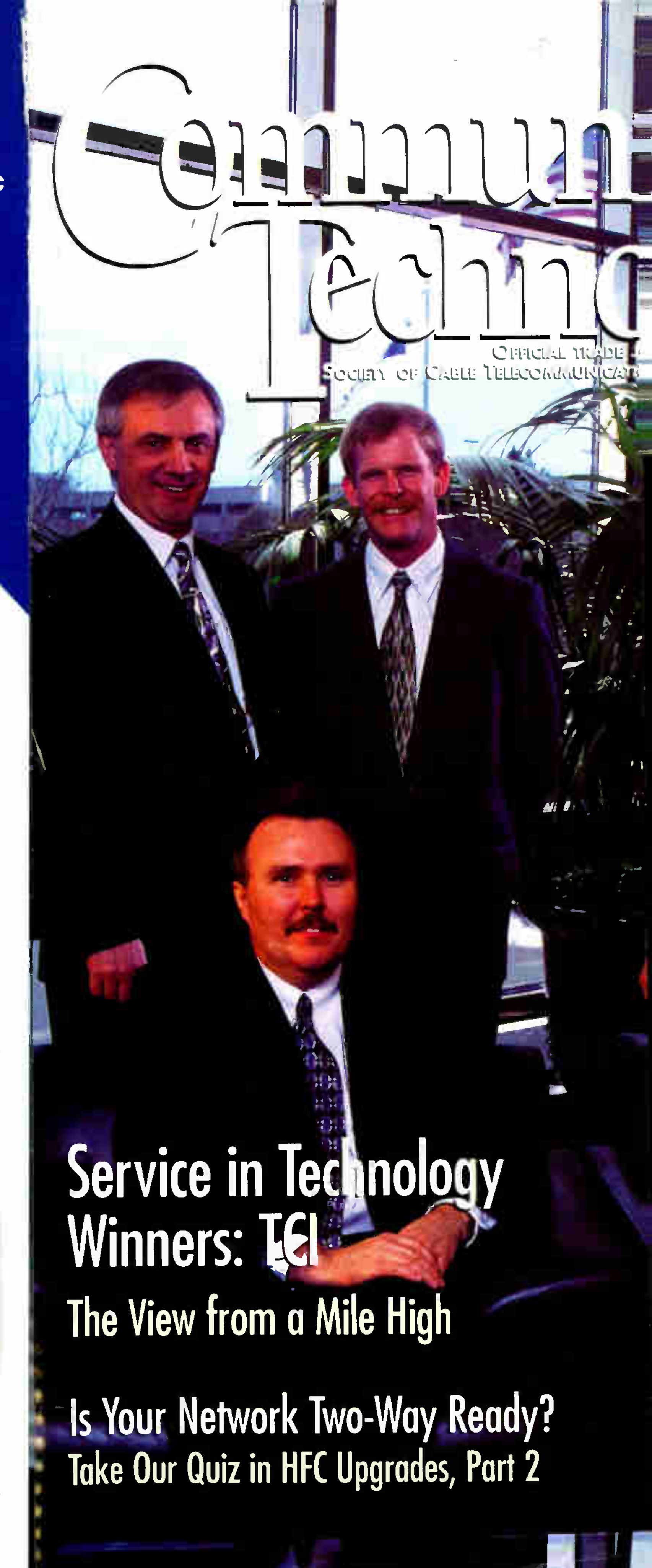

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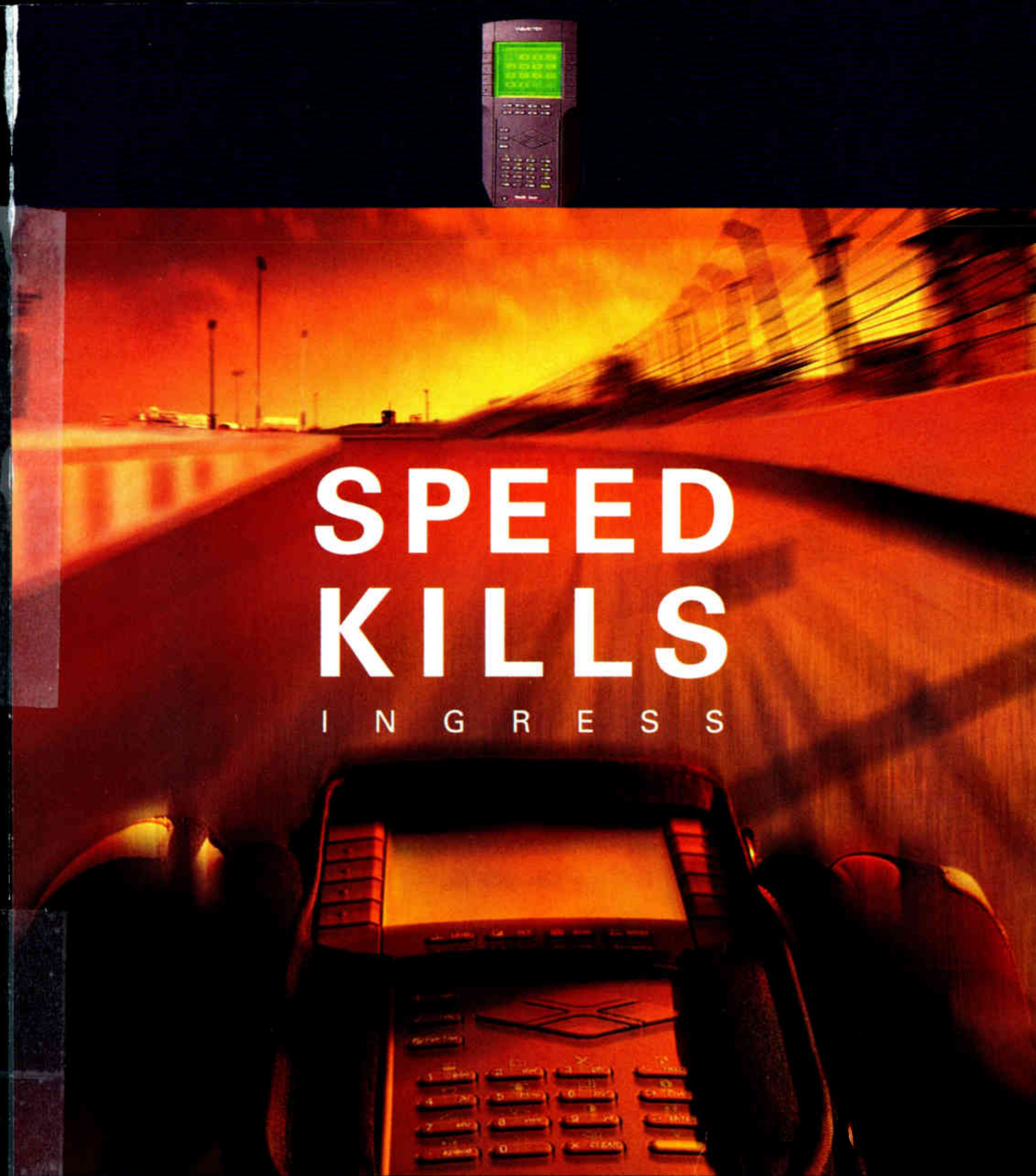

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FEATURES

Cover
Art direction by Maureen Gately
Service in Technology Award photo by Bob Sullivan

Cover photo: Representatives of the TCI team (from left to right): Seated are Tony Werner and Tom Beaudreau; standing are Oleh Sniezko, James Neil, Colleen Abdoulah and Ron Willis.

Congratulations TCI —
Winners of the 1998
Service in Technology Award

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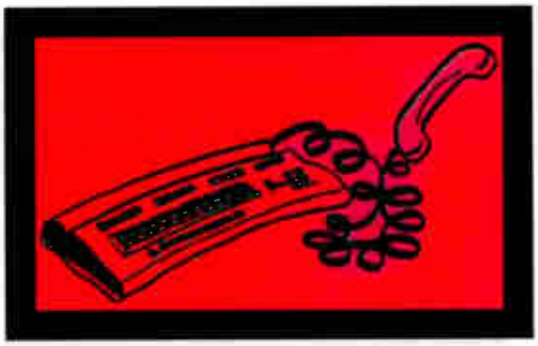

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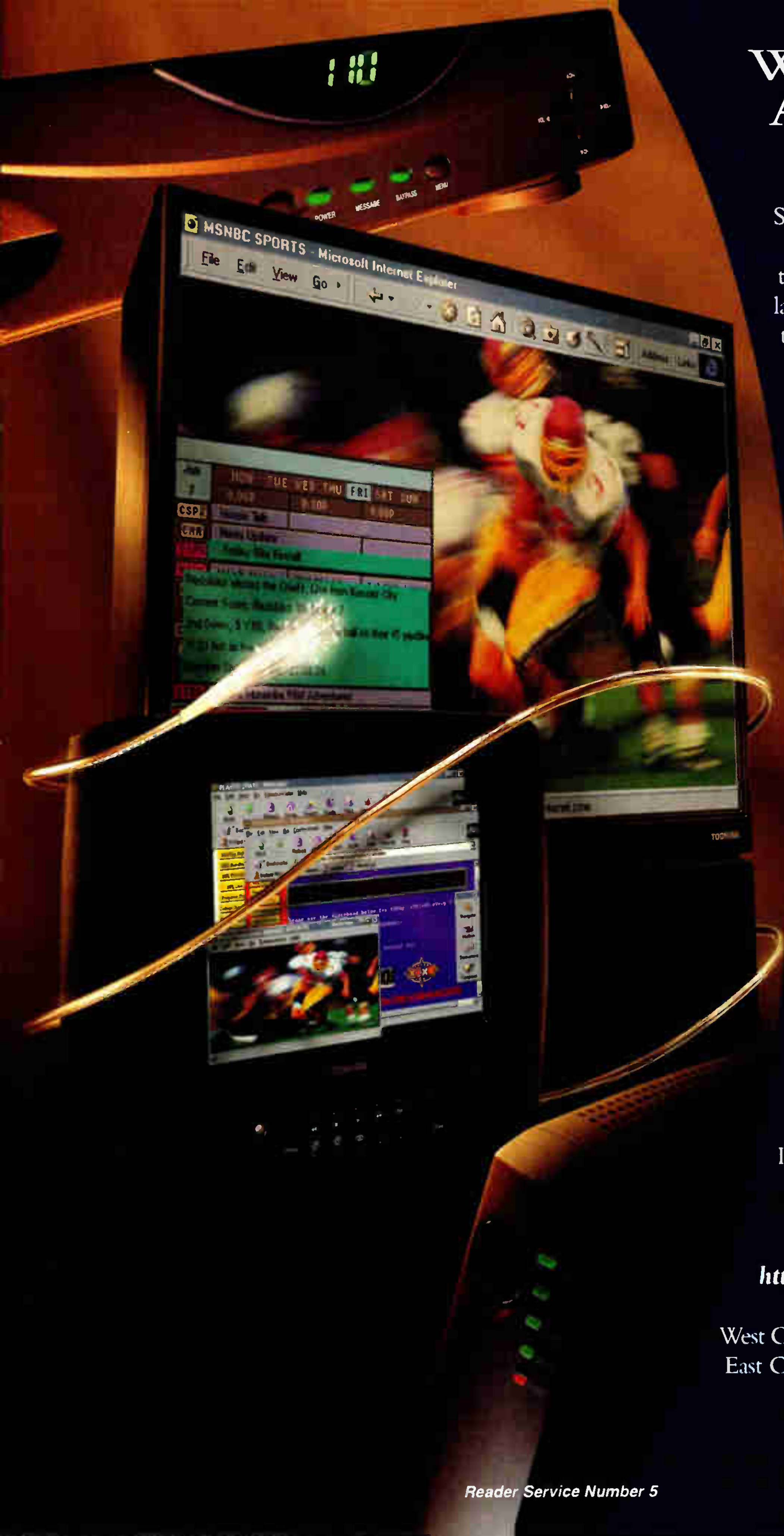

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In Touch with Tomorrow
TOSHIBA

Reader Service Number 5

By Paul Levine

Bill Riker:
Guidance in Growth

The March 1984 issue was *Communications Technology's* first carrying the endorsement of the Society of Cable Telecommunications Engineers as its Official Trade Journal. SCTE had three chapters and about 2,000 members (maybe), and *CT's* circulation was approximately 10,000.

Later that year, we were pleased to have Bill Riker join the SCTE as executive vice president. In his inaugural letter in *Interval*, the society's newsletter, he said, "My primary objective will be to elevate the perception of our Society to one of providing a unique and much-needed service to the engineering community." He added, "There are in excess of 30,000 individuals involved in technical operations who should receive this publication (*Communications Technology*)."

Partners in growth

For the past 15 years, the SCTE and *CT* have worked in concert for the good of the engineering community and cable TV as an industry; we look forward to enhancing that effort for the future. Today the SCTE has 15,000 members and 72 chapters and meeting groups; *CT* has a circulation of more than 27,000. We also have developed scholarship programs. The first SCTE scholarship came from a personal donation by Rex Porter in the 1980s. Prior to this, no scholarship program existed. Since that original donation, the fund has grown to three SCTE scholarship funds, participation in the Milton Jerrold Shapp Scholarship program and another fund set up jointly by the SCTE and the Mississippi Cable Television Association.

The launch of the National Cable Games was due to a joint effort between the SCTE and *CT*. These games have become a highlight of the annual SCTE Cable-Tec Expo, state and regional association meetings, and, just recently, regional Vendor Days.

The Service In Technology Award started in 1989 and is considered the highest honor in technology. It honors the individual or company contributing most to cable engineering that year. Additionally, each year a donation of $2,500 goes to the Scholarship Fund in the winner's name. The first award went to Bill and Anna Riker; subsequent awards have honored such companies as Time Warner Cable, Continental Cablevision, CableLabs and the SCTE's Standards Division. Individual winners include John Malone, Dan Pike and Tom Elliot, among others.

All *Communications Technology* employees are SCTE members. *CT* Editor Rex Porter is one of the few charter members still active in the cable industry. He also is a senior member, and in 1986 he was the Member of the Year and then was inducted into the SCTE Hall of Fame in 1992. *CT* Senior Technical Editor Ron Hranac also is a senior member and presently serves on the board of directors. He also has served two terms as board chairman.

With Bill Riker as president, the SCTE has grown from near obscurity to the eminence it holds today. *CT* is proud to be a part of that growth and the legacy that Bill has left with the SCTE. We wish Bill the best in his new position as vice president of operations and engineering at the National Cable Television Center and Museum. In wishing Bill the best, of course, we wish the same to Anna and Joanna. May they enjoy health, wealth and happiness in their new home in Denver.

Paul R. Levine
Senior Publisher

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Appreciation for Veterans

A wise man once said, "A good leader leads; a great leader leads with compassion."

Rex, your leadership in the Society of Cable Telecommunications Engineers and our industry is well established. What continues to impress me is your unfailing recognition and support of those cable TV veterans who have served our industry with distinction. My generation of foot soldiers owes you guys a lot for our jobs and our careers. In particular, I appreciated your comments and reflections regarding two fine southern gentlemen at last year's Eastern Show.

Milt Underwood of the Discovery Channel was the 1997 recipient of the prestigious "Otto Miller Award," which celebrates a career of distinguished service to the cable industry in the South. The fact that you, Milt and Otto knew each other during the early cable days in Alabama made it especially significant for Milt.

Travis Nabors of Mississippi, who passed away in 1995, worked side-by-side with the legendary Morris and Polly Dunn in pioneering cable TV in the '50s and '60s. A Travis Nabors scholarship for broadband cable technicians has been set up and, thanks to the cooperation of yourself, Bill Riker and Ralph Haimowitz, it will be awarded for the first time at this year's MCTA Convention in Biloxi. Of course, this scholarship is based on the various SCTE training programs and tapes.

These two pioneers, Milt and Travis, touched the lives and careers of many of our industry brethren, including my own.

Rex, keep fighting the good fight and, as we celebrate our industry's 50th anniversary, let's always keep a confident eye on the future. But let's never fail to keep a respectful and appreciative eye on the past.

Rick Jubeck
Chairman
Travis Nabors Scholarship Committee
National Sales Manager, Lemco Tool

Editor's Response: Thanks, Rick. I am somewhat envious of the younger generation of engineers in cable. We all will have to hang up our "hooks and belts" someday. But, before that happens, I applaud the efforts of "old-timers" who unselfishly share their experience and history with the newer generation of technicians and engineers.—RP

The Next Generation

I presently am a cable technician employed with Cablevision of Boston as well as a Telecommunications Fiber-Optics Associate student at Wentworth Institute of Technology. I would like to obtain more information about becoming a member of the Society of Cable Telecommunications Engineers.

I enjoyed your interview with Bill Riker in the January issue of *CT*. It was valuable information about the telecommunications industry. I believe that becoming an SCTE member would enhance my knowledge of the industry and opportunities that may exist on a national basis.

Please send any information pertaining to this organization. I look forward to hearing from you.

Anthony T. Brown
Randolph, MA

Editor's response: Thank you for your letter and the kind words about "CT."

Joining the SCTE will indeed enhance your telecommunications studies and career. SCTE has a student membership available, but I am not sure of the particulars. You

RETURN PATH
OUT

should speak with the SCTE staff in Exton, PA. Their phone number is (610) 363-6888, and their fax number is (610) 363-5898. Their Web site is http://www.scte.org. Pat Zelenka is in charge of the Membership Services department, but if you cannot reach her, ask for Paula Jones, Barbara Kugler or Marcia Stringfield.

Keep in touch. We love to hear from our readers.—RP

Return Path—'60s Style

Hello, Rex, it's been a long time since I talked to you. I still have a one-inch "solid" cable you provided as a sample. I was at Ameco from 1968 to 1978 and kind of closed it up as their last chief engineer, then went to work for ATR (then owned by WTCI and later MCI). I retired from MCI in 1995. I still do part-time consulting for them on microwave paths and frequency coordination.

I enjoyed "Return Path—'60s Style." It brought back memories of some of what we went through. "Discade" block conversion was the big one with sub-band during my time there. We put one system into Huntsville, AL, and a more complex one into Daly City, CA (which I don't think ever worked well for long).

Regards,
Don Morton

Editor's Response: Thanks for the letter. I wonder if today's techs and engineers know that we had solid polyethylene dielectric cables (no foam) back in the early days. We sold it to United Cable in Grand Junction, CO, and they needed pipe benders to bend it as they put it in the ground. When you ordered the cable for the discade systems, I worked for Times Wire & Cable, and I remember having to bundle the drops into multiple cable assemblies. When I traveled to Daly City to see that system installed, I was leery from the start. We used to call it "Rediffusion in America," and others called it "Pure Confusion in America."

Write to Us

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Riser Bond INSTRUMENTS

Reader Service Number 14

By Greta Durr

Who Will Carry Must-Carry's Baggage?

The must-carry burden comes with extra baggage for the cable TV industry, packed full of unresolved regulatory souvenirs, one of which directs the Federal Communications Commission to free the set-top's future from MSO market domination.

Under the Telecommunications Act of 1996, the FCC is required to regulate commercial set-tops so that manufacturers, retailers and other vendors unaffiliated with MSOs have a fair shot at the emerging market in transition. The legislation further ordered the FCC to establish and implement these regulations without jeopardizing operators' systems or services. Not an easy task, according to FCC officials in the wake of accusations from Congress that the Commission has been sluggish to regulate set-tops.

Leaders in the cable TV, broadcasting, electronics manufacturing and retail industries gathered for a Subcommittee on Telecommunications, Trade and Consumer Protection digital must-carry hearing April 23. Among the topics emphasized by participants was the attempt by Congress to regulate the set-top's role in digital must-carry before any concrete decisions have been made about the greater issue of what providers will be required to carry for broadcasters.

"I trust that the cable industry, amidst all the confusion over cable delivery of digital broadcast signals, will not attempt to stifle competition in the market for digital set-top boxes," Commerce Committee Chairman U.S. Rep. Tom Bliley said at the hearing.

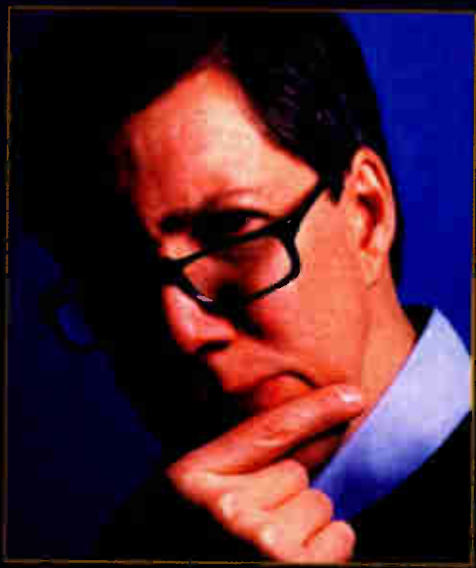
"Of course, the FCC could push this process along if it only would finish its set-top box proceeding, as required by the 1996 Act. But it appears that the FCC continues to drag its feet. I urge the FCC to act," said Bliley, a leading proponent of the 1996 Act.

FCC officials said that complying with this provision of the Act has been difficult due to vague language and the broad scope of regulation it seeks to establish in a rapidly advancing field.

"By the time we get through working on something, there's always a risk that there may be a new way to do it when we get done," said Commission Spokesman Morgan Broman in a private interview.

Days before the deadline was scheduled for feedback on the regulation order, Commission Chairman Bill Kennard presented a different perspective in a May 5 address to the National Cable Television Association in Atlanta. There, he said that if the industry couldn't devise a plan to encourage competition in the set-top market, the Commission would be forced to intervene. Law, in fact, already requires

Compatibility



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Reader Service Number 16

the Commission to regulate this burgeoning market.

As increasing numbers of industries vie for a slice of the growing set-top market, forward thinking becomes a greater challenge for the Commission, Broman said.

"The computer industry is for the first time really interested in what's going on here," he said.

During a discussion about the Explorer 2000 set-top, Scientific-Atlanta spokeswoman Caroline March-Long said that the set-top is appealing to outside industries in part because, "the PC market is sort of maxed-out."

At the hearing, Circuit City President Allan McCollough accused the cable industry of technological subterfuge that could stifle competition for the set-top market.

"Although desirable multifunction devices are technically possible, competitive availability of any box which includes the capability to receive digital cable signals is prevented through the use of cable-system-specific technical and security 'secrets' required in the box. We believe that this obstacle to competitive availability is also the single biggest obstacle to customer adoption," McCollough said, echoing Bliley's comments.

"These boxes may prove to be the critical gateway to delivering digital TV to the consumer," said Bliley. We must therefore ensure that the boxes are largely open devices and thus competitively available."

Enforcing a competitive environment for set-top deployment at this early stage in the transition to digital must-carry is further complicated by outsiders' apparent dependency on cable technology to compete effectively in this arena, officials said.

Broman said that CableLabs' OpenCable specifications are important to the Commission because of the body of knowledge they represent in set-top technology.

A major point made by cable industry leaders at the hearing was that MSO collaboration with outside industries based on OpenCable specifications has been the best way to maximize inteoperability and rapid deployment for the ultimate benefit of consumers.

"Making OpenCable a reality has required the cooperation and consensus of many players in the cable, computer and consumer electronics industries," TCI President Leo Hindery told the subcommittee.

Hindery lauded industry set-top collaboration with companies such as Cisco Systems, Microsoft, Sun Microsystems and WorldGate, General Instrument, Hewlett Packard, Lucent Technologies, Philips Magnavox, Pioneer, Scientific-Atlanta, Sony and 3Com. Hindery called the mass collaborations "a truly remarkable example of cross-industry cooperation, consensus and investment."

Despite CBS' controversial announcement that they were opting for the bandwidth gluttonous 1080i signals for analog TV sets, Chairman Michael Jordan praised the cable industry at the hearing for helping broadcasters get a grip on how they

might best handle the transition to digital.

"To their credit, anticipating the need to sort out our respective digital transition challenges, the cable industry … initiated a series of conversations with broadcasters to begin a process to share information and expertise on digital issues. It is a conversation we welcome since well more than half of the audience for the CBS TV network programming receives that programming through a cable system," he said.

S-A Set-Tops to Deploy Widely

The future is now for Scientific-Atlanta's new digital interactive set-top, with nine North American MSOs, representing about 33 million subscribers, deploying the Explorer 2000 this year.

Cox Communications, the fifth-largest U.S. cable operator, is among the latest to announce a commitment to the new set-top by purchasing 15,000 units and associated headend equipment.

Other MSOs with commitments to deploy the set-tops in 1998 include Time Warner Cable, Comcast Cable, Adelphia Communications, Marcus Cable, MediaOne, and three major Canadian operators, including Rogers Cablesystems Ltd., Videotron and Cogeco.

Scientific-Atlanta attributes part of the product's early success to its CreativEdge program, which has facilitated third-party application testing and integration by providing new interactive services for the set-top's developers.

A Sun microprocessor that supports video-on-demand (VOD) by SeaChange, office suite software from Inergy Online, Internet access and Internet protocol (IP) telephony are among the set-top's features.

Officials say the deal with SeaChange will give operators a chance at the $15 billion video rental and sales markets by being among the first to offer VOD.

SeaChange's Mediacluster video servers and content management system, melded with Scientific-Atlanta's OpenCable-compliant digital broadband system, fit with the rest of the set-top's repertoire. Most of the components are housed in system headends to provide simplified subscriber service and system maintenance efforts.

Inergy's WebDesk2000 office suite enables word processing, Web site creation, enhanced e-mail and secure file storage.

S-A plans to document the end-to-end system integration and report to CableLabs to help advance OpenCable.

Initiative Promotes Internet Devices

Cisco Systems Inc. has announced a technology-licensing program intended to accelerate the availability of low-cost, easy-to-use Internet-access devices. The Cisco NetWorks program includes licensing software to manufacturers of network access products such as Internet phones and fax machines, cable modems, set-top boxes and network computers.

The initial licensees in the program are Sony Corp. and Samsung Corp. CT

Greta Durr is assistant features editor at "Communications Technology" in Denver. She can be reached via e-mail at gdurr@phillips.com.

SCTE to Evaluate Standards Testing

The Society of Cable Telecommunications Engineers Interface Practices Subcommittee will conduct analog and digital signal test evaluation workshops in conjunction with its second standards development meeting on June 8 and 9 in Denver.

Standards developers and users will have the opportunity to appraise and demonstrate IPS test procedures during the workshops, which will be held just prior to Cable-Tec Expo '98 at the Colorado Convention Center. IPS members, equipment suppliers and test operators will be on hand to participate in the laboratory.

The following test procedures will be evaluated during the IPS workshops:

- SCTE IPS-TP-206, Composite Triple Beat Distortion
- SCTE IPS-TP-207, Composite Second Order Distortion
- SCTE IPS-TP-208, Cross Modulation Distortion
- SCTE IPS-TP-201, Insertion Gain or Loss, Frequency Response and Bandwidth
- SCTE IPS-TP-202, Return Loss
- SCTE IPS-TP-203, Isolation
- SCTE IPS-TP-205, Noise Figure
- SCTE IPS-TP-209, Power Consumption
- SCTE IPS-TP-211, Group Delay
- SCTE IPS-TP-204, Hum Modulation

Document authors include Brian James of CableLabs' Tac Test Centre, David Large of Media Connections Group and Ed McQuillen of RDL Inc. Suppliers participating in the workshops include Hewlett-Packard, RDL Inc., Avantron and Hukk Engineering.

Once evaluated, each test procedure will be voted upon by the IPS. If adopted, SCTE's engineering committee will consider the document. Upon approval, it then will be submitted to the American National Standards Institute for approval as an American National Standard.

For more information about standards development, contact SCTE Director of Standards Ted S. Woo, Ph.D., at (610) 363-6888, ext. 228, or twoo@scte.org.

Two SCTE Standards Get ANSI OK

Two SCTE standards documents recently became the first broadband test procedures to be recognized by ANSI.

ANSI/SCTE # TP 007-1998, titled "Coaxial Cable Structural Return Loss," and ANSI/SCTE # TP 407-1998, titled "F' Connector Return Loss" were approved by ANSI on March 26, doubling the number of SCTE documents to be identified as American National Standards.

ANSI/SCTE # TP 007-1998 provides instructions to measure the structural return loss (SRL) characteristics of flexible RF coaxial drop cable from 5 MHz to 1,000 MHz. SRL is a ratio between the reflected

and the reference signals or the reflection coefficient (r).

ANSI/SCTE # TP 407-1998 provides instructions to measure the return loss characteristics of a single type "F" connector-to-cable interface, at the beginning of a cable, from 5 MHz to 1,000 MHz. This test method applies to SCTE specifications IPS-SP-402, IPS-SP-403 and IPS-SP-404, and makes use of the time domain gating feature of the network analyzer to remove the far-end connector effects from the near-end connector being tested.

SCTE will continue to pursue national recognition of its cable telecommunications standards; current plans include document development in digital video and cable modem technology and OpenCable.

For more information about the Society's progress in standards development, contact Director of Standards Ted Woo, Ph.D., at (610) 363-6888, ext. 228. Updated information also can be found on the SCTE Website: http//:www.scte.org.

Awards Encourage Workplace Safety

To support and foster the growing importance of creating safe work environments for employees in the broadband industry, the SCTE is introducing two new safety awareness awards for MSOs.

The SCTE Health and Safety Subcommittee has created the Silver and Gold Awards to recognize the efforts of MSOs committed to a safe and healthy workplace, and to raise public safety awareness.

The Silver Award will be given to any MSO whose total incident rate records are at or below 25% of the national average for our industry. The national average is available from the Bureau of Labor Statistics. Each MSO should complete the summary information on the appropriate form and submit it to SCTE for consideration.

The Gold Award will be given to any MSO whose total incident rate records are at or below 50% of the national average for our industry. This award will be earned only by companies that have demonstrated a significant commitment to safety.

Eastern Vice Chairman Jim Kuhns, who also chairs SCTE's Training Committee, says, "These awards are designed to honor those companies that have successfully implemented and maintained safety performance programs to an exemplary level."

All MSOs are eligible to apply for either of these annual awards. The application deadline is May 11. Qualified MSOs will be recognized during Cable-Tec Expo '98 in Denver this June.

For more information, contact SCTE Vice President of Technical Programs Marv Nelson at (610) 363-6888, ext. 229, or at mnelson@scte.org.

The SCTE is a national nonprofit professional organization serving the broadband industry's technical community. SCTE currently has more than 15,000 members from the U.S. and 70 foreign countries and offers a variety of programs and services for the industry's educational benefit. SCTE has 72 chapters and meeting groups and has technically certified more than 3,000 employees of the cable telecommunications industry. CT

Reader Service Number 24

Interview with a Leader

By Rex Porter

Coaxial International's Ron Hranac on Achievement

Ron Hranac

Editor's Note: Of the many interviews we have done and will do, this one is special for me. Not only are we at Phillips proud to be associated with Ron Hranac, but this interview also will provide assurances to our readers that extra effort, attention to detail and continued education can result in attainment of career goals. Ron is senior vice president of engineering for Coaxial International, a Denver-based consulting firm. He also is senior technical editor for "Communications Technology" and "International Cable" magazines.

Communications Technology: *Ron, you and I have similar experiences, as we began our careers in cable. You started in the local origination (LO) side of the business for Teleprompter, then designed and constructed KRPL's LO studio back in the early '70s. Tell us about that period from 1972 through 1976.*

Ron Hranac: Let me go back a bit before that. I was first aware of cable as a youngster in the late 1950s, although I didn't really know what it was. I remember some family friends who had something called cable TV, and their kids could watch "Captain Kangaroo" each weekday. We didn't have cable, and the local broadcast station carried "Captain Kangaroo" only on Saturday mornings. I even remember the metal boxes on the poles!

Ironically, my first job in cable was in my hometown of Lewiston, ID, working for the same cable company that provided service to our friends back in the '50s. I was hired by then Program Manager Bill Raschka as a part-time camera operator for Teleprompter's LO studio, and the pay, $1.75 an hour, was just 10 cents an hour above the prevailing minimum wage.

A couple years later, I had worked my way up to program manager, running the LO operations. Unfortunately, not long after that, Teleprompter made a corporate decision to shut down all LO studios except where required by franchise. I went to work for KRPL, a radio station in Moscow, ID, designing, building and operating a TV studio for a leaseback LO operation with Moscow Cable Co.

Communications Technology: *Then, for the next two years, you learned the business as an installer-technician for Teleprompter. How do you think your feelings for "doing the job right" moved you from installer to technician during those years?*

Ron Hranac: I went back to work in Teleprompter's Lewiston system as an installer in 1976. That was a great place to learn the outside operations part of the business. Some of the guys had been there since the system was built in 1953.

The thing that impressed me most was everyone's willingness to take the time to teach how to do the job right. Heck, I wasn't allowed to go out on my first install alone for the first three months, and during that time I was always riding with someone, learning the ropes of the job.

Moving to installer-technician was a natural progression and provided the opportunity to be on call every few weeks and get a little extra overtime. I used to take product brochures and instruction manuals home to read at night, and I was never afraid to ask questions.

Those days were a lot of fun! I'll always feel indebted to the guys I worked with in Lewiston: "Dee" Miller, Walt

McCall, Jeff Tarbet, Wes Scoles, Jack Milligan, Bob Simmons, Bob Munden, Del Hallberg and Steve Nogle, and, of course, Bill Raschka for hiring me in '72.

I signed up for my first National Cable Television Institute course in 1977 (I think it was called "Technician I.") and finished it 10 months later. In 1978, a job opening for electronics technician (sort of like assistant chief tech) in Teleprompter's Richland, WA, system became available when the bench tech retired, so I transferred.

While working in the Richland system, I joined the Society of Cable Telecommunications Engineers (Editor's note: Then known as the Society of Cable Television Engineers) and attended my first regional technical conference in Portland, OR, with one of my co-workers. That was a tough trip, because Ted Axtell and I both had a nasty case of food poisoning. Still, I managed to sneak out of the conference long enough to drop by the Federal Communications Commission's Portand office to take, and pass, the First Class Radiotelephone License exam.

In September, 1979, I made what was then a very tough and scary decision and left Teleprompter for a system engineer position in Jones Intercable's Lake County, CA, system.

Communications Technology: *During the early '80s, it seems Jones Intercable needed your engineering expertise across California, Oregon, Utah, Arizona, Colorado and Wyoming. Tell us how you think active involvement in the SCTE helped you in those days.*

Ron Hranac: I found the SCTE to be a very valuable resource in the early '80s and an important asset to my career development. Jones was very supportive of participation in both manufacturer-sponsored and SCTE training seminars.

That, plus a personal eagerness to attend the seminars, learn and keep asking questions, was critical to making training work. Companies have to support training, and people have to want to learn. With technology evolving as fast as it is now, this is especially true today.

Communications Technology: *While with Jones, you served as SCTE's regional director. You also served as the national SCTE secretary, president/chairman, and on the executive committee. This was surely a whirlwind tour for you during a six-year period. Tell us about these activities.*

Ron Hranac: You can blame Sally Kinsman for that. Sally was Region 2 director when my family and I moved to Denver in 1983. In 1986, she was planning to relocate to the Seattle area and convinced me to be a candidate in the 1987 election.

Once again, Jones was very supportive of my involvement in the SCTE; I estimate that during that six years as Region 2 director, a good 10% to 20% of my company time was devoted to SCTE activities.

My first national office was secretary, something the other board members probably came to regret. In '88, the board elected me president, probably so they no longer would have to haul 20 pounds of handouts home from each board meeting.

Communications Technology: *Tell us about you duties as corporate engineer and then as senior staff engineer from 1984 through 1990.*

Ron Hranac: Life in the corporate engineering department back then was, without a doubt, hectic but fun. The company was in a major growth mode and we had corporate "SWAT" teams that traveled all over the country to evaluate systems for potential acquisition.

In between those trips, I built and managed the company's corporate test and evaluation laboratory, a 54-channel headend in the new corporate office building and was involved in technical training. I also did most of the company's microwave link engineering and traveled to several systems to perform annual proof tests on amplitude modulated link (AML) and frequency modulated link (FML) microwave equipment.

Communications Technology: *You worked with Bob Luff at Jones, and I know you had a leading role in launching some cutting-edge projects.*

Ron Hranac: When Bob joined the company, one of the first projects he assigned me was to manage the technical side of the launch of Sky Merchant and Galactic Radio, satellite services operated by Jones. We had 19 audio subcarriers on one transponder, along with Sky Merchant's video.

In the late '80s, I became involved in some of the company's United Kingdom operations and got my feet wet in the international part of our business. About the same time, Jones developed the cable area network (CAN) fiber architecture, and while some of my colleagues in the corporate engineering department were more directly involved with its deployment, it did provide an opportunity to get in on the ground floor of a cutting-edge technology.

Communications Technology: *At an SCTE Board meeting in 1990, I remember you asked me to walk with you into the hallway outside. You said, "I have an opportunity to go on board with 'Communications Technology' magazine as their senior vice president and editor. What do you think?" I quickly said, "Take the position." I continue to browse through editorials you wrote years ago, as well as appreciate your technical guidance of "CT" today. How do you feel about sharing knowledge with others through the media?*

Ron Hranac: In 1985, *Communications Technology*'s Wayne Lasley approached me at an SCTE Rocky Mountain chapter meeting and asked if I would be willing to write an article based on the seminar I had just taught. That turned into a three-part series on bench sweep, and I've been involved in one way or another with *CT* ever since.

Sharing knowledge through the pages of a magazine like *CT* is a good way to reach a large and diverse audience. I also think it's a way to pay back all of the people who've taught me over the years. They set a good example in their willingness to share what they know, and carrying on in that tradition by writing for *Communications Technology* or speaking at SCTE seminars seems to be the right thing to do.

> "In '88, the board elected me president, probably so they no longer would have to haul 20 pounds of handouts home from each board meeting."

Communications Technology: *Sometimes, these days, you are hard to reach since you handle clients for Coaxial International on five continents. Want to share some frequent flyer miles?*

Ron Hranac: Anyone who says travel is glamorous doesn't do it enough. Seriously, I've enjoyed the opportunity to travel. Without question, the best part of it has been the people I've met over the years.

Communications Technology: *You are living proof that dedicated cable people can come up through the ranks to attain recognition as technical leaders in cable engineering, cable operations, advising financial institutions, working closely with equipment manufacturers, interfacing with cable engineering consortiums, telephone/long distance* *companies, and electrical power utilities. To reach this plateau in your career, I know you took advantage of Broadband Communications Technician/Engineer (BCT/E) testing (becoming the first person to be certified and now certified at both the Technician and Engineer levels). Tell us how the BCT/E and NCTI training helped.*

Ron Hranac: NCTI courses and other training provided the core material, being in a hands-on environment put it to work, and the BCT/E program formed a set of goals with which to measure it all. I've been very fortunate to have worked for companies over the years that recognized the value of education and training and supported active participation in the SCTE. If I could give any advice to newcomers in cable, it would have to be: Learn all you can; never stop asking questions, and share what you know with others.

Communications Technology: *You are involved in the Denver Amateur TV League. I understand you are a trained Skywarn tornado and severe weather spotter for the National Weather Service, as well as an avid ham radio contester.*

Ron Hranac: All of these revolve around one of my favorite hobbies: ham radio. About 10 years ago, a group of us built a ham TV repeater on top of Lookout Mountain, west of Denver, using mostly cable TV equipment. The repeater, still in use today, is used to relay NTSC amateur TV signals in the 420 MHz and 1.2 GHz ham bands.

One use of the repeater, until very recently, was to relay live TV video of severe thunderstorms and tornadoes to the National Weather Service. I've been a Skywarn spotter for several years, in part because of the chance to use ham radio in a public service role and also because Denver and the eastern part of the state get the occasional tornado.

Even though the NWS has relocated to Denver's new airport, which unfortunately is out of range of the TV repeater, we still use ham radio voice and data communications from all over the state to relay storm spotting information to Weather Service officials.

Communications Technology: *You are one of the most sought-after advisors on the SCTE List. How do you like having the List to keep in touch with technicians and engineers from around the world?*

Ron Hranac: I think the SCTE List is one of the most valuable technology resources the industry has available today. It provides a near real-time forum for the exchange of technical information. A user can post a question in the morning, and usually there will be several responses to that question posted the same day.

> "Companies have to support training, and people have to want to learn. With technology evolving as fast as it is now, this is especially true today."

Communications Technology: *You served one term as president (1988-1989) and one term as chairman of the SCTE board of directors (1992-1993). What experience stands out most from your memories of those two terms?*

Ron Hranac: As I look back, the incredibly rapid growth of the Society during that time stands out, as does the chance to work with the SCTE's national headquarters staff. They are among the hardest working people I know, and some great friends. But one very special memory is the relationship we developed with Tom Hall and the U.K. SCTE.

Communications Technology: *Where do you see cable TV going as we prepare to enter a new century?*

Ron Hranac: Making predictions is a tough thing to do, Rex, so I'll take a conservative approach. For the next few years at least, I don't see any revolutionary changes in the way we do business. Delivery of entertainment services will still be our bread and butter, and we'll continue to get better at it, especially with competition from direct broadcast satellite (DBS) breathing down our necks.

Digital video will become more a part of the traditional entertainment lineup, although analog will be here for a long time. Who knows, we might even see HDTV someday! Incremental revenue from services such as data communications and cable modems will grow, and this move into non-entertainment services will require us to do an even better job. That means much more emphasis on training, quality and reliability.

Communications Technology: *And finally, what one person had the most impact on your meteoric rise in the ranks of cable TV engineering?*

Ron Hranac: My biggest inspiration in life and career was my maternal grandfather. Grandpa Charlie never went beyond an eighth-grade education, but he had an IQ over 190. He was involved in horticulture research throughout much of his life, and did work with chemically-induced genetic mutation when most others were still using grafting and cross-pollination techniques.

At age 35, he contracted polio. Doctors told him he'd never walk again, and his response was, "The hell I won't." Well, his stubbornness proved the doctors wrong, and he lived into his 80s. Shortly after he was diagnosed with polio, with the assistance of a nearby university he entered several plants in an international competition and took the top three places.

When I was in grade school and junior high, he and I used to have some pretty deep discussions about the theory of relativity, ancient Egypt, the possibilities of using the Earth's magnetic field to generate electricity (his dream was to see this idea used to power automobiles), and other equally complex topics. He was a fascinating man; I miss him and those long talks dearly. I now have a 3-year-old grandson and hope I can be even half the inspiration to him that my grandfather was to me. CT

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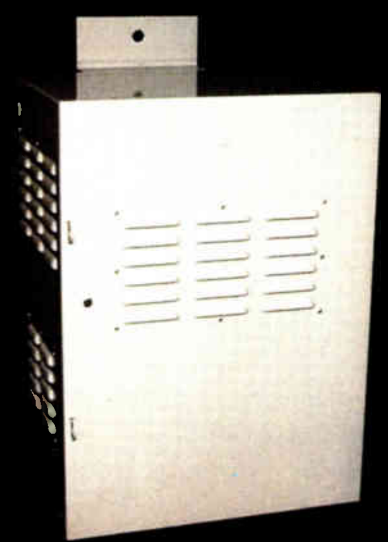

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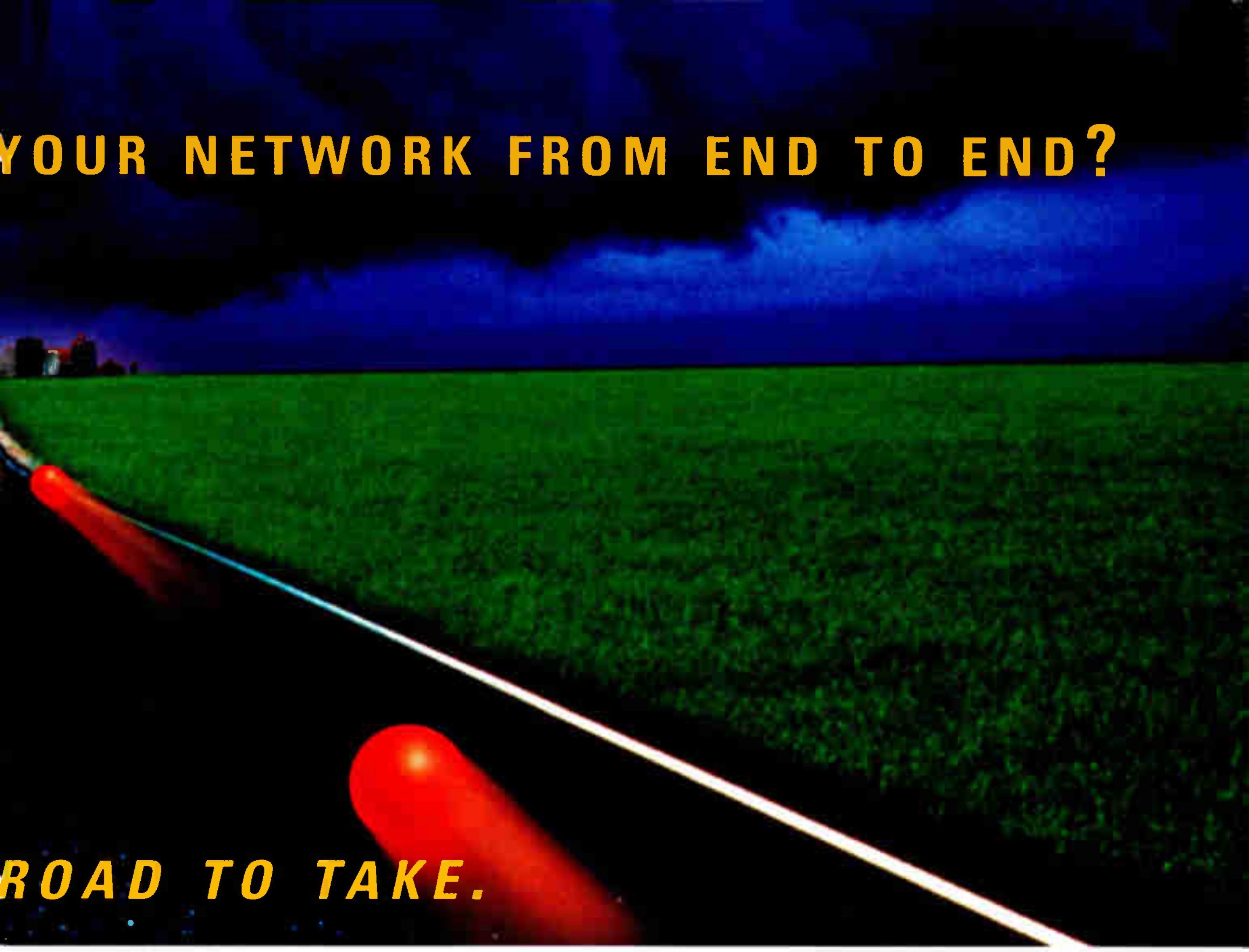

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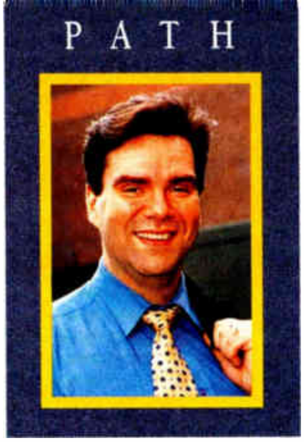

The Power of Mud

How do you dig a hole under a river? The answer is, with the awesome tunneling power of...mud.

That's right, mud. Jones Communications recently connected its Alexandria, VA, and Prince George's County, MD, headends by boring under the Potomac River. Last time, I told you about the permitting headaches Jones' engineers encountered just setting up for this job. The permitting process for the project was a walk in the park, though, compared to the actual boring and conduit placement under the river. And it took a heck of a lot of mud.

Because of concerns from the city of Alexandria, boring for the connection started across the Potomac in Maryland. Jones Senior Director of Engineering Tom Gorman and his team of contractors had a staging area off the Capitol Beltway where they set up the boring rig for the job. This is an impressively large example of heavy industry—like the biggest Roto-Rooter you've ever seen. The boring tool is equipped with a directional head steered remotely with electronics; the cutting actually is done with a highly pressurized mixture of bentonite mud.

Mud engineering

As you might imagine, digging a hole under a river means a steady supply of lots and lots of razor-sharp mud. So much mud, in fact, that keeping up with this project's mud demands meant maintaining a major mud pit, where highly-trained mud engineers (I am not making that up) made sure the bentonite was kept at the desired consistency.

What I want to know is, where does a person go to learn how to be a mud engineer? I've just never thought much about improving on mud. You've got your dirt, you've got your water...how do you get graded on that? Could you fail? How

would you admit that you failed at making mud? There's clearly more to this than meets the eye.

As the engineers bored the hole, they fed 5-inch diameter conduit down the bore, pushing it further on with additional sections of pipe. Things were really just getting going when the construction team ran into gravel and other sediment, which made it nearly impossible to maintain the cutting pressure needed to complete the bore from the Maryland side. (With it was lost the goal to set a record for the longest continuous 5-inch diameter bore—a tragedy in American mud-based sports and technology team history. The dream, however, survives.)

They had no other choice: They had to double back and start again in Alexandria, with the two ends meeting in the river.

Incidentally, that's not the only hurdle the Jones team had to clear. They also discovered that even a metal conduit will fall victim to a physical malady that I can only call "droopiness." It's like pushing cooked linguine: After you've pushed it a certain distance, directing it with any accuracy becomes tricky. (I must note here, however, that if you have enough time to push linguine you are lonely, indeed.) So, they cut a 10-inch diameter metal sleeve through which they ran the 5-inch diameter conduit. This new sleeve was rigid enough to control more accurately.

Anyway, back to joining the two sections. Now I know people say the Chunnel under the English Channel that connects England and France was a design challenge. I remember reading that the two sides almost missed each other in the middle. To that, I offer only the following sarcasm and derision: "Baloney." That tunnel was *yards* across. Are you telling me the combined engineering skill of English and French crews couldn't line up two huge holes they'd been planning for years? Now that Jones bore, *that* was a *challenge*. Imagine connecting two 5-inch diameter bores—that's like firing off two howitzers from a mile apart and trying to get the shells to hit each other on the points, midway between.

Tripping out

For your average communications construction crew, though, it's just another day on the job. In fact, they perform this procedure so often, they even have a cute little name for it: "tripping out." In the Jones case, it involved lifting the conduit from both approaches onto a barge in the Potomac, where the two ends were joined, then dropped back to the bottom of the river and covered over. Not quite a complete underground bore, but close.

So that's how you dig a hole in dirt using mud. Next time, I'll show you how to receive broadcast radio signals using nothing more that the forks and spoons in your silverware drawer. CT

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By Ron Hranac

The Simple Things Really Do Matter

I just returned from an extended overseas trip with some of my colleagues from the consulting company I work for. The trip included, among other things, technical evaluations of several operating cable TV networks. The where and who aren't important for this discussion, but I do want to share some observations and comments to show how overlooking the simple things can cause big problems. First, a little background information.

The systems in question have plant that in most cases ranges from as little as a few months to 7 or 8 years old, and most common bandwidths up to 750 MHz are in use. Architectures include a mix of traditional tree-and-branch, fiber supertrunking, and a limited amount of hybrid fiber/coax (HFC). A node in one of the systems has active reverse and an operational cable modem trial. Much of the headend, network, drop materials and equipment came from the big-name manufacturers (including some refurbished equipment from brokers and distributors), with the remainder produced in-country or imported by local firms and sold under a domestic label. This approach is fairly typical in a lot of international markets, so that's no particular surprise.

Not quite what it seemed

The shocker was the condition of most of the networks and drops we evaluated. Network construction quality ranged from poor to tolerable, although to be fair, some looked quite good. The drops were, almost without exception, of poor quality. Picture quality was fair in the subscribers' homes we checked, and signal leakage was severe in every system. The reverse path in the two-way node where the cable modem trial is underway (maybe I should say struggling) has incredible ingress, and upstream laser clipping was obvious. A driveout of that particular service area showed nearly nonstop forward path signal leakage.

What went wrong? After all, the systems had been built with generally good quality materials. (There were a few exceptions; more on this in a moment.) Heck, the newer 750 MHz plant even took advantage of contemporary HFC technology and architectural approaches, with 500 homes per node, standby powering and so on. What went wrong, in my opinion, was too much emphasis on the big picture and not enough on the simple things.

"Nearly every F-connector we checked had been tightened finger tight at best, and some were what I would call 'wiggle' loose."

Specific problems

Here are a few examples of what I mean:

- ✓ Most of the systems used and continue to use cheap imported F-connectors that can be pulled off the drop cable by hand even after proper cable preparation, including folding the braid back over the jacket, and use of a hex crimper. These same connectors apparently were improperly annealed at the factory, making them susceptible to cracking when crimped. Why anybody would even consider manufacturing or selling this kind of junk is beyond me. Shame on the companies that buy it.
- ✓ To make F-connector matters worse, many were crimped with pliers instead of hex crimpers. Few outdoor drop connectors were weatherproofed, and those that were used boots without silicone grease. Nearly every F-connector we checked had been tightened finger tight at best, and some were what I would call "wiggle" loose. You know, where the connector is held to its mating port by just a few threads.
- ✓ Except for some newer drops that use messengered cable, the majority are non-messengered and supported by spiral grips. Can someone please tell manufacturers to stop making grips for non-messengered drops? If they weren't available, then system operators wouldn't be able to buy them and might have to, well, install drops properly.
- ✓ Heat shrink tubing had been used on many of the hardline connectors, but a lot had no weatherproofing at all. In some cases, the heat shrink tubing had been cut too short prior to installation, resulting in incomplete coverage of the connector or exposed cable. In other cases, heat shrink tubing had been installed but wasn't heated or shrunk.
- ✓ Many of the construction problems were

found to be cosmetic in nature, such as improperly formed expansion loops or sloppy cable routing. More serious construction problems included the use of cheap pole hardware that had rusted after only a few years' exposure to the elements, placement of cables too close to power, and the previously mentioned improper weatherproofing.

- ✓ Where they were used, some of the "refurbished" amplifiers and passives we saw had defective, worn out, or missing gaskets between the lid and housing. Unfortunately, a few of the refurbished models were so old that replacement gaskets no longer are available. System personnel have had to fabricate covers for the amplifier housings to minimize water ingress when it rains. When I first saw the covers, I thought they were sun shields.
- ✓ Network and drop grounding is virtually nonexistent. Subscribers are told to unplug their TVs, VCRs and cable during storms. I am not making this up.
- ✓ Service calls were unusually high in almost every system we visited, although this really wasn't a surprise, considering everything else we saw. The service call breakdown was fairly typical, too: About 75% were drop-related, and the remainder were because of something in the network.

Consequences

The list goes on. As you look at each of the major problems I just described, they can collectively be boiled down to relatively simple things: cutting corners in critical areas to save a few bucks; lack of training; inadequate supervision of the work being performed; and no follow-up quality control. Sadly, the attempt to save a little money up front will cost the operators of these particular systems a lot of money in the long run because of the need to replace network and drop components that normally should last a very long time.

Some of what we saw can be cleaned up relatively easily, but poorly installed or missing weatherproofing—including the equipment housing gaskets—means water already has damaged the cable and components. Loose drop connectors can be tightened easily and those installed incorrectly replaced, but here, too, if there was no weatherproofing, then the coax will have been damaged by water ingress and likely will have to be replaced as well, at least from the pole to the house. Non-messengered drops are just plain dumb. Messengered cable is the only way to go for all overhead drops, regardless of length, but you've heard me harp on this many times before.

Solutions

How could the majority of the problems have been avoided? By paying attention to the simple things! Training of construction and installation staff, along with effective supervision and quality control, would have ensured that the work was done correctly in the first place, particularly network construction, weatherproofing, drop installations and such. The tougher sell would have been to management—that is, convincing them to invest in training, good F-connectors, messengered drop cable, and being more careful with some of the refurbished gear. Regarding the last item, perhaps paying a little more for an extended warranty or getting later models that still have replacement parts available would have been a wise move. Of course, hindsight is always 20-20, right?

So, what can be learned from this? First, using new equipment from the major manufacturers (in the example I've been discussing, this was the case for the most part) and deploying the latest HFC architecture doesn't automatically guarantee a good network. Too often I see operators in the United States and abroad making the mistaken assumption that the newest technology and best components will result in a state-of-the-art system. This attitude is dangerous and can be very costly. The plant has to be built and maintained properly, with the drops installed correctly. All of this is done easily by emphasizing some important low-tech things: training, supervision and quality control. The bottom line is that the simple things really do matter! CT

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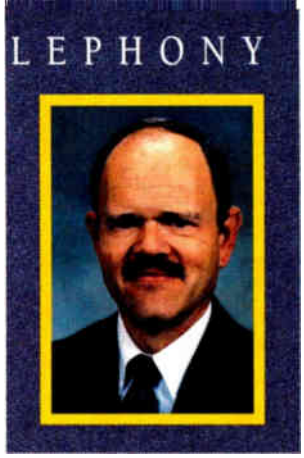
By Justin J. Junkus



Telecommunications "Killer Applications" Are Made, Not Born

Killer applications are the products you sell to end users that bring in revenues you dream about. This month, I'd like to suggest how one could be grown for cable telecommunications. Perhaps in the process, this column will stimulate some new thoughts on how cable can capture the telecommunications market share it deserves.

Since this is a telephony column, I'm going to use an example that originates in the telephony world—unified messaging. We'll begin by looking at how the telephone industry is growing this product, and then we'll move to what could be done with it in a digital cable environment. Just so I don't lose your interest early on, we're going to be talking about an application that works with high-speed data and digital set-top converters, as well as with personal communications systems and telephony.

What is unified messaging?

Unified messaging is a combination of services we all use—voice mail, fax, e-mail and pager systems. "Unified" refers to adding two features: capture of all messages in one storage database, and the ability to retrieve all those messages from any of the interfaces normally used to retrieve them. To clarify this definition, let me provide a few examples of features that have been marketed by telephony providers with a unified messaging offering:

- Text-to-speech conversion and vice versa (needed to convert between voice or fax-mail and e-mail)
- Call routing to designated phone numbers based on time of day (includes routing to a cellular phone during transit times)
- Pager notification of message waiting
- Remote access to voice mail
- Remote access to fax
- Remote access to e-mail
- Receipt of fax or voice mail at a personal computer (PC)
- Receipt of e-mail by telephone via text-to-voice conversion
- Around-the-clock remote retrieval of stored data via voice access
- Hard copy generation of the retrieved data via fax or e-mail
- Automatic sending of a message from a stored address list
- Visual voice mail, with the ability to prioritize message retrieval

> "With enough new applications, consumers will see cable as the service provider of choice for all their broadband needs."

These products traditionally work by computer-telephony integration (CTI). The telephony service provider owns a telephone switch at its central office and adds an interface to a messaging system. To be truly "unified," the messaging system also must be connected to a gateway to a data network. Usually, this is done with some type of data switch (router), and high-speed access lines to the Internet. The messaging system comprises a number of storage devices for user mailboxes and subscriber greetings, port interfaces, voice recognition and synthesis systems, one or more processors that manage the flow of information between the system components, and associated software systems.

There are several vendors of messaging systems to choose from, and the telephony switch owner makes the choice of system based upon compatibility with his switch, system capacity and features. In most cases, some customization is required, either to make the interface work to the service provider's specifications, or to modify existing features to make them marketable to the service provider's customers.

What this could mean to cable

It's time for cable operators to start thinking CCI, or Cable-Computer Integration. Even if the operator doesn't offer telephony service (yet), there is potential for offering enhanced unified messaging to its customer base. Here are two cable-specific examples of marketable services:

- On-screen TV notification of messages waiting
- On-screen TV retrieval of voice or e-mail

Think of the possibilities for using these two services alone. A subscriber might use them for life-line notification from elderly relatives. The cable company

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might promote future pay-per-view (PPV) events with targeted e-mail to its own subscribers.

Cable already offers high-speed data services via cable modem, so these messaging capabilities also could be marketed:

- PC notification of messages waiting via high-speed cable modem data service
- PC retrieval of voice or e-mail messages

What about voice messaging for a cable operator that doesn't own a telephony switch? Theoretically, cable customers could subscribe to the operator's unified messaging service instead of the phone company's. The incumbent phone company would have to route their calls on "No answer" to the cable company's messaging service number, and then the cable company system would take the message and store it for later retrieval. True, the subscriber would not get the stutter dial tone or message waiting lamp indication that only a direct connection to the telephony switch can give, but the cable operator could provide a pager as part of the service. That way, any type of message from any source could alert the subscriber that it needed to be picked up—and that's one better than having to go to the phone to see if someone called. (By the way, if the operator is thinking of someday offering Internet protocol, or IP, telephony, it might make sense to think through how this expanded unified messaging could work with that service. The pager adjunct seems to make even more sense here, since IP telephony and other telephony service probably will coexist.)

What it would take

Messaging systems and their interfaces to pagers, data networks, and, of course, telephony switches, already exist. What needs to be added to make the system cable-unified is an interface to the set-top converter and the associated headend control equipment. This would be a lot easier if OpenCable were a reality. For the time being, it would require an operator to coordinate some customization between the manufacturers of their set-top converters, the headend equipment and the messaging system. Because customization usually is expensive, I suggest the following as some ways to spread the cost of implementation.

Develop a critical mass of potential subscribers by joint venturing development with similar-sized operators in other franchise areas. This is a lot easier than some of the other business arrangements we have seen in cable. You don't need to be geographically adjacent. You don't need to offer the same services in the same combinations. All that's required is that you both have a common vendor for the messaging system, and another common vendor for the set-tops and headend controllers.

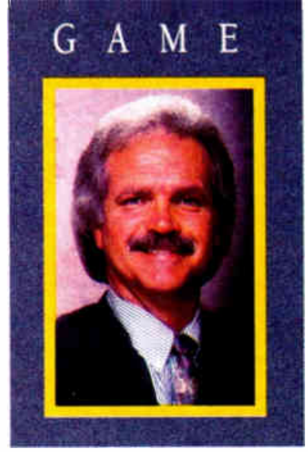
Lobby for a cable industry association or organization to sponsor the development of the interfaces, or create one specifically for the purpose of joint development of applications. This would be one way to spread costs across the largest possible customer base, but the question is, "Which organization?" Our industry-wide organizations, such as CableLabs and the Society of Cable Telecommunications Engineers, typically make standards recommendations, but they don't sponsor software development for commercial application. Perhaps we need a new organization that has industry-wide applications development and distribution of the associated technology as its specific charter.

I can't guarantee that either of these alternatives is realistic in today's environment, but I do know that we have not been very successful in the rapid introduction of new technology by the go-it-alone approach. Unified messaging may not be the best killer application for cable, but this same team approach to spreading costs holds true for any promising revenue-generator. Working this way, with a tangible end product that immediately could be applied in the industry, has an advantage of potentially rapid deployment and cost-sharing. With enough new applications, consumers will see cable as the service provider of choice for all their broadband needs.

I am especially interested in comments concerning the marketability of unified messaging by cable companies. Please address any feedback to jjunkus@aol.com.

Justin J. Junkus is President of KnowledgeLink Inc., a consulting and training firm specializing in the cable telecommunications industry.

By Terry Wright



Managing the Formless

Greased Pigs and Data-Service Management

If you've ever tried to catch a greased pig, then you have a good idea of the challenge facing the cable industry in managing high-speed broadband Internet/data services. You finally get your arms around it, start feeling good about the situation, and in an instant it slips away.

Now that the National Cable Television Association National Show is behind us, most of us can get back to the high-speed broadband data services agenda. I do hope you enjoyed the show. I'm sure you noticed the plethora of high technology and services on display from just about everyone in the game. It's not so much this data technology and related services that I wish to examine in this month's column, but rather the challenge that managing the service delivery infrastructure becomes once such services are deployed.

Let's begin our examination of this challenge by considering a few aspects of it that also will serve as an exclamation point to my April column.

In the April '98 edition of "The Data Game," I tried to convince you that standard definition digital TV (SDTV) vs. high definition digital TV (HDTV) probably is the wrong debate to have, at least for now. (If you don't believe me, just poll your family, friends and neighbors to find out how many of them plan to rush out and plop down $3,000 or more for an HDTV any time soon.)

The cyber-challenge

As I said in April, I believe the real issue is whether television as we know it, in its present analog or any emerging digital form, will survive the invasion from cyberspace. Why? Because cyberspace increasingly is going visual and already represents content on demand under nearly the ultimate user-control scenario.

> "Cyberspace increasingly is going visual and already represents content on demand under nearly the ultimate user-control scenario."

Not only is there traditional Moving Pictures Experts Group (the same MPEG used in digital TV) on the 'Net, a variety of other video delivery approaches also are making headway. For example, there are ASF-based products (Advanced Streaming Format) such as VDOnet's VDOLive and Motorola's Truestream, as well as IP Multicast, real-time streaming protocol (RTSP) and proprietary schemes not associated with any kind of standard.

Although demand for Internet-based content streaming is strongest in the business community (it's the technique of choice for internal company-wide communications), it's just a matter of time before one of these methods catches on and becomes economically viable for supporting consumer-level applications. (Everyone eventually will use video mail.)

While it's unlikely that telco-based dialup Internet access will promote video streaming applications (28.8 kbps and even 56 kbps generally constrain acceptable quality), cable modems very likely will spur the spread of these applications into the consumer segment. So what does this have to do with the infrastructure management challenge? (End of April column exclamation point)

Bandwidth and management

These various video streaming approaches consume enough bandwidth to significantly disrupt data traffic patterns in broadband cable networks. And since (cable modem-connected) consumers eventually will initiate these applications at unpredictable times, infrastructure managers (network/server system managers) likely will experience a wide array of behaviors from all the applications that normally consume this bandwidth.

More important, however, is that these bandwidth-consuming applications are only the tip of the iceberg with regard to complicating management of the service delivery infrastructure. (However, they did provide a handy way to re-emphasize the premise of my April column, while readily demonstrating the dynamic nature of Internet.)

So now what?

It's not too difficult to imagine the Internet's continuing increase in complexity, which in turn will make managing your data/Internet service

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delivery infrastructure all the more challenging. Networked elements smart homes, multiple personal com puter (PC) homes, the introduction of network computers/appliances (with unique bandwidth requirements), the proliferation of applets, and increas ly "intelligent" (and visual) Web servers are all good examples of things that will complicate the infrastructure management task. But the real concern is "What can I do about it?"

The simple answer is "Not much," less you want to invest in some pretty e pensive and sophisticated equipment (much more costly than the most expensive cable modem termination system, or CMTS) and expertise. Of course, "No much" is an unacceptable answer.

Options

Your competition typically monitors th local loop every night (as most of us sleep), decommissioning problematic trunks, to ensure that we all have dial tone the next morning. This translates into perceived service reliability, stability and quality, representing important competitive dimensions in which cable o tors must compete if they are to succe in data services.

From my nearly 30 years of data networking and computing, I can tell you that even veteran data networking perts have trouble keeping up wit Internet's evolution. You might con er outsourcing the infrastructure m agement function to a group that specializes in delivering and manag high-speed Internet services. This might sound like good news since 3,000 to 4,000 Internet service providers become immediate candidates for this function.

But don't be lulled by the number Do yourself a huge favor; make sure that the group you select thoroughly understands broadband and cable modems, can demonstrate that understanding to you, and already has demonstrated that understanding to other cable operators. T

Terry Wright is chief technology officer at At lanta-based Convergence Systems Inc. He c be reached at (770) 416-9993 or via e- *tlwright@convergence.com.*

By Alan Babcock

Working with Volunteers Is Like Herding Cats

Not Many People Can Make It Happen

Well, Bill Riker's resignation from the Society of Cable Telecommunications Engineers will be old news by the time you read this, but I wanted to say just a few more words about Bill's contributions to the SCTE and our industry.

Finding time

I have worked for the SCTE for only a bit more than a year in an official capacity, but I was an active volunteer for several years prior to joining the staff. As a volunteer, I learned a lot about the challenges of getting work done with other volunteers. I have further experienced this difficulty as an employee. Someone once said that working with volunteers is like "herding cats." I can attest that this picture is pretty accurate. It isn't meant to be demeaning—it's just the way things work.

If you have a job, you most likely are going to spend your work hours doing the things you are paid to do. You install cable service, sweep amplifiers, supervise other people, create or deliver training programs, consult, sell, or perform myriad other tasks. If you don't work at the tasks you were hired for, you might need to find someone else to hire you for some other set of tasks.

When you get home at the end of the day, you need to shuttle the kids to soccer

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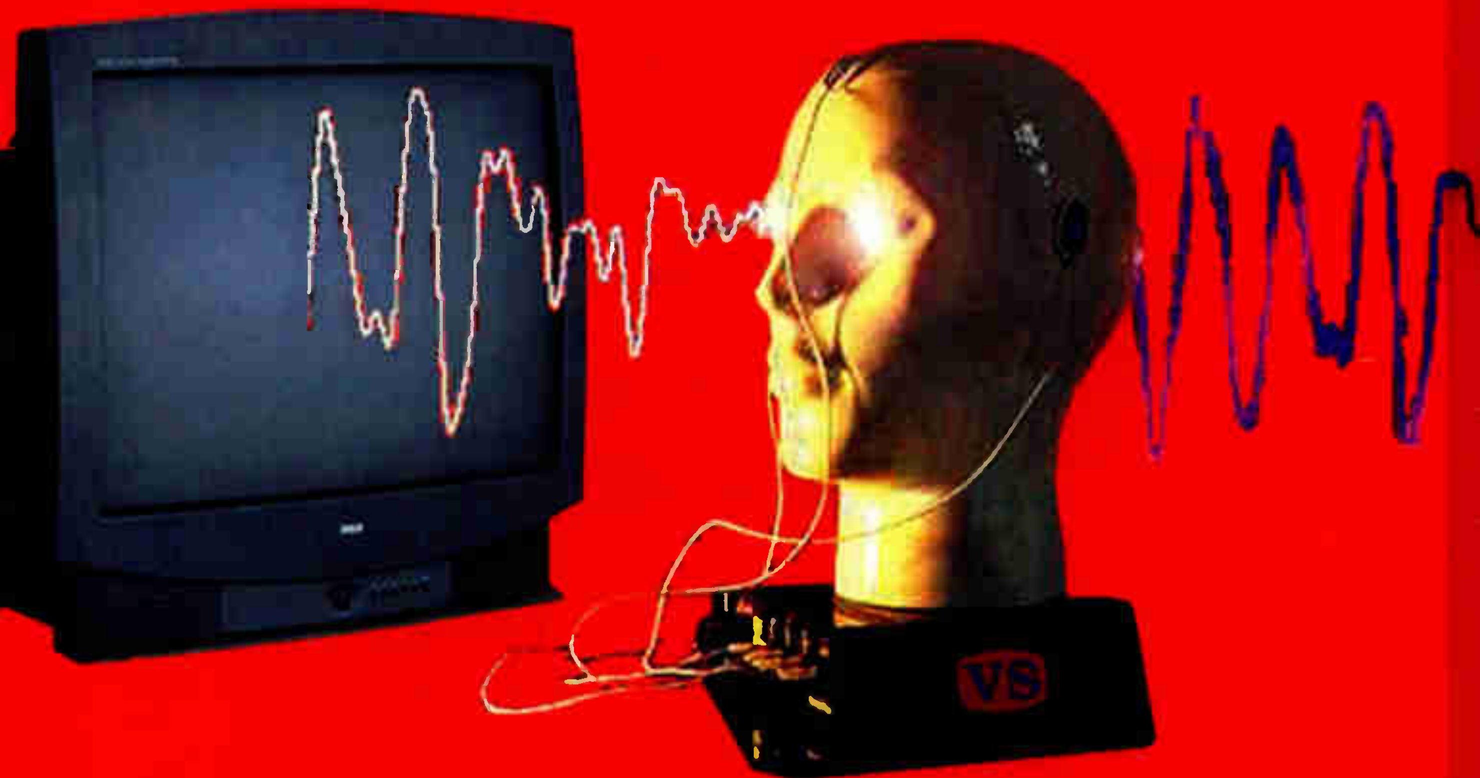

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practice, band concerts, Boy Scouts, Girl Scouts, baby-sitting jobs and so forth. You may need to watch the kids while your significant other goes to work, softball practice, or evening classes.

So where do you find time to volunteer for something like SCTE? It is getting more difficult every day to find the time to volunteer for the organizations that need your help. We all are very independent creatures, rather similar to cats.

What to do with that time

The SCTE has become an organization that fosters cooperation and participation from a diverse field of engineers, technicians, salespeople and others. Large companies (many with trade secrets) work together through SCTE to enhance the technical knowledge of all who care to listen.

Volunteers at the local level find time to coordinate chapter meetings, offer certification exams and put on terrific regional "Vendor Days" shows. Committees provide direction to ensure financial success and an appropriate future direction for the Society.

Through the standards-setting process, we are significantly influencing the future of telecommunications. Like cats, we are independent thinkers with our own agendas, ideas and solutions.

The board of directors provides direction to Bill and the SCTE staff. The representative election process is paramount to our future success because it assures that new ideas are presented and considered by each new board. As in any political representation process, the collective personality of the board also changes with each annual election of new members.

Successful organizations must balance these new ideas and personalities against a relatively consistent direction and path to the future. Bill has helped the board balance its decisions to keep the Society on a steady course. The result has been a number of new programs and products that support a consistent vision of "Training, Certification, Standards." Healthy argument and discussion have occurred to define the programs and products that have made the SCTE stronger.

What it yields

The SCTE is a successful and recognized organization today because Bill has been able to herd cats. The SCTE consists of individuals and companies with very independent ideas. Bringing divergent opinions into a forum where they can be discussed is a significant factor in the success of the SCTE.

In my mind, the greatest service that SCTE provides to the telecommunications industry is the opportunity to unite in discussion and the pursuit of technical solutions that fit the needs of our industry. This opportunity exists because Bill's leadership has created an organization where our strength is the product of independent ideas.

Alan Babcock is director of training development for the Society of Cable Telecommunications Engineers. He can be reached via e-mail at ababcock@scte.org.

Service in Technology Award

— Promises Kept

By Rex Porter

Communications Technology and the Society of Cable Telecommunications Engineers are pleased to recognize TCI as the recipient of the 1998 Service In Technology Award, the cable industry's most prestigious engineering honor. This award is presented each year to the individual or company making the year's greatest contributions to the cable engineering community.

In 1994, John Malone dedicated the National Digital Television Center and spoke of new and innovative services that would come to the cable subscriber. TCI would pursue a digitally compressed future. Since that speech, TCI and the rest of the cable industry faced a critical national press and skepticism from the financial community, both believing the industry had failed to deliver on its promise of data, digital TV and other sophisticated services.

Instead of retreating, Malone continued to defend the industry's position. He proclaimed cable's ability and dedication to supply the most modern services to its customers. The years immediately following the 1994 speech were filled with substantial work in digital compression technology. These were cooperative efforts between several companies, but people like Tom Elliot, David Beddow and Tom Beaudreau from TCI drove these issues almost on a full-time basis. In 1996, the technology was ready, and TCI launched its first system in Hartford, CT.

Team-building

In early 1997, Malone became determined to launch this technology and service on a mass scale. He proceeded by gathering a team which could guarantee results.

Malone selected Leo Hindery to provide executive leadership. Hindery was known throughout the telecommunications industry for leading InterMedia Partners from start-up to one of the nation's leading MSOs. Leo began an aggressive plan to restructure the company

Pictured above from left to right: George C. Rosehart, *Senior Director of Training and Launch Services - HITS;* Michael M. Probsdorfer, *Director of Customer Support;* Charlie R. Kennamer, *Senior Director of Engineering Services - HITS;* James R. Bishop, *Customer Operation Manager;* Renae K. Bogh, *Vice President, Business Affairs - HITS;* Dan Real, *Director, Business Development - HITS;* and Richard Fickle, *Vice President Business Development - HITS*

Richard C. Fickle
Vice President
Business Development - HITS
TCI Technology Ventures Inc.

through joint ventures, which would allow a vast empire of systems to be managed through clustering. Keeping TCI's promises of digital services to cable customers was the theme of meetings and conferences, as Leo traveled with TCI's message that action and results should replace rhetoric.

Malone and Hindery chose Marvin Jones to head up TCI's cable operations. Jones is one of the few MSO operations executives with experience in every phase of cable. Before joining TCI, he worked his way up from installer, through the engineering ranks to system management, then to chief executive officer of United Cable TV. In Marvin Jones, Hindery found an executive whom system operators and engineers could trust because he directs system operations with a background of total experience in the field.

They promoted Tony Werner, respected throughout the cable TV engineering ranks, to lead TCI's engineering efforts. Tony recognized what was required to prepare the networks for new digital services.

Standards

TCI's first digital launch in Hartford occurred on October 20, 1996, passing 310,203 homes. However, while preparing other cable systems for digital TV, TCI found itself, always in the forefront, mired in activities involving specifications and standards. Recognizing that subscribers'

> Malone selected Leo Hindery to provide executive leadership.

data modems and set-top converters should be compatible from system to system and city to city, TCI promoted the efforts of CableLabs' development of OpenCable set-tops as one of many projects aimed at consumer satisfaction.

Perhaps what was not totally understood was the magnitude of this entire effort, which involved headend upgrades, terrestrial interconnects, security enhancements, billing interfaces, product training and more.

At the same time, the next generation set-top was being designed, and consideration was given not only to digital TV service but also to additional services, such as data/Internet signals, pay-per-view (PPV) and Internet protocol (IP) telephony. Specifications would have to be agreed upon for modems, switches, digital compression and digital transmission platforms.

Digital roll-out

The actual digital roll-out was headed by three departments. The National Digital Television Center and headend activation was headed by David Beddow and Rich Fickle. This group assisted in launching service to 346 digital hubs, representing 12.5 million households. The staff numbers 25 people at the Headend Prepack Operations, 50 people in Field Technical Operations (site surveys, headend installations and troubleshooting) and 22 people in Channel Lineup Configuration and Support.

Crews were located in regions across TCI's system map consisting of TCI engineers, Integration Technical Service personnel and others as needed. Different crews performed specific jobs at each location and then handed off that location to cable operations to perform other tasks leading to that site's certification.

These crews were assigned responsibility for a regional cluster of headends. First, a site survey for all headends was developed, which would include such information as size, number of open channels, number of networks, satellite headend equipment, adequate space, cooling, de-icing for dishes and telephone capacity for the headends. On the vendor side, TCI struck agreements with certain equipment suppliers to provide service as close to "turnkey" as possible.

Scientific-Atlanta and Eagle supplied the satellite dishes; Alpha, the power supplies; General Instrument, the headend equipment; and Walton, de-icing equip-

Colleen Abdoulah
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James W. Neil
Project Engineer
TCI Communications Inc.

ment for the dishes.

Various concerns arose in designing the headends. Engineers decided what frequency each digital signal would occupy, leading to a database that tracks all data configurations. Also, these design engineers helped gather data configurations to build channel maps and overcome analog interference.

General Instrument provided a pre-pack operation. At any given time, 16 headends were being built in one warehouse back at GI with digital feeds from Headend in the Sky (HITS) in Denver. The finished headends then were loaded, completely packaged, onto moving vans and shipped to their system destinations.

At each destination, field engineers (a combination of GI and HITS engineers, and some contractors) fired up each headend, which was subjected to a 40-point checklist ATP test. At this point, each headend was certified as able to handle digital channels as well as PPV channel purchases. Upon certification (once the headend could "talk" to the Digital Center and vice versa, the set-tops worked properly and all power/air conditioning was approved), the headend was reported as "activated" and turned over to the system.

The second group falls under Tony Werner at TCI engineering. They worked with system staff to test the local networks to ensure that the plant was ready for digital transport. Certification tests were performed, including bit-error rate (BER) tests and examination of analog system performance. Testing also included digital carrier-to-noise ratio (C/N), digital levels, digital availability, analog C/N, phase noise, composite second order (CSO), composite triple beat (CTB) and many other areas. When problems were discovered with the physical plant, local system technicians were assigned to repair the problems.

In addition, TCI engineers worked with system staff in each major market to leverage existing fiber and amplitude modulated link (AML) networks to minimize the number of digital downlinks required. This project was managed by Oleh Sniezko and Jim Neil. In doing so,

TCI has kept its promise to implement and deploy digital TV throughout its systems and across the nation.

they added fiber in many markets and activated dark paths in others. They also worked with manufacturers to develop specific equipment, such as precision translators for digital signal and other equipment, all intended to speed implementation and to reduce cost. In the end, they reduced the initial number of downlink sites by nearly 200 locations, saving nearly $20 million in capital. "This was one of the best-managed efforts that I had ever seen," Werner says of Oleh's and Jim's performance.

Market launch

The digital market launch was directed by Colleen Abdoulah and Tom Beaudreau.

TCI operating and field support teams have launched service to 310 communities, representing 11.8 million customer households. These results were achieved between June 1997 and March 1998.

The staff includes 60 people in Project Management (tech ops, engineering, marketing, training, digital TV operations launch managers and field support teams), four people in Channel Lineup Management, 35 people in Digital Billing Interface Upgrades and 170 people in TCI Instructor-Led Digital Training (customer service, installers, system management).

Digital training is a big issue with TCI. A specialized course has been developed for five regional training centers, each staffed by TCI and GI instructors. Each system

Oleh Sniezko, M.Sc., M, B.A.
Vice President, Engineering
TCI Communications Inc.

This antenna farm is the heart and soul of TCI's Headend in the Sky (HITS).

sends at least one person to the closest training center, and training has been so successful that the centers have graduated more than 700 students in a month.

The billing side is considered very complex because the billing system is totally addressable. Leased circuits have been dedicated from the Digital Center's headquarters to each digital system across the nation.

Subscriber services

As part of an ongoing customer satisfaction program, TCI now offers a Digital Cable self-installation kit. The kit's video gives step-by-step installation instructions and shows how to use the navigator. Customers should be able to install their own digital set-tops within 45 minutes.

Also, TCI has announced a commitment to include seven digital channels of Your Choice TV in its digital lineup. This service will allow viewers a selection of various times to order and watch TV programs soon after their original airings. TCI and Liberty Media are launching a package of eight digital, Spanish-language cable TV networks in the summer of 1998. These companies plan to build a tier of digital programming services for the U.S. Hispanic market.

TCI has launched digital service to more than 300 communities. These include such major markets as Denver, San Francisco, Salt Lake City, Seattle, Chicago and Dallas. Digital customers currently total more than 275,000, using more than 345,000 advanced digital set-tops.

Competition, cooperation

As TCI moved ahead, other industries' communications giants took notice of TCI's success.

At the Las Vegas Consumer Electronic Show in January, TCI signed a letter of intent under which TCI would license a version of the Microsoft Windows CE operating system for a minimum of five million digital set-top boxes. At the same CES show, TCI signed another letter of intent with Sun Microsystems to incorporate a PersonalJava platform as a standard software application for digital set-top boxes. Once more, Malone and TCI stood firm in their efforts to protect the future of cable operators and digital equipment suppliers.

In the face of claims by competing industries that cable had no plans to run high definition TV (HDTV), TCI responded for the industry by stating that, "We are doing everything possible to ensure that our systems and digital devices can passively carry high definition signals regardless of format. Vendors are working to develop the headend equipment that will allow us to transport HD broadcast transmissions as soon as they are available."

An image for the future

Today, TCI's image has changed. A recent survey of TCI subscribers in the Denver area gave the MSO high marks in customer satisfaction with their cable service. And within the financial community, TCI also receives high marks. The company's stock surged to an all-time high in 1998 to more than $35. Moody also upgraded TCI to full investment-grade credit status.

"This is very important, especially because the industry is being driven by TCI in large part," said Stevyn Schutzman, cable and media debt analyst at Salomon Smith Barney. "TCI went from having a rough 1996, to turning themselves around by early 1997, to now bringing themselves back full-circle to investment-grade." In changing its rating, Moody's said that it expected TCI's strategy to continue to succeed.

TCI has kept its promise to implement and deploy digital TV throughout its systems and across the nation. Further, TCI has provided digital services to other cable systems and MSOs with its HITS Digital Terrestrial Distribution System. TCI has installed hybrid fiber/coax (HFC) networks to replace original coaxial systems to deliver the bandwidths needed not only for digital TV but also for Internet/data and IP telephony.

A popular saying among cable people is, "As TCI goes, so goes the cable industry." Let's hope other industry leaders will join the leadership of TCI and deliver on all that the industry can be. CT

Rex Porter is editor of "Communications Technology." He can be reached via e-mail at tvrex@earthlink.net.

Tony E. Werner
Executive Vice President of Engineering and Technical Operations
TCI Communications Inc.

Tom Beaudreau
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Ron Willis
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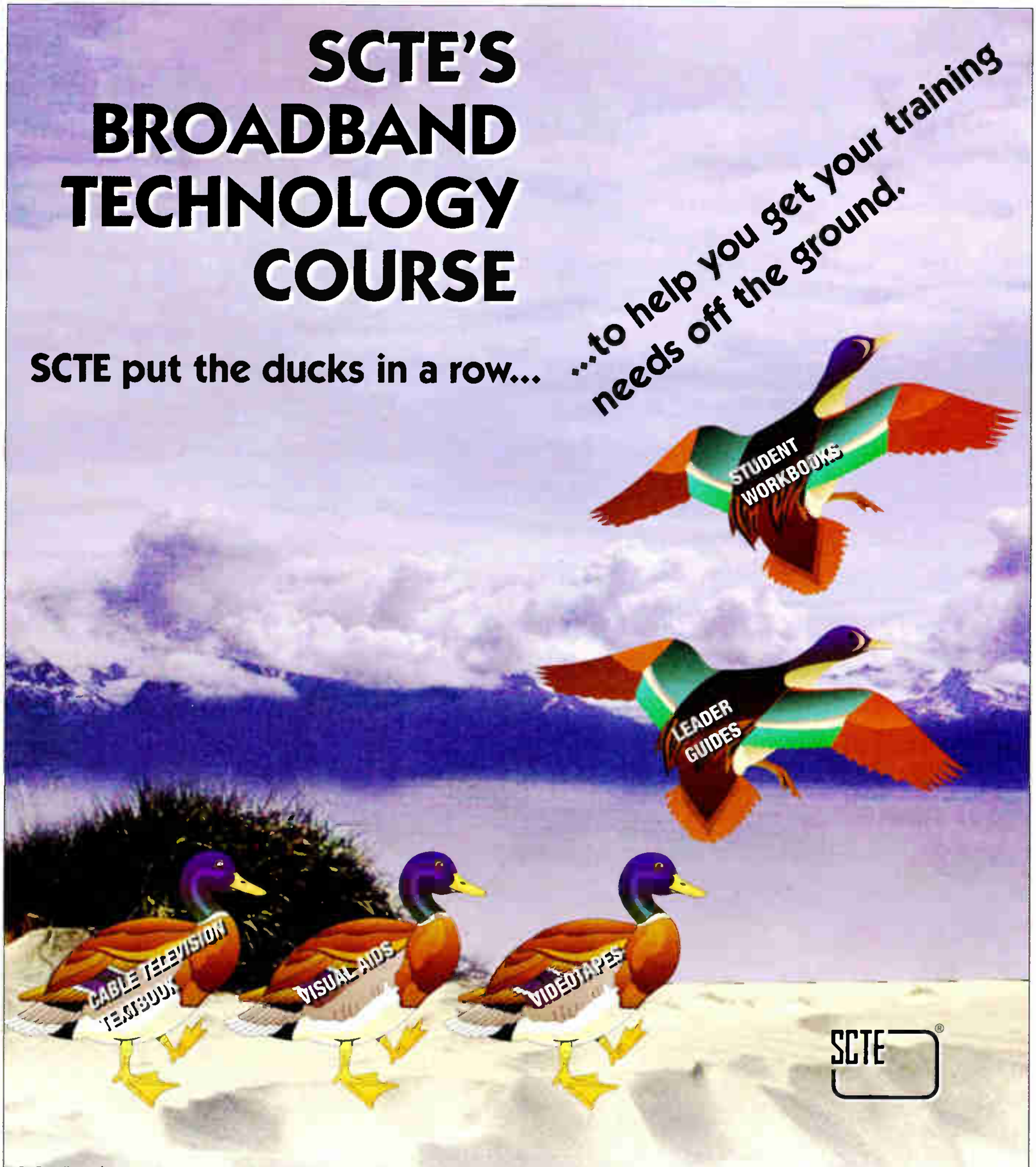
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HFC Upgrades, Part 2 of 2

By Laura K. Hamilton

The following is the second in a two-part special report on technical choices the cable telecommunications community is examining as engineers upgrade their hybrid fiber/coax (HFC) networks. Last month, we considered multiplexing, choosing cable, powering, standardization, and improved network performance.

This month, three vice presidents of engineering (two from MSOs and one from a consulting firm) share with you the knowledge they gained while deploying advanced services.

Is your network ready for two-way services? Wouldn't it be nice if you had a simple quiz to self-test your answer to that deceptively simple question? Well, on page 82, Ron Hranac, senior vice president of engineering at Coaxial International, offers you just that. Circle your answers to these 10 questions, add up your score, and find out if you're kidding yourself about being ready for two-way or if you've got the goods.

MediaOne in Los Angeles has substantial hands-on experience upgrading plant for broadband services. Vice President of Engineering Marwan Fawaz offers up tips on avoiding pitfalls and describes how MediaOne got the job done on page 92.

Finally, from TCI's Oleh Sniezko comes straight-ahead advice for return path design (page 98). Coaxial RF plant and the optical reverse link form the transmission path for the reverse signals. Both have different configurations and roles, and they affect performance in different ways.

Laura Hamilton is senior editor at "Communications Technology." She may be reached via e-mail at lhamilton@phillips.com.


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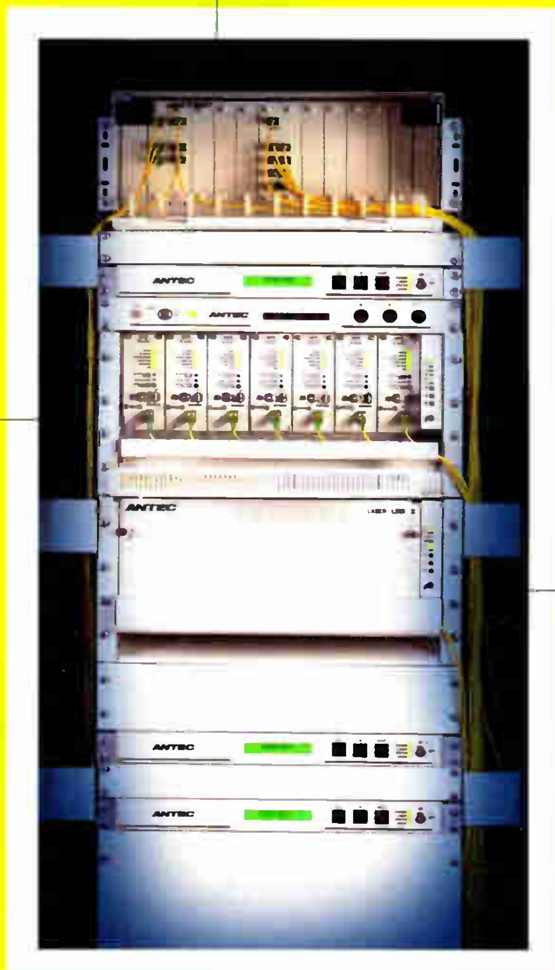

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Are You Ready for Two-Way?

By Ron Hranac

Take the following quiz to see just how ready you and your network are for launching two-way. Pick an answer that is closest to your particular situation. Scoring instructions ıd comments are at the end of the quiz.

Oh, yes, "Bob" is a figment of my imagi-ation, despite the fact that he may resem-. someone you know or have known.) ave fun!

What is your system's architecture?

a. Good old fashioned tree-and-branch ith a couple really long trunk cascades. ome to think of it, we sent Bob out to alance the Summitville trunk run last all. He should be about done with it in another week or so. It's 67 amps deep, you know. Plus three line extenders. But they're derated.

b. We put a fiber backbone in a few vears ago, so our longest trunk cascade is bout 12 deep. I guess you could call it a ıodified tree-and-branch, but it does make use of some fiber.

c. It's fiber-to-the-feeder, of course— sn't that what everyone uses? There are four or five actives after the node, depending on the neighborhood. Node sizes average about 1,000 to 1,200 homes passed each.

d. We got real aggressive and went for a near-passive hybrid fiber/coax (HFC) design. There is one active after the node.

2. *What kind of signal leakage program do you have?*

a. Well, we need to do a better job with leakage, but it seems there is never enough time or manpower. We try to fix all leaks greater than 50 µV/m, but we definitely treat those that are greater than 150 µV/m as an outage. They get fixed right away. Our last cumulative leakage index (CLI) was 61.

b. Everything above 20 µV/m gets logged and fixed within a couple weeks of finding it. Our last CLI was 53.

c. We fix leaks down to 10 µV/m, and all of our technical staff have operational leak detectors in their company trucks as part of the quarterly monitoring. Our annual CLI is consistently in the 45 to 50 range.

d. We fix all leaks we find, period. In some cases we've turned off service to subscribers with leaky TV sets, at least until they have a repair shop fix it or they replace it. Our CLI usually is in the low 40s, and this year we had our first flyover. At first the pilot thought we turned off the leakage test signal, but he did find a hot spot. That was in an apartment complex where we later found an illegal connection.

3. *How often do you sweep your system?*

a. When the system was upgraded three years ago, the contractor balanced and swept the amps. The only time we do anything with levels now is if we have to change a module because of an outage or similar problem. Otherwise we leave things alone. The automatic gain control/automatic level control (AGC/ALC) keeps the system running fine.

b. We adjust amplifiers once a year by measuring the low and high pilots with a signal level meter. With our HFC architecture and the relatively short cascades, it's not necessary to sweep.

c. Our line tech tries to sweep all amps once a year, but definitely every couple years. Bob spends a lot of time doing service calls, line maintenance and leakage, so it's hard to dedicate him to full-time sweeping.

d. We have a full-time sweep tech, and every active is swept at least once per year. Bob also checks all ends-of-line on a quarterly basis to see if there are any frequency response problems. ➤

4. *What kind of drops does your system have?*

a. We still have quite a few old copper braid drops, but they seem to work OK. All of our overhead drops use grip supports because we found that was a lot less expensive than messengered cable.

b. After the rebuild, we installed new premium sealed F-connectors on all of the drops, but the drop cables themselves were not changed, so we have a mix of grip drops and messengered drops.

c. About five years ago, we switched to messengered cable for all overhead drops, along with one-piece F-connectors. I'd say that 10% to 20% of the drops are older and still need to be replaced, but we change out the old ones whenever we do an install, reconnect or service call.

d. All of our drops use tri-shield cable and all overhead drops are messengered We also use premium sealed F-connectors. We developed an installation quality control program based on the Society of Cable Telecommunications Engineers' In staller Certification Program, and that re ally cut drop-related service calls.

5. *Is your system's design two-way capable*

a. When we had the system upgraded, we weren't anticipating two-way. Even though power supplies are pretty much maxed out with just one-way, we can re power if necessary. Besides, signals can either direction through the cable, so we're not really worried about activating two-way. I don't think the feeder's DC-1 will be a problem because I heard that in home two-way devices can be turned up to +57 dBmV or +58 dBmV output.

b. Yes, we had two-way taken into account when the design was done, includ powering. We'll have to install diplex filt modules in the amps, and we might hav to change a few high value directional c plers (DCs), but that should be about a

c. When our design was done, we spec'd two-way operation, even thoug the system is only one-way now. Our highest value coupler is a DC-8, and ou highest value tap is either 26 dB or 29 d depending on whether the line extender output is derated. All the amps have bui in diplex filters, and powering was designed for the extra load and voltage drop that will occur when we plug in the reverse modules.

d. Not only was it designed for two-way, but all the reverse modules were in stalled when the system was built. We have to do some alignment and mayb troubleshoot some ingress. In fact, we been using part of the reverse to get cit council meetings back to the headend, and we've done a couple modem trials in some of our techs' homes.

6. *If you had your choice, how would you align the reverse path?*

a. The line equipment available today is so much better than what was available than just five or 10 years ago. Most manufacturers use surface mount technology, so quality and consistency from unit to unit is almost like cloning. Frankly, it's just a matter of plugging in the reverse modules and making sure they operate at maximum gain setting to ensure the best carrier-to-noise ratio (C/N).

b. That's easy. I'd put a Ch. T-10 modulator at the end of the system and adjust for correct input and output level at each reverse amp.

c. The most cost-effective way to align the reverse is to use one of those multiple-carrier signal generators that puts out two or four carriers. That way Bob, our line tech, can easily check levels with a signal level meter (SLM) or if necessary a spectrum analyzer.

d. The reverse has to be swept at the same time the forward is swept, starting at the headend or node and working out toward system extremities. I'd probably go with something that can sweep in the presence of digitally modulated signals to ensure that we see what the whole reverse path frequency response is doing all the way back to the headend.

7. ***What role do you see training playing in successful two-way operation?***

a. Structured training would be nice if there was more time in each day, but we've just got too much going on. I figure we can learn on-the-job as we go because that has worked well in the past. I really don't see a lot of difference with two-way, just signals traveling in the opposite direction.

b. We already have a monthly training class, each lasting two to four hours. We've been incorporating some of the things that have appeared in *Communications Technology* and other publications, and the equipment manufacturers have been real good about providing copies of their instruction manuals and application notes that pertain to two-way. Mixing this with hands-on experience as we fire up the reverse should be pretty effective.

c. We bought the two-way videotape series from SCTE, the two-way book by General Instrument's Raskin and Stoneback, and have collected every related article and paper published on two-way during the past couple years. We've also had the manufacturers come in and do in-house training for us. All of this is in addition to our regular in-house technical and safety classes.

d. Besides our weekly in-house classes, I've been sending my techs and installers to local SCTE chapter meetings on a regular basis, along with requiring them to take relevant National Cable Television Institute courses. All of our installers have completed SCTE's Installer Certification program. We also purchased the SCTE two-way videotapes, collected two-way articles from *CT*, bought various conference proceedings manuals, books, and have worked together with equipment vendors for product-specific training. We even follow comments and discussions that appear on the SCTE-List.

Prior to the real thing, we plan to build a "mini" system in the tech room so all of us can practice two-way alignment on a bench-top cascade instead of on our subscribers. ➤

8. *Have you had a chance to activate any reverse, and then look at what's coming back to the headend on a spectrum analyzer?*

a. Our system doesn't have a spectrum analyzer, so we haven't been able to do this. Unless it's really bad, I don't expect ingress to be a problem, since we can turn up the in-home equipment to +57 dBmV or +58 dBmV and run all the reverse amps at maximum. This should keep reverse signals higher than most interference.

b. Yes, we did, and I was surprised at the amount of ingress and other interference coming back to the headend from a relatively small area of the network. It looks like we've got some work to do.

c. Yes, we did this in one node. Even after Bob did a preliminary balance with the four-carrier generator there was still some ingress, although it wasn't as bad as I thought it would be. We then put high pass filters on all of the drops in that node's service area, and it really cleaned things up, so it looks like what little ingress we do have is mostly from drops.

d. We've looked at some of the reverse from a couple nodes and were surprised to find that ingress was practically nonexistent. I first thought Bob pulled out a reverse pad as a joke, or maybe we had a defective or missing reverse module, but everything was working properly. I think our drop practices and tough signal leakage program have made a difference.

9. *Considering that most reverse path signals most likely will be some sort of digitally modulated signals, how do you plan to measure and set their levels?*

a. I understand that cable modems and similar equipment that will be in subscribers' homes is pretty much self-adjusting using something called "long-loop AGC (automatic gain control)," so it shouldn't be necessary to make any adjustments. Besides, if they're digital, they should operate over a wide dynamic range and not be particularly level-dependent.

b. Since digitally modulated signals behave like wideband noise, we'll probably measure each signal in pretty much the same manner as measuring noise by making an SLM or spectrum analyzer measurement and then applying a bandwidth correction factor.

c. Initially we'll use our power meter to establish each digital carrier's amplitude, compare it to a spectrum analyzer measurement, and then use an appropriate correction factor for future measurements with the analyzer.

d. We upgraded our spectrum analyzer's software with the latest version that includes digital power measurement capability, and we recently ordered some field test equipment that includes the manufacturer's digital measurement option.

10. *Are you and your system really ready for two-way?*

a. Like I said before, I don't think it's a big deal. To be honest, I think some of the problems we hear about are way overblown and are probably just an excuse for the vendors to sell more new equipment.

Admittedly, we'll have to do some repowering when we install the reverse modules, but overall two-way is essentially the same as one-way operation, except that signals will go both directions. We might have to tighten a few loose connectors and change out some of the older drops, but I think the digitally modulated signals will be pretty robust, even with our long trunk cascades. So, yeah, we'll be ready.

b. Well, from what I've seen in some of the tests we've done so far and from what I've read or heard from others, we have a lot of work to do. It won't be easy, but we'll eventually get there.

c. We have to tighten up the plant and drops a bit, and I'm sure there will be some surprises along the way, but things will settle down and two-way will play.

d. I was surprised by the relative lack of ingress when we fired up the reverse in a couple nodes, but we really have had some tough installation, leakage and maintenance programs in place for the past three years. Our techs and installers grumbled a lot early on, but they've seen the payback with fewer service calls, better pictures, and a network that's now a lot easier to keep working. So I'll stick my neck out and say we and the network are about 90% ready.

Scoring

OK, now it's time to add things up and see if you and your system really are ready for two-way. For each "a" answer give yourself one point; each "b" two points, each "c" three points, and each "d" four points. Now add up your score. The following comments are intended to be general in nature, so there may be some overlap in the scoring ranges.

10-15: Don't Kid Yourself. If you scored in this range, you're not quite ready for prime time, and you probably can forget about an operational reverse path until major changes are made.

If cable modems are supposed to be in your immediate future, you'll probably be limited to using telephone return versions. For RF return, it's likely that your system's tree-and-branch architecture won't easily support two-way. You may need to shorten cascades with fiber, get rid of high loss passives such as DC-16s and tap values greater than 29 dB, and possibly have to do some repowering to accommodate the increased current draw of reverse modules.

Most likely, your drops will give you a lot of trouble, and short of replacing all bad drops up front, you can figure on using high pass filters on most one-way drops. One cost effective idea would be to replace bad drops as subscribers take the two-way service rather than outright replacing large numbers of them.

You need to tighten up signal leakage monitoring and repair to get downstream leakage well below the Federal Communications Commission's 20 µV/m limit (shoot for 5 µV/m); otherwise, ingress will kill you. Buy a sweep setup and have Bob start sweeping all amplifiers to clean up frequency response problems. Training needs to be placed really high on your agenda. ➤

16-25: Roll Up Your Sleeves. Making two-way work will be a challenge, and you're right if you've guessed that there is a lot to do.

If your network already has a limited amount of fiber, but the architecture is still primarily tree-and-branch, it still may be necessary to deploy a bit more fiber to reduce the number of homes in each fiber service area. This will have to be evaluated on a case-by-case basis.

Tighten up signal leakage to help manage ingress; try to set a threshold lower than the FCC's 20 µV/m limit. Forward and reverse system sweeping needs to become a priority; having Bob set amplifier levels with an SLM isn't good enough. Your newer drops, assuming they were installed correctly, should present few problems, but older, non-messengered drops will cause headaches. Use high pass filters where you find problems; it may not be necessary to install them everywhere. Look at your network design, and try to get rid of high value DCs where practical.

Beef up your in-house training a bit, and if you don't have them already, consider getting SCTE's series of videotapes on two-way. Look at your test equipment, and see if it's possible to upgrade one or two units with digital power measurement capability. If not, think seriously about getting a dedicated instrument for measuring and setting digitally modulated signals.

26-35: You're on the Right Track. Your architecture probably is just fine for two-way operation, and your relatively small node sizes will help to manage reverse path problems.

Even though your signal leakage program keeps things pretty tight, you'll find that you can't let up once you activate the reverse path. If you are planning to use a low-cost four-carrier generator for reverse alignment, use it only for rough balance. They just don't allow you to see what's going on in between the carriers.

Reverse sweep is the best way to keep frequency response as flat as possible. If you haven't purchased a reverse sweep setup yet, consider getting one that also will allow you to measure digitally modulated signals. Finally, it probably won't be necessary to install high pass filters on all drops, but you should plan to keep some on hand for problem drops.

36-40: You've Got the Goods. If you scored in this range, deploying two-way services should be a relatively painless experience.

You're bound to have a few problems when you activate the reverse, but they should be minor. Pay special attention to reverse levels, amplifier alignment and laser inputs. Keep the plant tight, and use high pass filters to fix the occasional problem drop. CT

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TEN YEARS AGO, WE
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Building Your Advanced Network

How MediaOne Got the Job Done

By Marwan Fawaz

If you're preparing to upgrade your plant to offer broadband services for residential customers — or even adding service for business customers — there are potential problems and pitfalls to consider. This article will walk you through how MediaOne addressed these considerations.

Before you start to build, be sure to consider the following:
- Have you done enough planning? Are you allocating resources, not just for the planned services, but strategic planning that also reflects the area's growth potential?
- Have you seriously discussed potential political barriers? For instance, does your municipality want to own its own broadband pipe, and why?
- Are you sure of the reliability of your subcontractors? Do they recognize the perils of laying cable, what kind of mistakes could occur and the financial consequences if a mistake does occur?
- Are your vendors promising hardware that today is still vaporware? Will it really be ready on time?

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When MediaOne designs a network, our primary purpose is to create an infrastructure to support a multitude of residential and commercial services for today and the future. In the greater Los Angeles service area, for example, it seemed obvious to serve business customers in addition to our residential customer base. The same hybrid fiber/coax (HFC) plant upgrade we were building for residential broadband service could, for just a small incremental investment, meet the more demanding business network requirements as well.

Our service area in greater Los Angeles provides a unique high-density combination of residential neighborhood, entertainment and aerospace industries.

Our business-to-business service in the Los Angeles metropolitan area is called MediaOne Connect, and it complements our existing broadband service, which includes 750 MHz cable TV video, high-speed data, telephone services and soon will have digital video.

Today, MediaOne in California, in addition to high-speed data for our residential customers, offers businesses their own network for moving uncompressed video, voice and data at speeds up to 622 Mbps.

Our broadband network transmits this data via fiber-optic-based networks using point-to-point and/or

BOTTOM LINE

Key Questions for Your HFC Build

If you're planning to offer expanded two-way services over your cable plant, you'll need to address a number of questions. Take the example from MediaOne in Los Angeles.
- **Have you done enough planning?** Thinking long-term allows you to plan the amount of technology that will be needed to accommodate not just for present traffic, but for any increases in the future.A neighborhood with six fibers allocated to it may need more fiber in a few years.
- **Have you seriously discussed potential political barriers?** City officials always are looking for additional revenues. Be prepared to negotiate away some fiber for city use.
- **Are you sure of the reliability of your subcontractors?** When you are digging trenches, permits allow you only a small window of construction time. Contractors need to be on schedule, and you need to monitor this.
- **Are your vendors promising hardware that today still is vaporware?** If it's still in development by the manufacturer, then you want it available by the time the entire network is available to the customers.

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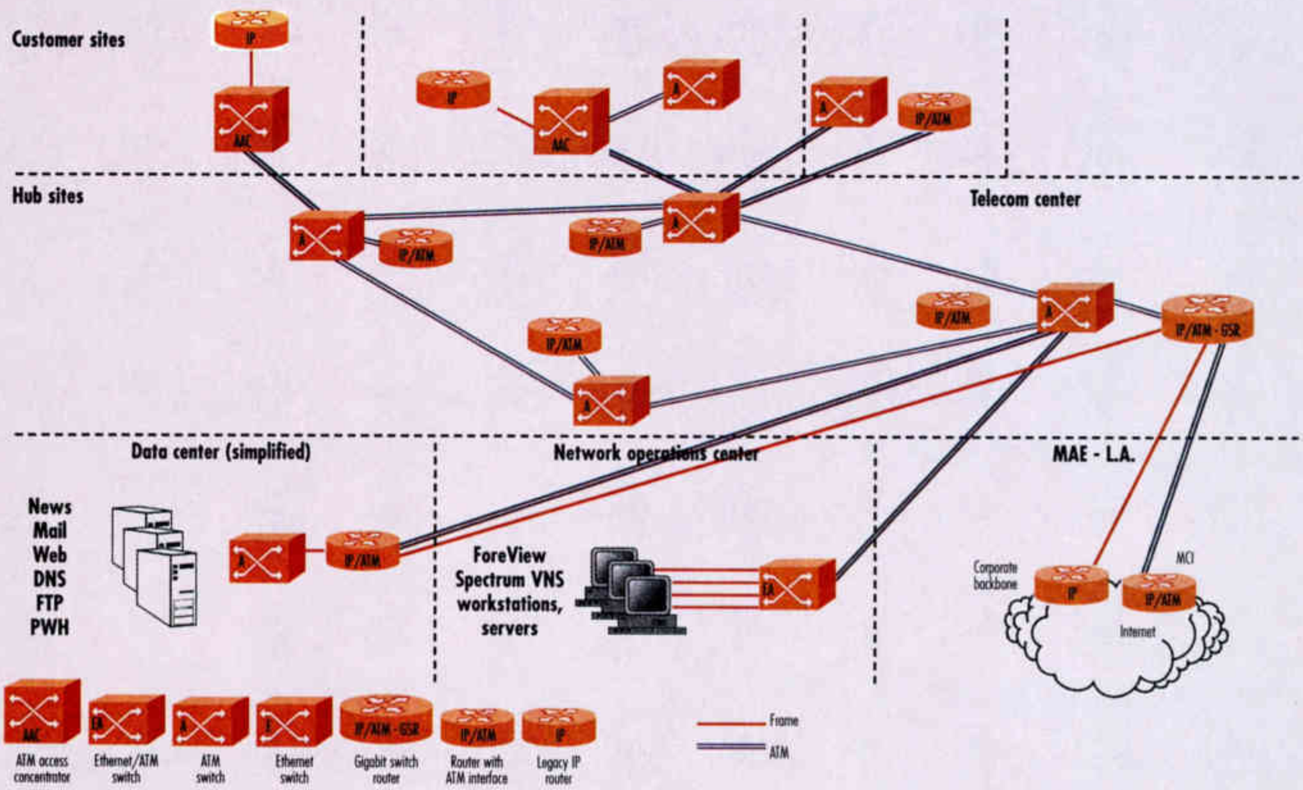
Reader Service Number 52

Figure 1: Routed ATM backbone



synchronous optical network (SONET) self-healing rings.

Our InternetOne service was created for businesses, educational organizations and government agencies that need the Internet as a part of their daily operations.

InternetOne includes the use of MediaOne's Internet national backbone capabilities, offering flexible bandwidth levels for dedicated local line access and the Internet service link in MediaOne Connect's backbone node co-located facilities.

MetronetOne is a service for large, multi-site corporations and businesses to help implement their Intranets and Extranets. MetronetOne delivers a virtual private network that transfers information to geographically dispersed locations at speeds up to 622 Mbps. MetronetOne-IP is designed for companies connecting multiple locations within a metropolitan area.

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> "We were truly surprised by just how resistant some cities were to our plans."

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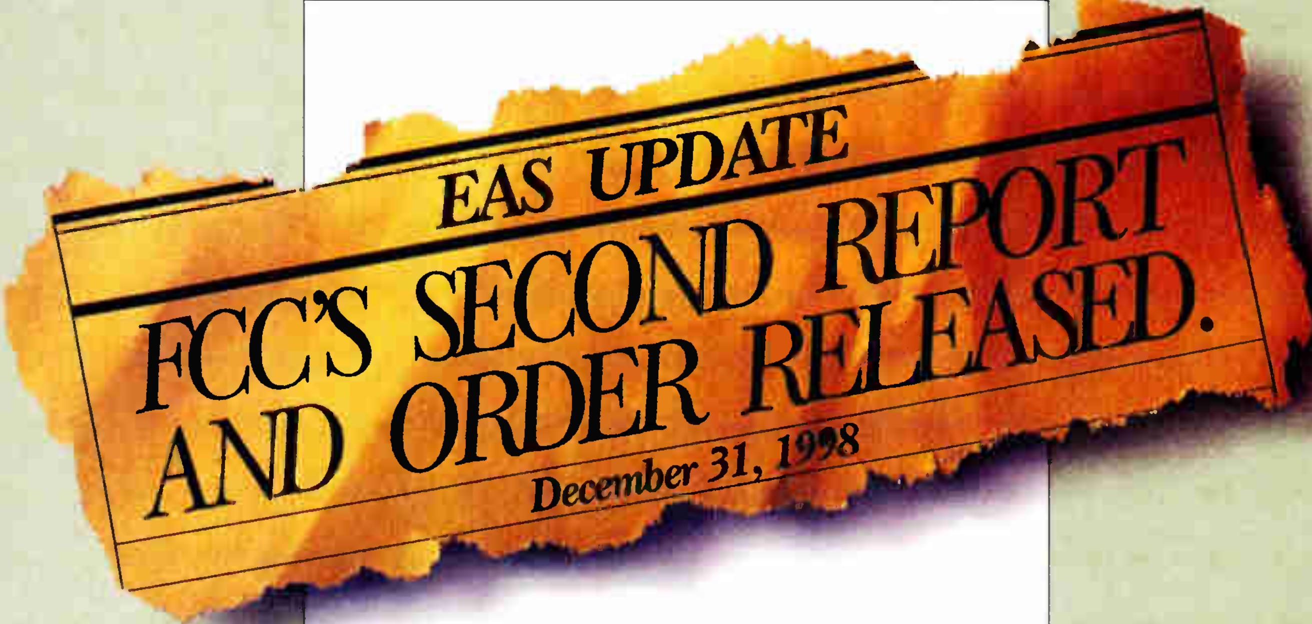

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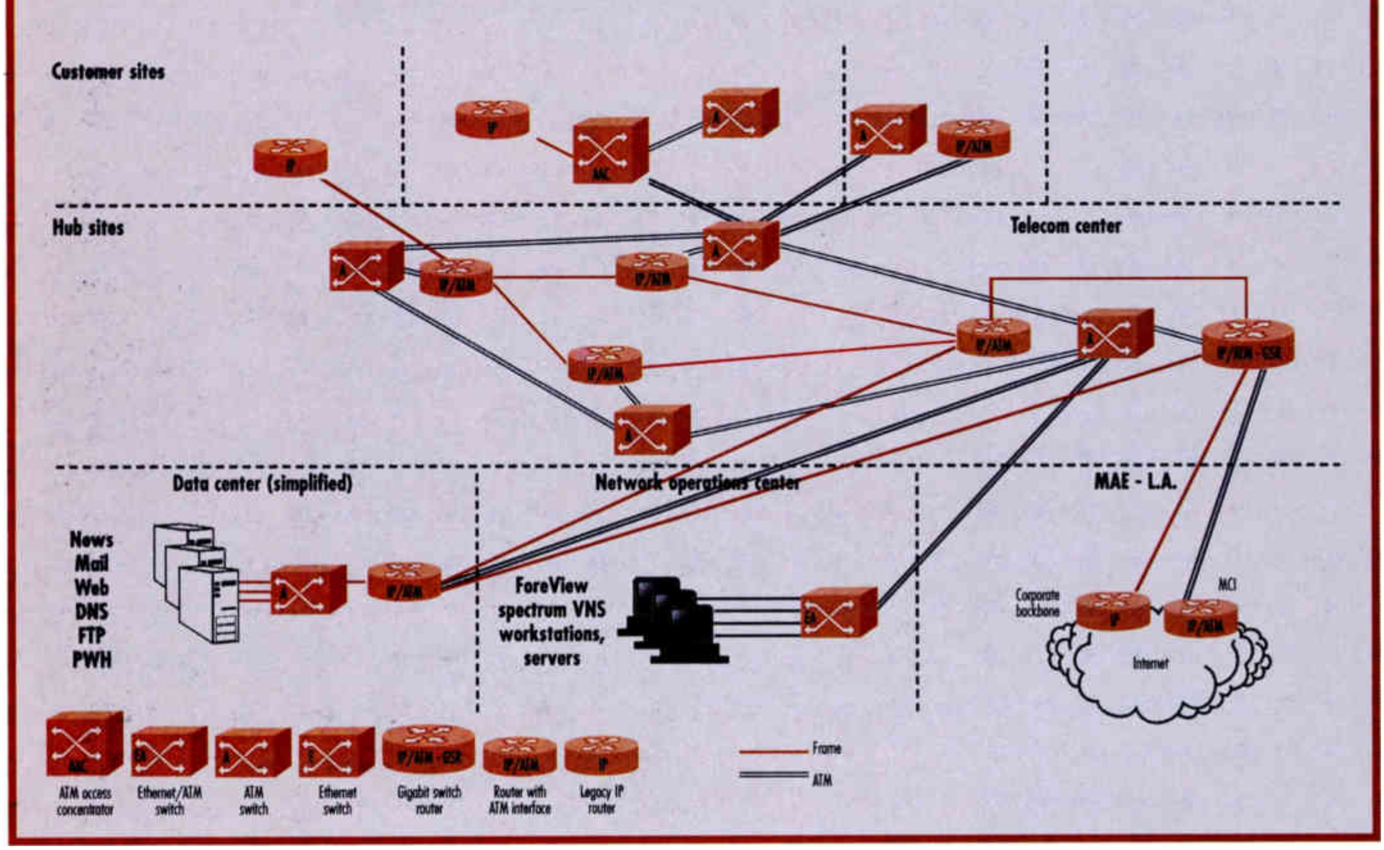
Figure 2: Hybrid POS, ATM backbone



Planning and permits

To build such a network in a marketplace the size and scope of greater Los Angeles, we determined the needs of the metropolitan area and allocated our resources accordingly.

MediaOne Connect allocates by clusters of business users, much as we would allocate for residential areas. Our HFC design practices call for one node (serving area) every 500 homes, and we allocate six fibers per node. One fiber is dedicated for upstream transmission, another for downstream. Two are dedicated for redundancy, and the remaining two are allocated for potential users, splitting nodes or local INET uses.

In business areas, the minimum number of fibers allocated for each cluster is eight. This number is increased by multiples of eight, depending on the size and number of business users.

Again, thinking long-term allows you to plan the amount of technology that will be needed to accommodate not just for present traffic, but for any increases in the future. In five to 10 years, that neighborhood with six fibers allocated to it may exceed that demand as businesses grow, new buildings are built, or new technologies come along that demand heavier broadband traffic. Our options at that time will be either to extend fiber closer to residential customers or rely on wave division multiplexing (WDM) technology; the same applies for businesses.

We needed to identify the number of fiber strands to build through main routes where the businesses existed. And we did that in the planning stage, because it's more cost-effective to do in the planning stages, rather than building another bundle in the same trench you dug just a few years earlier.

Another step in the planning phase is identifying the type of business the network will serve. MediaOne Connect breaks businesses down to small, medium and large sizes based on the number of fibers allocated.

The initial thrust of MediaOne Connect is large businesses where bundles of 48 to 96 fibers are home-run back to a hub or node. Medium and small businesses are accommodated via the HFC network where traffic can be shared with residential users.

We were truly surprised by just how resistant some cities were to our plans. Cable operators traditionally are viewed as entertainment providers, and city officials always are looking for additional revenues. The lesson we learned is the need to educate, inform and prepare city officials and their communities about the short-term and long-term value of the system.

It's not engineering, but you'd better be prepared to work along with your public affairs department to solve the following riddle: "How much fiber will you allocate for city use at no cost to us?" Communicating value and understanding that this may be an opportunity for their businesses to increase their productivity vs. their competitors by enabling them to communicate faster and more efficiently in the long run should be explained.

After briefing and negotiating with city officials, we finally get to crack the surface of some asphalt. But opening a trench on some of these streets takes an act of God, right along with up to 10 times the amount you originally planned to spend. The city often will ask you to dig deeper trenches, and when it comes to restoring the street, they will expect you to make it look better than it did before you began. In some areas, trenching could cost $75 to $100 a foot. In other areas, it could cost as little as $10 to $12 a foot.

When you are digging trenches, you want only the finest, most trustworthy, most experienced contractors. Contractors need to be on schedule, and you need to monitor this. In Los Angeles, where we have many freeways to cross, this translates into needing many, many permits.

Those permits allow you only a small window of construction time. There is a litany of horror stories related to contractors' splicing a cable line. We all have them. But in this environment, millions of dollars are at stake, and liability is high.

Hardware needs

The next set of challenges for MediaOne Connect is in dealing with hardware providers. In retrospect, laying down the fiber is the easy part. There's the hardware to consider: vital IP routers and ATM switches—state-of-the-art equipment that's high in demand sometimes is hard to get delivered on time.

If it's still in development by the manufacturer, then you want it available by the time the entire network is operational for the customers. Try to get your SONET equipment supplier to talk to your ATM switch manufacturers, and in turn connect their equipment to another manufacturer's routers.

While doing all this, find support systems that provision, survey or monitor all the above. Delays encountered while integrating these different transmission and switching technologies can cause missed delivery of data to a very critical and demanding customer base.

Luckily, fiber infrastructure allows us to be extremely flexible, and that's exactly the mindset you want to have. You must be sensitive to customers' needs and give them what they want, rather than dictating what they need.

If you are operating in a metropolitan area with growing businesses and there is a demand for high-speed communication, combining your engineering and design business services with residential services may be the most cost-effective way for your company to go. But it took us two years to get to where we are today. CT

Marwan Fawaz is vice president of engineering for MediaOne's Western Region in California. He can be reached by phone at (310) 647-3000 or by e-mail at mfawaz@mediaone.com.

Coming Home

Remember These Reverse Path Design Considerations

By Oleh J. Sniezko

In the hybrid fiber/coax (HFC) network, two distinct elements, coaxial RF plant and the optical reverse link, form the transmission path for reverse signals. Both have different configurations, characteristics and roles, and they affect reverse path performance differently.

One of the major differentiators between these two elements is the funneling behavior of reverse path impairments. Both intrinsic and extrinsic impairments accumulate from all sources connected to the reverse path coaxial system. The reverse optical links, however, usually are dedicated to a portion of the coaxial system and do not add to the funneling effect unless several of them are combined at the receive end. Moreover, they virtually do not contribute extrinsic impairments.

The character of the impairments predominant in a coaxial system is different than the character of the impairments generated in optical links. The limiting impairments (egress, common path distortion, noise and so on) in the coaxial portion of the reverse path are present and funneled without the presence of the desired signals. Nonlinear distortions are under the control of the designer. In optical links, the only critical impairment generated without the signal present is noise. The limiting impairments are nonlinear distortions caused by laser clipping.

Another important characteristic of the coaxial section is its thermal instability. This results in level fluctuation. The optical links are reasonably stable with temperature and, due to the long-loop automatic level control (ALC), levels in these links also are stable.

These differences set different design criteria for the two distinct sections of the reverse system. The challenge is to design the network to lower the likelihood that impairments beyond the designer's control will affect network performance. Hence, the coaxial portion should be designed for the highest possible carrier-to-interference ratio to maintain acceptable performance in the presence of high-level funneled impairments. The optical link, on the other hand, should be designed for a maximal dynamic range to avoid laser clipping by the impairments funneled in the coaxial portion.

Network analysis

Reverse network configuration and network alignment points (Figure 1 on page 101) allow for this individual optimization of the HFC network's two portions. Moreover, the long-loop ALC power management system present in most of the advanced-service equipment allows for last-moment optimization of the total power load and of the individual service levels in the two portions of the network.

For example, adjusting AT1 and AT2 in opposite directions by the same amount changes levels for all services in the optical link only (lowering AT1 and increasing AT2 increases levels in the optical links). Note that AT2 can be available in the receiver (usually placed interstage). Use this attenuator for adjustment, since it allows for increasing dynamic range of the output stages of the receiver (lower nonlinear distortions). Adjusting only AT1 changes the levels for all services in the RF section of the network. Adjusting only AT2 changes levels in the entire HFC network. Individual adjustments of AT3 affect only the particular service levels from the particular service area.

These possibilities allow for independent optimization of the RF levels at any point in time without service disruption if the network is designed properly.

The optical attenuator (OAT) lets you optimize or unify the optical power level to the receiver, regardless of optical loss variances among different optical links. This lets you choose the best dynamic range for the reverse optical link.

Coaxial section

The design and alignment of the coaxial portion is relatively simple. Since the service levels in this section of the HFC plant can be defined later, the only things to do are:

- Design and align it for unity gain operation.
- Calculate the level of thermal noise at the input to the optical node.

- Check for sufficient dynamic range in the coaxial section of the network.

Despite misleading simplicity, there is one decision to make: Select the reference points for unity gain. The alternatives are the input to the active module or the input to the station housing.

The first alternative is easier for the designer because network performance is easier to calculate. Moreover, both dynamic range and thermal noise levels can be optimized for the coaxial section if the active module input is used as the reference point for unity gain. However, this alternative is more difficult for field implementation because many internal configurations of the reverse path are in the embedded base of the amplifiers. Although newer generations of amplifiers have mostly balanced loss from all the reverse input ports, in older amplifiers the differences in loss from different ports can be as high as 20 dB. (See Figures 2 through 4 on pages 102 through 104.)

The second alternative is much easier to implement in the field. However, it results in far from optimal reverse coaxial section performance. A compromise would specify different levels for amplifiers or ports with high loss from the input port to the reverse active modules (trunk bridger ports, minibridgers and such) and amplifiers or ports with low loss from the input port to the reverse active modules (trunk express ports, line extenders and the like). However, this compromise essentially is the

Figure 1: HFC network configuration

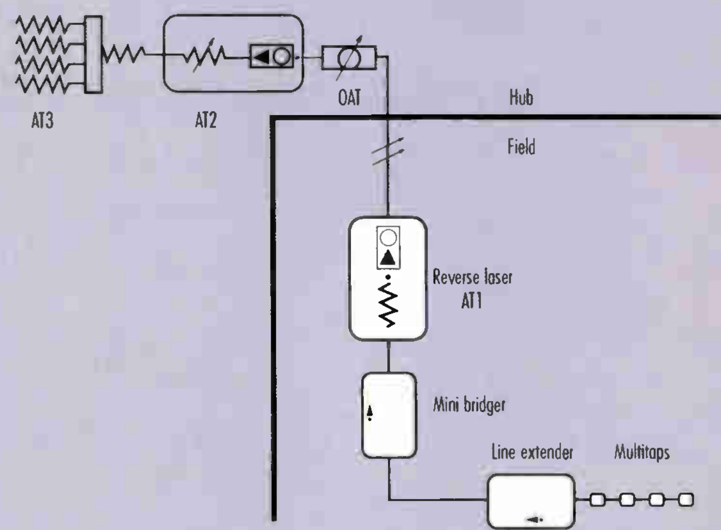
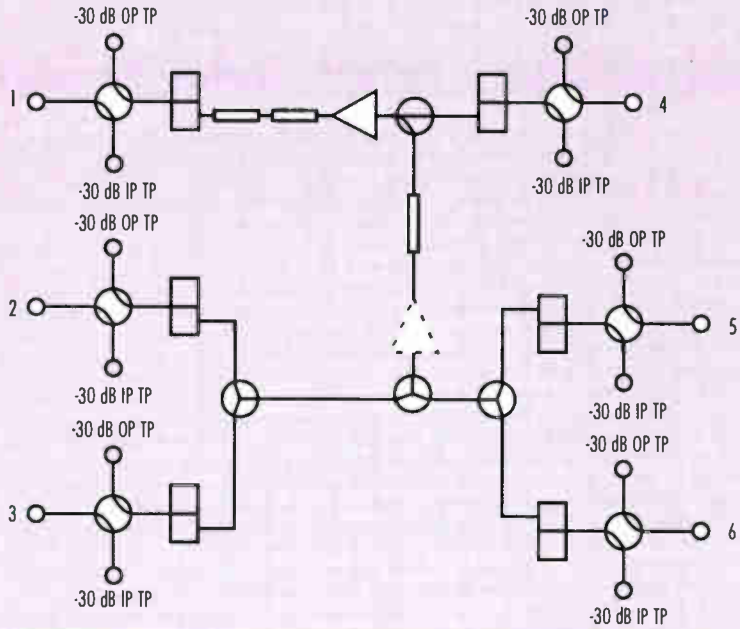


Figure 2: Reverse path configuration example

a) Typical trunk amplifier



same as the first approach.

The funneling effect of thermal noise depends on the reference point selected, noise factors and the number of amplifiers combined into a single laser. The minimal level of noise is determined by ambient temperature and is inherent to all matter, including actives. However, the actives add to this minimal level due to their imperfection (internally generated noise). The equations (on page 106) quantify funneled noise for the coaxial section.

Dynamic range vs. NPR

To maintain the level of performance with funneled impairments, the coaxial network should be designed for a sufficient range of inputs over which the noise power ratio (NPR) remains equal to or better than the required value. Due to a different funneling mechanism for thermal noise and for intermodulation noise caused by extrinsic interference, plots must be further interpreted based on the required carrier-to-noise ratio (C/N) and required C/IMN for a single amplifier.

Available service levels

The funneled noise and the dynamic range relationship to NPR allow calculation of the service performance if the level of the service signal is determined. This level is limited by the maximum output level of the terminal devices, the loss between the output and coaxial section reference point and a safety margin for equipment inaccuracy and thermal instability of the network (between the terminal device output and optical receiver input). The thermal instability of levels will be compensated for by the long-loop ALC but will affect C/N and dynamic range.

Sufficient set of parameters

This analysis shows that the following set of parameters and network characteristics is sufficient to design the reverse coaxial section and calculate its performance:

1) Network configuration:
- Number of amps of different types
- Cascade depth
- Loss between coaxial section reference point and terminal equipment output
- Network margin

2) Amplifier gain from the reference point to its output (sufficient for unity gain)

3) Gains between inputs (reference

Figure 3: Reverse path configuration example

b) Minibridger with balanced reverse

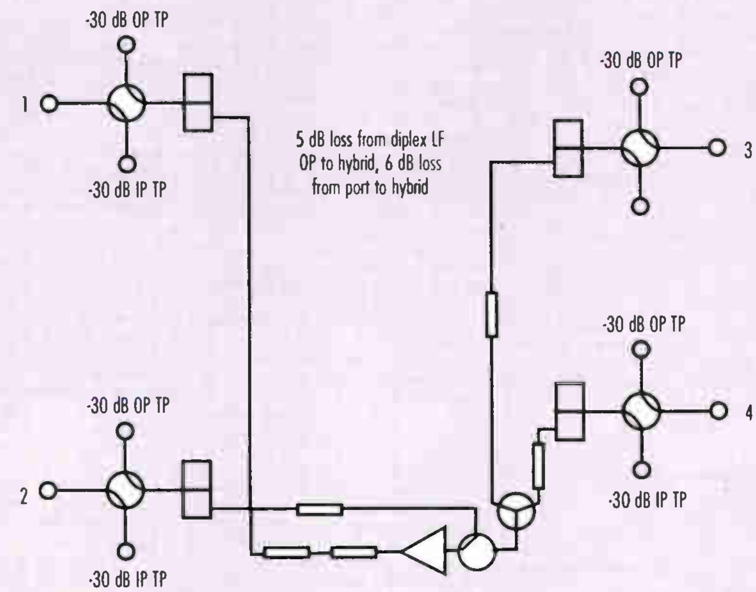
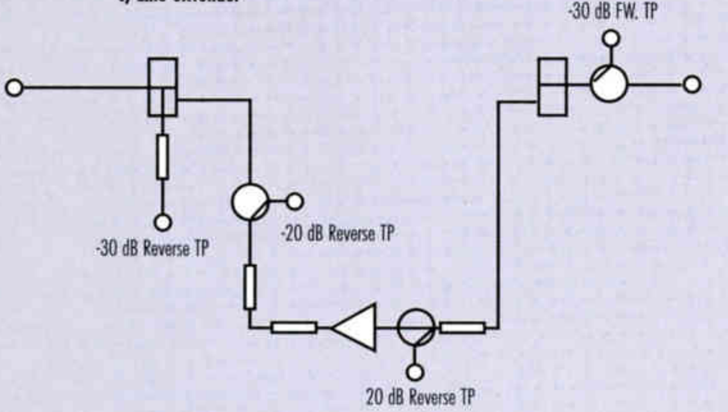


Figure 4: Reverse path configuration example



points) of amplifiers of different types
4) Noise factors for different amplifiers at their reference points
5) Dynamic range vs. NPR
6) Available output level from the terminal equipment

Optical link

The optical link performance depends on more factors and parameters. The reasons are numerous, and examples include optical loss, lack of standards and a multitude of technological choices.

Design parameters

Two elements in the reverse optical links, the laser transmitter and optical receiver, often are specified together. However, most parameters for these components can be specified independently, and for some of them it is beneficial to do so.

Specification sheets for the reverse laser transmitters should list:

- Dynamic range as a function of required NPR for loads occupying 35 MHz reverse bandwidth with optical fiber link loss as a parameter
- C/N for the same optical fiber link loss for a particular RF input signal power density in dBmV/Hz, measured at a reference point (such as a node reverse input port) for different internal configurations of the reverse laser transmitter or optical node (assuming a standard optical receiver with 8 pA/Hz1/2 noise performance and 8 A/W responsivity)
- C/N as a function of fiber loss and optical level to the reference receiver
- C/N correction factor for a recommended receiver (if different than the reference receiver) as a function of fiber loss and optical level to that receiver (for the same laser) ➤

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Equation 1: Minimal thermal noise

$$N_{th}\,(dBmV\ 1\ Hz) = 10 \bullet \log kT - 78.75 = -125.1\,dBmV\ 1\ Hz$$

You can easily derive dynamic range data (a plot or a table) for other link loss budgets from the standard C/N curves for lasers or complete optical links, since the only change in dynamic range caused by the loss changes is caused by C/N degradation.

The second parameter (a number) allows for setting adequate input levels to the reverse laser for the C/N required by a particular service.

The last two parameters (plots or tables) usually are combined; in some applications the receiver recommended by the laser vendor is used.

The specification sheets for the reverse optical receivers should list:

- Optimal optical input power (optical input power at which the laser dynamic range reaches its peak) and recommended optical input power range (for example, the range within which the laser dynamic range is better than its peak value less 3 dB)
- Range of the RF output signal's total power within which the receiver operation is linear

Equation 2: Total coaxial noise at optical node input

$$N_{coax} = N_{th} + 10 \bullet 10 \bullet \log\left[Q_1 \bullet 10^{\frac{G_1 + NF_1}{10}} + Q_2 \bullet 10^{\frac{G_2 + NF_2}{10}} + \ldots\right] + G_0$$

Where:

k = Boltzman constant

T = ambient temperature in °K

N_{coax} = the total amplifier noise power at the node station input

$NF_1\ NF_2$ = the input noise power of each station type

$Q_1\ Q_2$ = the quantity of each station type (stations with different than unity gains between reference points are considered different)

$G_1\ G_2$ = gain between the reference points of stations of different type

Q_0 = gain between the input of the last RF active (upstream) and the optical node input

The values of the first parameter numbers can be affected if the nonlinearity of the receiver's output stages affect the dynamic range of the laser. To remedy this, perform the tests with RF output levels set to middle range in receivers with adjustable output level using an interstage pad.

Measure the second parameter numbers with low fiber loss so the output level range is not affected by the laser dynamic range. (Low optical modulation index, or OMI, can produce high outputs from the receiver if optical loss

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is low.) The optical input level to the receiver should be set to the optimal level.

A link gain value is the only parameter that must be tested for the complete link. Measure this parameter at a specified link loss, but remember the value of the link loss is not critical, since the output level of the receiver changes in a defined way.

Performance allocation

As mentioned before, keep the levels of service signals in the reverse optical link as low as possible to limit laser clipping by the funneled coaxial section impairments. Hence, by design, the optical link usually defines the C/N for the reverse path, despite the thermal noise funneling effect in the coaxial section. This may be difficult to achieve if the reference point selection does not allow for coaxial section optimization. As a rule of thumb, the author recommends setting the funneled thermal noise level of the coaxial network 3 dB to 6 dB lower than the optical link's thermal noise for the highest link loss.

Absolute level limits

The absolute levels for service signals are determined by long-loop ALC and level availability from the customer terminal equipment.

Summary

It is important to select optimal requirements for reverse path active components. The reverse path sections should be optimized for the best margin of uncontrolled impairments. For the coaxial network, these are funneled additive impairments. For optical links, it is clipping caused by the funneled coaxial impairments.

Both main sections can be designed and optimized almost independently except for the level relationship between them. CT

Oleh Sniezko is vice president of engineering for TCI Communications. He can be reached at (303) 267-6959.

BOTTOM LINE

What's Important To a Reverse Path Designer?

The parameters needed to design the reverse path of the coaxial portion of a hybrid fiber/coax (HFC) network are limited. The number of parameters for optical link design is higher, and the design and performance optimization process is much more complex.

Select an optimal set of requirements for the reverse path active components. The sections should be optimized for the fewest uncontrolled impairments. For coaxial networks, these are the funneled additive impairments. For optical links, it is clipping caused by funneled coaxial impairments.

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MENU

Six Assessments For Making Two-Way Work

By Thomas J. Staniec

Two-way captures cable engineers' attention. Various organizations work at a feverish pace, with all manner of discoveries coming to light. Functionally, at the end of the day, only one question needs to be asked: "Just what does it take to make a two-way network perform in a manner that will support high-quality communications services?"

The answer is being pursued by many individuals, and the answers given may look widely disparate. Therein is the rub: How a network performs largely is determined by the choices made for a given system over a period of time. So, generally, a standard solution to return operation is virtually impossible.

When confronted with this situation, the procedure should be the establishment of a reasonable expectation, a skeletal operations method provided in a customized manner and the mental ability to "go with the flow." This article will address a skeletal operations method that has proven successful in the deployment of two-way communications networks.

The lay of the land

Today, numerous networks have been built with high bandwidth and advanced technology. In many cases, equipment was selected based on cost, performance and the type of business we envisioned the industry would provide to customers. That business service analysis has led to the use of interesting combinations of different manufacturers' equipment.

The days of turnkey systems or one-manufacturer allegiance are gone. Now it is not uncommon to see forward lasers from one manufacturer, fiber node housings from another, and forward receivers and return optics in the housings from a third ... you get the idea ... not to mention that amplifiers may be from yet another source. Given these combinations, just how do you make the configuration operate cohesively?

How can a network with this wide diversity of equipment be operated and maintained to provide a highly reliable communications network? This is no easy feat, and the problem is compounded by a general lack of two-way operating experience in the industry. As the installation of Road Runner has progressed, a "cookie cutter" installation procedure for the hybrid fiber/coaxial (HFC) network has seemed like the Holy Grail.

Reality is proving, however, that the mix of equipment makes a system demand not cookie-cutter procedure but an exercise in compromise. I say compromise because, while all equipment theoretically is equal, in reality it is not. Therefore, a thorough evaluation is required to determine how best to operate the overall network.

The best place to start is at beginning

Surprisingly, starting at the beginning often is overlooked. What is the beginning? It starts with an assessment of the network as a sum of parts to ensure consistency of operation. One important element of this starting assessment is that it should assess more than the physical network. It is all-inclusive. It should look not only at what comprises the network but also at:

1) What you know
2) What your personnel know
3) Your operational procedures for maintenance and troubleshooting
4) What types of test equipment you have and how well you use them ➤

5) The equipment types used in the network and their operational requirements
6) The attitude your organization brings to the job

Those six items cover a lot of ground. Success is based largely on how well-prepared you and your organization are for operating a communications network. To quote J. Danforth Quayle, "If we don't succeed, we run the risk of failure." In this case, no truer words were ever spoken. So as not to "run the risk of failure," a sound case can be made for the "Five Ps:" Prior Planning Prevents Poor Performance. In short, when you start, take a real inventory and develop a plan based on that inventory.

"Make a new plan, Stan"

So Stan, how do you make a new plan? You can start by doing a hard-look, no-holds-barred analysis of where your organization is positioned. That may be a real eye-opener (and not pleasant), but it's the only way your organization will grow in the long term. In large part, training invariably proves to be a problem.

For example, Time Warner has established an information base and program design to deal with return operation in conjunction with the national training center and engineering and technology

BOTTOM LINE

No Such Thing as Standard

Creating a reliable two-way network is no easy feat. Network performance depends largely upon choices made for a given system over a period of time, and systems have equipment from many different manufacturers, which complicates matters. Thus, a standard solution is nearly impossible. You need to establish reasonable expectations, a skeletal operations method and considerable flexibility.

One important element of this starting assessment is that it should assess more than the physical network. It is all-inclusive. It should look not only at what comprises the network but also at:

1) What you know
2) What your personnel know
3) Your operational procedures for maintenance and troubleshooting
4) What types of test equipment you have and how well you use them
5) The equipment types used in the network and their operational requirements
6) The attitude your organization brings to the job

Just like getting healthy, getting ready for two-way operation requires a change of lifestyle. Failing to make the change could be costly.

departments. These groups examine, debate and implement solutions, which will be integrated into training programs and operational procedures designed to develop the shortest path to two-way operation in a communications environment.

Digital readiness everywhere is the Holy Grail. And an in-depth training program with a skeletal format for implementation by all users is the focus.

Starting the equipment assessment

Having operated two-way networks for about 14 years, I would say I have tried, failed, regrouped, tried and failed again more times in one lifetime than I prefer to remember. Building a theory, testing it, modifying it or discarding it is second-nature at this point. The principles of sound operation for the return network are comparable to the forward but with some twists.

Some of the obvious differences in the return network are noise funneling, flat input levels at all amplifiers and the seriousness of ingress. If you take the equipment combinations discussed earlier, an even higher level of complexity is added. To overcome the eclectic combination of equipment, start by assembling all the data sheets and alignment instructions for the manufacturers' equipment used.

Verify the operational range of each type of equipment. Once the levels for each piece of equipment are established, try to find a common level set that can be used across the network platform. This sounds easy, but, as I have experienced, it is not. The problems center on a number of points all the way from the input to the return amplifiers in the line extenders to the output of the return receiver.

The make-or-break point in a network is the return laser transmitter, so your constant level setup procedure should use the laser drive level as the point of operation. The output of the return optics receiver should be set to the same level as the return laser input.

In reality, the blanket statement of using the return laser input as your gold standard is merely a good first approximation. However, the operational levels provided by the manufacturer assume Gaussian noise and only the desired carriers.

Actually, in real life nothing could be farther from the truth. The return network has ingress from fixed frequencies, impulse interference and a virtual raft of undesired trash that saps the usable range of the return laser. When you couple that with some really flaky lasers, you have a network that operates poorly with no operational headroom.

One way to combat this phenomenon is to test the return lasers with a simulated digital test signal that shows the point of best operation for the return laser. Armed with this information, you can establish a much more educated reference level.

Currently, in almost all Road Runner installations, a return laser test is run using an arbitrary waveform generator and a spectrum analyzer to determine the range of operation for the return lasers in a

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given system. The test was devised by Jack Moran of Motorola ISG and formatted on a Le Croy arbitrary waveform generator with a Hewlett-Packard 8591C spectrum analyzer using a K-31 digital power measurement option.

Running the tests takes a couple of hours and provides good insight into how a specific return optics combination performs and how much headroom you may need to establish. With this information, you can set up your equipment in a manner that assures good operation.

Note that I mentioned "return optics combination." The reason is that return receivers can be just as flaky as the return transmitter (if not worse). Recent work in one network found a return receiver that overloaded easily and, with a 1 dB increase in level, could be driven into composite triple beat (CTB) so badly that it was rendered unusable.

The system corrected for the problem in two ways. First, a 5 dB optical pad was installed in front of the return receiver; second, a very high value pad was installed at the RF input to the return laser transmitter. The effect was stunning. The use of both attenuators gave the optics combination a very tight 12 dB operational window at the laser input and a poor carrier-to-noise ratio (C/N) at the output of the return receiver.

The laser testing revealed that the optical attenuator was contributing more than just attenuation to the problem. The unit could not be mated and unmated reliably without severe deterioration to the network's operation. The problems were traced to a less than precise fit and optical return loss of the attenuator. Using a different optical attenuator by another manufacturer yielded about a 6 to 8 dB improvement in the RF input to the return laser. That provided a window of about 20 dB up from the original 12 dB.

The engineering lesson to be learned from this is: When return optical links average 1 dB to 3 dB and return lasers typically have a -3 dB output power, buy a return optical receiver that can handle -4 dBm input. Secondarily, make sure the RF portion of the receiver can handle the RF power being presented to it by the output of the optical receiver. In general, opt for a linear receiver and parameters based on video signals.

This example presented one more interesting phenomenon. The RF noise floor changed significantly depending on the optical attenuator used to cut the input power to the receiver. If you choose to attenuate in the optical path, make sure the unit you use has a very high optical return loss, probably in the range of greater than 50 dB. This observation also makes a case for the use of optical isolators on the output of the return transmitters. Yes, I am aware of the cost of optical attenuators/isolators. But this paper is about what improves headroom and makes a network operate better.

More work could be done to verify how network operation is affected by the proper use of added loss to the return optics paths. Testing has shown that these short optical paths in the return may affect the operation of the receiver and laser pair. Interestingly, testing done with a number of optics combinations suggests that overloading of the receiver may happen more often than previously realized. If you note unpredictable performance from the optics path, further investigation of the return receiver might be warranted.

CLI: Is it relevant to the return?

That is truly an interesting question. My stock answer is, "No, there is not a lot of correlation." However, a curious observation was made at some Road Runner locations. These locations have nearly zero ingress in the return portion of the band without high pass filters, equalizers or any other devices. This is a recent observation, but when looking at cumulative leakage index (CLI) flyover results for "clean" systems vs. systems requiring work in the return, a common thread emerges. Every one of the clean systems has on its flyover 99% of all leakage in the range of -6 dB to -20 dB at the flight altitude.

This means that the ground-based CLI ride readings are between 5 μV/m to 10 μV/m everywhere in the system, including all drops. The procedures require that all installation, service and supervisory personnel carry leakage detectors and check all drops at each visit.

As health professionals say to people who want to eat better and get in shape, "This is a lifestyle change." This is not a short-term procedure. You do not just slap on a detector and hope in the course of a month to have all your problems resolved. This is a staged process where the screws are tightened down on all leaks no matter how big or small.

Circumstantially, after having seen this success in handling leakage, I would agree that in these cases, lack of signal leakage is a good predictor of a clean return system.

That said, based on a small sample of data, if you are operating only to the Federal Communications Commission limit of 20 μV/m, the data from a flyover probably is not an adequate reference marker. You will need to study the individual breakdown of leaks measured. If 70% or fewer of your leaks are not in the lowest category, predicting the quality of the return probably is not accurate.

Note that this is only discussing flyover. I have not yet seen documentation on how ground-based measurements correlate. My guess would be that if you were doing leakage to 5 μV/m in the coaxial plant and all of the drop system, you would in fact have a clean return network. Keep in mind that this resolves static fixed frequency ingress. But it does not necessarily have any effect on impulse ingress, as evidenced by its presence.

Two questions to ponder are: "Can I make a lifestyle change and make it stick? Will I have the support I need and the manpower to do this job?" If you cannot answer affirmatively, you need to consider other options. ➤

So how should I proceed?

One process that has been successful is to amass all pertinent data on the equipment used in the network. In general, networks that operate well use lasers and receivers with specifications for video operation. When selecting units described as digital, be careful. You may get more than you wished for. That is not to say all units are problematic—they are not. But you need to do your homework.

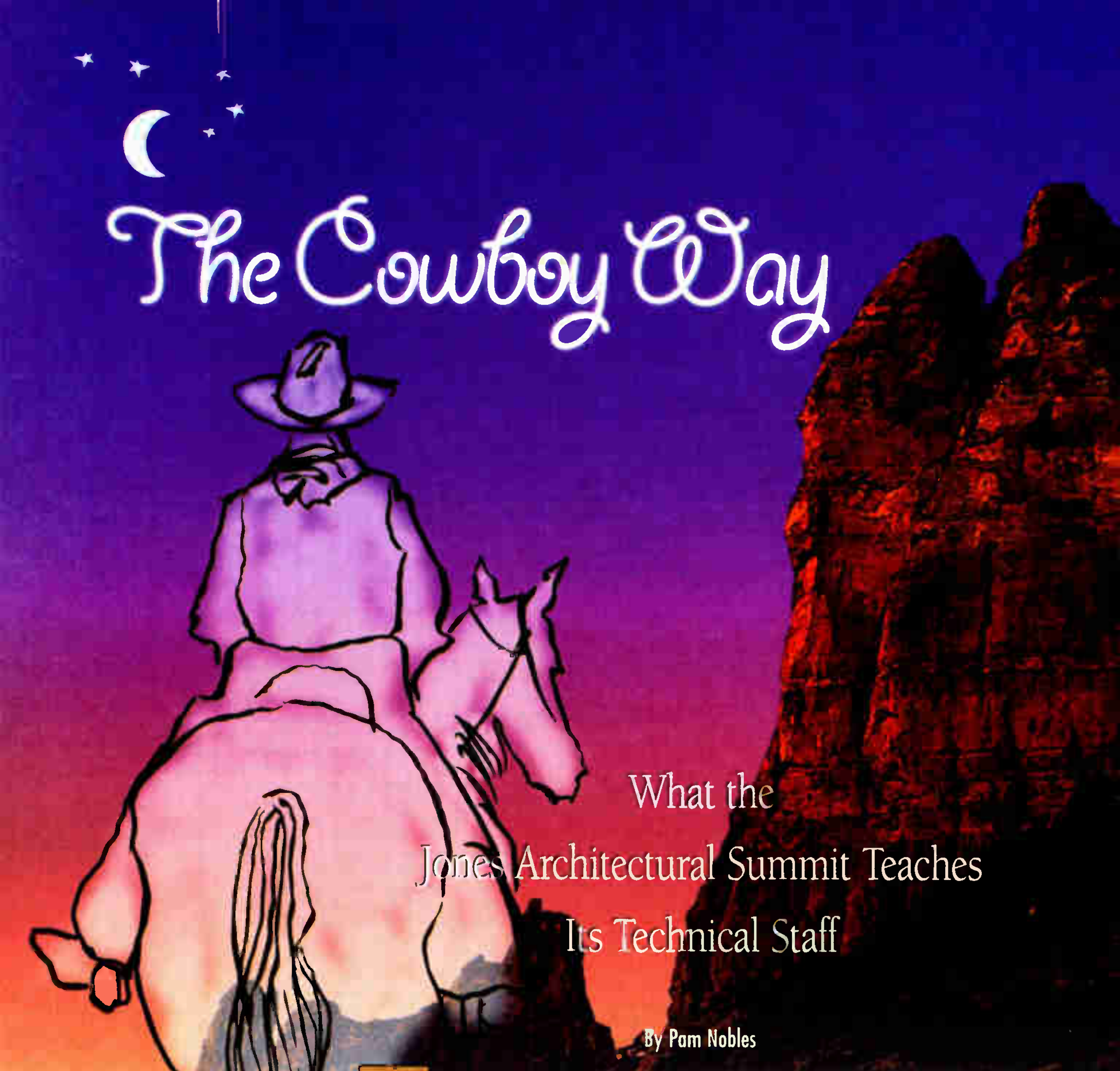
Select a level for use across the complete platform. Run the output of the receivers the same as the input to the laser. Make sure your receiver matches the operation of the laser you have chosen on your typical optics link so you do not overload it. If you must use optical attenuators, make sure they have a good optical return loss.

In the RF portion of the network, make sure you are fully aware of all internal amplifier losses to the input of the return amplifier. Balance for flat levels to the input of every return amplifier. Treat the signals as video signals and operate them in accordance with the established level set derived by performing laser operational tests. The laser testing should establish the video C/N point of 30 dB and the carrier-to-CTB point of 30 dB. Determine the extent of typical ingress in your network and apply a level back-off to accommodate what could be significant undesirable power in the network. At setup, target a receiver output C/N, referenced to video, of no less than 40 dB.

Resolve your ingress problems in whatever manner works best for your organization and personnel. If you can make the lifestyle change, do it. If you cannot, you have the options of total filtering, problem/partial filtering, spot problem correction or hoping for a modulation scheme so robust that you never have to worry about the return at all. If you choose the last one, I'd like to talk to you about a bridge I have for sale. CT

This article was adapted from a technical paper presented at the Society of Cable Telecommunications Engineers Cable-Tec Expo '97.

Thomas Stanicc of Time Warner can be reached at (315) 433-5222.

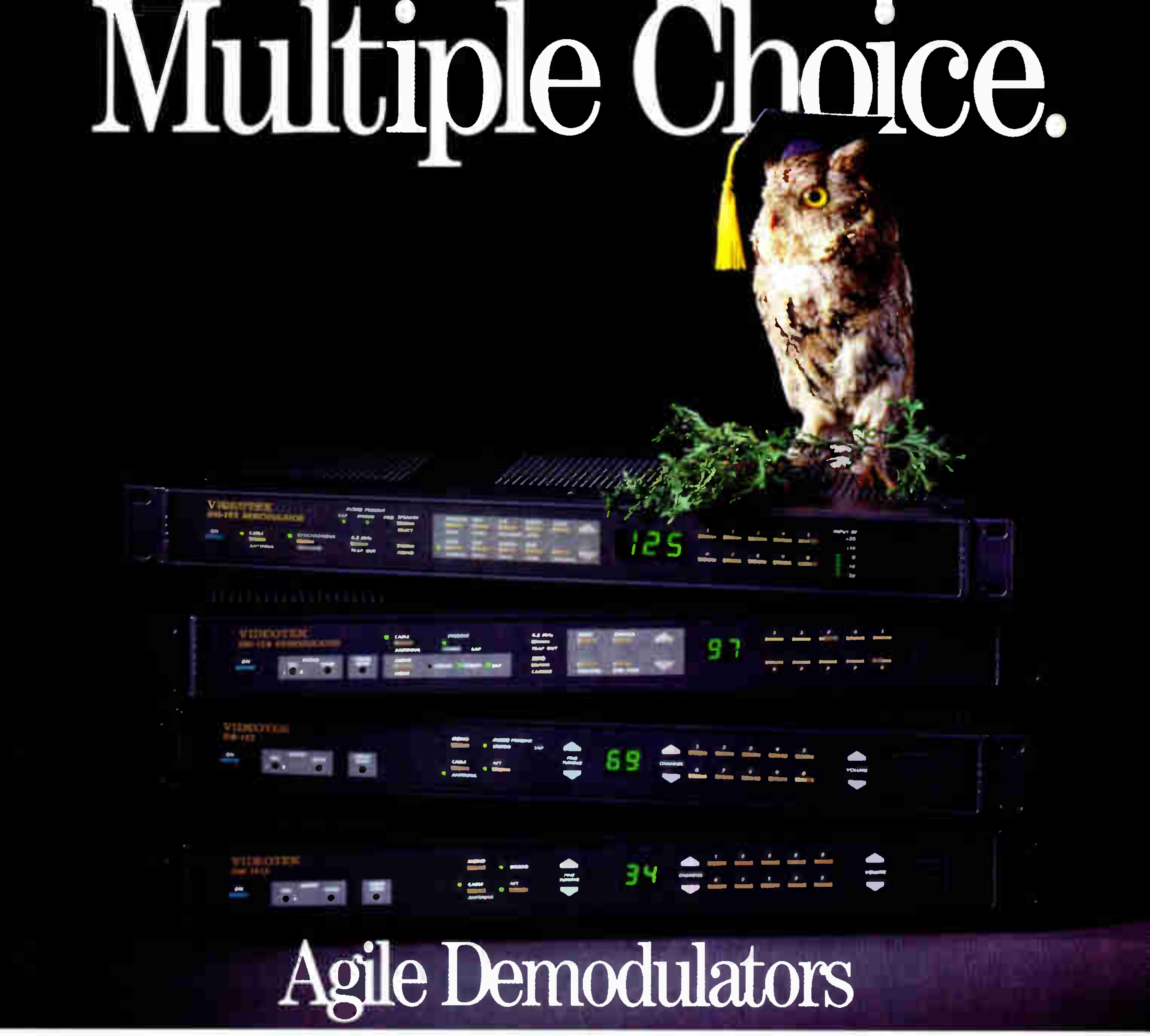


The Cowboy Way

What the Jones Architectural Summit Teaches Its Technical Staff

By Pam Nobles

The last particles of sunlight danced on the horizon. "Home on the Range" drifted sweetly over the hills and through the ravines. A small twist of smoke from his campfire seemed to intertwine with the harmonica's notes as the breeze carried them both. The cowboy looked out over his cattle, all resting peacefully. Yes, he was alone out here on the range—but not really. He had a whole company behind him—setting the direction on his compass. He knew where he was going and what it would look like when he got there. It was up to him to determine the specific path to his destination.



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The cowboy theme is appropriate for this year's Architectural Summit, since we will kick off our second annual summit on June 7 in "cow town" Denver three days prior to the Society of Cable Telecommunications Engineers Cable-Tec Expo. It also is appropriate to compare our engineers to cowboys. They both work alone, are autonomous and are their own bosses. Jones Intercable's corporate Technical Operations group sets the "guardrails" and points the direction.

As our strategic direction moves us from limited partnerships to company-owned properties, the operating systems need to embrace the reality that they are not "islands." The big picture includes more standards and more direction—we continue to balance unique solutions with proven best practices or standards.

Jones' engineers and managers will benefit from three summit themes:
1) Share lessons learned
2) Set company direction
3) Promote company philosophy

Share lessons learned

The purpose of the Architectural Summit is to share the lessons Jones Intercable associates have learned and provide a path to implementation. Sharing lessons learned always has been practiced at Jones, and we will continue to formalize this process.

Originally called Architectural Summit because of the communication of the company's architectural standards, this year we will include Technical Operations' updates, since much of what we learned last year now is "business as usual." A major component introduced last year was the company's construction standards and contract labor request for proposal (RFP) procedures. We will examine the major construction projects in progress and discuss what this investment means. We'll review our risks as a corporation, specifically with respect to committed construction in progress. The "on-time, on-budget, as designed" financial project tracking process was developed to track this risk and will be introduced at the summit. This process was developed and piloted with the aid of our system project managers and will receive the "final blessing" at this meeting.

We'll revisit our architectural philosophy, and update our definition of what a "Full-Service Network" means to Jones and our rebuild/retrofit migration philosophy. Systems will share "war stories" of lessons learned and look for common themes. For example, if mapping consistently holds up construction progress, what might we do about it?

With the advent of major construction projects comes the concern for the safety of our contractors. Part of our responsibility is bridging the gap between the project

BOTTOM LINE

An Architectural Roundup

Each year, Jones Intercable's Technical Operations Group meets to discuss the technology of the day and how to incorporate it into the company's routine operations. It's a "How are we doing?" reality check that enables Jones' technical staff to consistently provide cutting-edge service to its customers, and to motivate employees to deliver their best.

The 1998 Jones Intercable Architectural Summit will be held this year in Denver three days prior to the Society of Cable Telecommunications Engineers Cable-Tec Expo.

Jones engineers and managers participating in the summit will benefit from three themes:

- Share lessons learned: The purpose of the Architectural Summit is to share the lessons Jones Intercable associates have learned and provide a path to implementation.
- Set company direction: One day is devoted to new architecture for Jones and to introduce the company's return path strategy.
- Promote company philosophy: The Summit provides an opportunity to strengthen the values by which Jones operates, which are made stronger through face-to-face interactions.

managers and the systems' safety managers. What exactly is the safety managers' role in large construction projects? How do they balance this with their already full plate of safety issues? In partnership, we will determine this and communicate and implement the necessary processes.

"Deliverables" continue to be important—we're not just spouting philosophy, but are equipping our engineers with the tools for successful implementation.

> "Innovation and creativity always have been a source of pride for the cable industry—we strive to leverage this in our associates."

Set company direction

We will devote one day to new architecture for Jones, and introduce the company's direction for return path with respect to design, implementation (construction) and operations. Lessons learned continue to include research that the corporate network management group has sponsored.

Promote company philosophy

The Summit also provides an opportunity to strengthen the values by which Jones operates, which are made stronger through face-to-face interactions. All associates, existing and new, need to be aligned with the company's overall culture and philosophy. Innovation and creativity always have been a source of pride for the cable industry—we strive to leverage this in our associates.

Philosophy and stories: To know where we are going, we need a starting point. Stories provide the initial vision, create this common experience, and give us all something in which to believe. Sharing the stories of successes and failures is a theme woven throughout the Summit. Jones continues to use "storytellers" to keep the culture alive, to develop and tell our own success stories and, in this way, continue to pass on lessons learned.

Philosophy and the development of leaders: We recognize at Jones that people are more than company assets. They are unique, emotional, creative individuals, needing relationships, all with their own gifts, all wanting to have purpose in their lives. A leader's goal is to create an environment that allows associates to flourish, one that allows us all to use our unique gifts.

Leaders lead by creating an environment of self-management, where motivation factors—achievement, recognition, challenging work, responsibility and growth—are intrinsic to a job. Leaders instill a sense of significance, an experience of equality, a contagious enthusiasm, a commitment to growth and a unifying passion. Leaders create a vision to be shared. Shared ideas and beliefs become duties to which people willingly respond. This is the type of environment we strive to create at the Architectural Summit and throughout Jones. Remember, it's people, not technologies, that get the job done.

We have found others within the industry willing to share with us, and we appreciate their openness. We will continue to share conclusions with the industry through papers and magazine articles in *Communications Technology*. Each topic will be covered in enough detail so application of what is learned is immediate.

So, share some lessons with someone this week. And, if you're attending the Cable-Tec Expo, don't be surprised if you see one of those bandanna-wearing, harmonica-playing engineers from Jones Intercable out sharing as well. CT

Pam Nobles is manager of technical development for Jones Intercable. She can be reached at (303) 792-3111.

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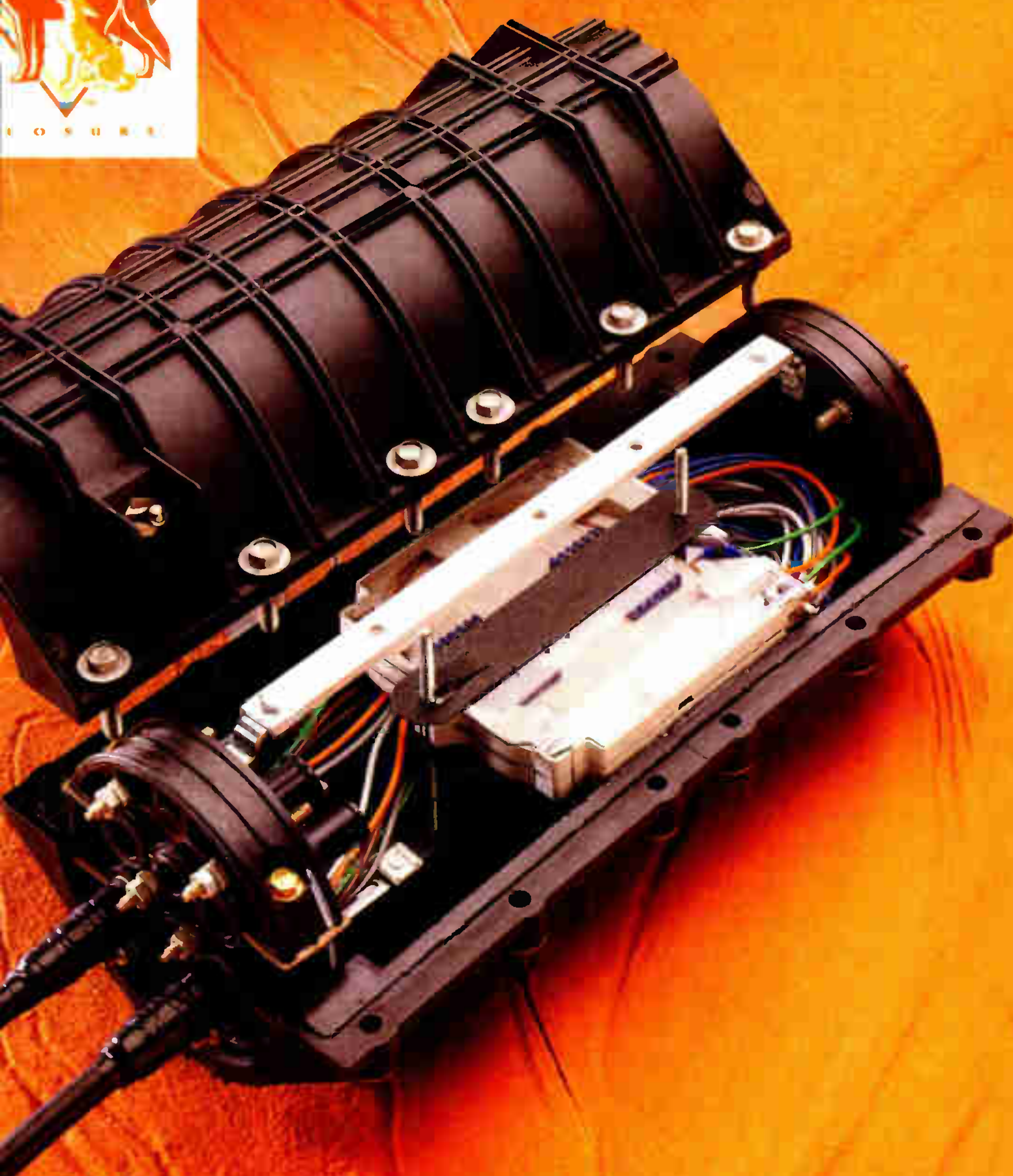

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Reader Service Number 82

Test Your Return

Six Questions for a Tighter Reverse Path

By Dan Kahn

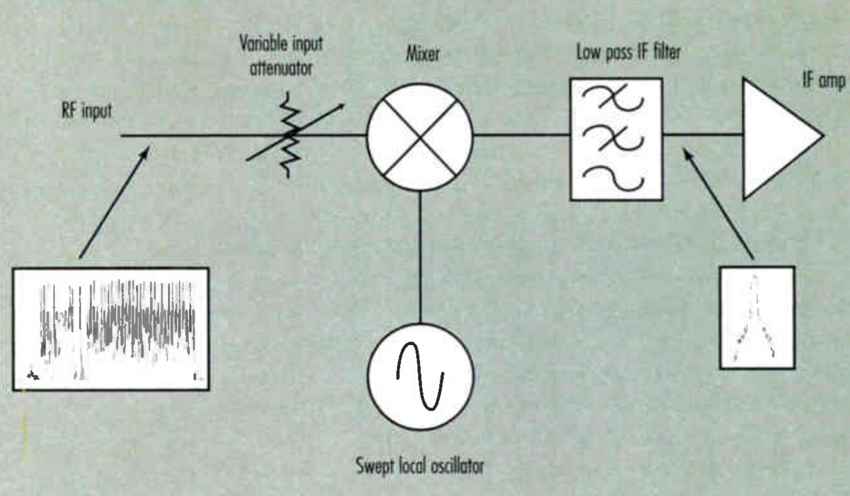
The topic of return path testing invariably calls up a number of questions, particularly related to how this testing compares to the forward path. This article discusses some of the most frequently asked questions raised when engineers work on the return.

1 *When using a spectrum analyzer, why do I need to filter out the forward path signals when measuring return path noise?*

To answer this question, let's look at the front end of a spectrum analyzer and see why this happens. (See Figure 1.) The first thing the RF signal sees when it enters the analyzer is a variable attenuator followed by a broadband mixer. The local oscillator, which drives the mixer, is swept between the limits set by the start/stop frequency parameters. Since any band-limiting devices are after the mixer, all the energy entering the analyzer hits this first mixer. This mixer has a limited dynamic range, and the amplitude of the forward path carriers may be as much as 40 dB higher than the noise being measured at the return path test point.

Since the analyzer input attenuator is set low for noise measurements, the forward path carriers may overdrive the mixer, causing distortion in the analyzer. An ideal return path test point would have perfect isolation from the forward path signals, but this is not the case in the real world. To eliminate this potential distortion, install a low pass filter covering the frequency band of your return path before the input to the analyzer prior to making the noise measurement. A diplexer with the forward path side terminated works well for this in a crunch. ➤

Figure 1: Spectrum analyzer front end



Reader Service Number 83

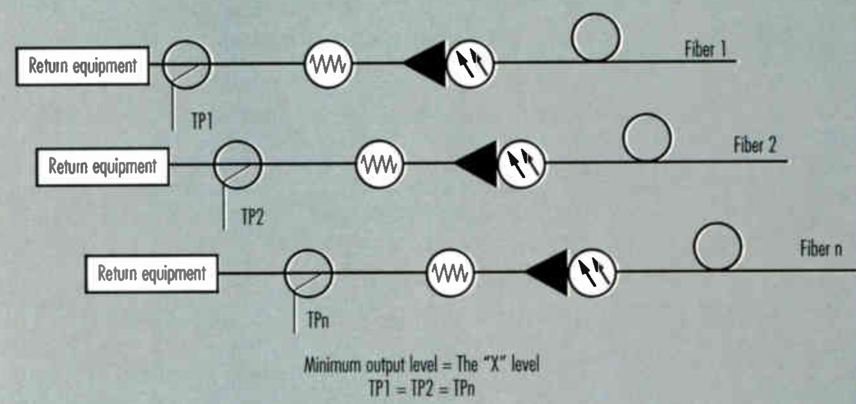
What is return loss, and how does it affect performance?

Return loss is the amount of power reflected from a mismatched load relative to the amount of power delivered. The ratio is expressed in dB, with a value of 0 dB equal to 100 percent reflection and a high value indicating a well-matched load. A return loss of 30 dB means 0.001% of the power is reflected by the load back to the source. With this small amount of power being reflected, the source and load are considered well-matched.

Reflected power will add to and subtract from the incident power, thus changing the incident amplitude as a function of the distance between the source and load. The term "standing wave" refers to the changes in amplitude due to a mismatched source and load impedance. Both the source and the load experience return loss. There also will be reflections from a mismatch in source impedance. These reflections repeat until the amplitude of the reflection is so small that it is of no consequence.

Return loss, or the reflected power from a mismatch not only has varying amplitude; it also has a varying phase that changes over transmission distance. In an analog video signal, phase and amplitude variations change the hue and the saturation of the color signal as well as the RF carrier level. Since digital information is both

Figure 2: Determining the "X" value



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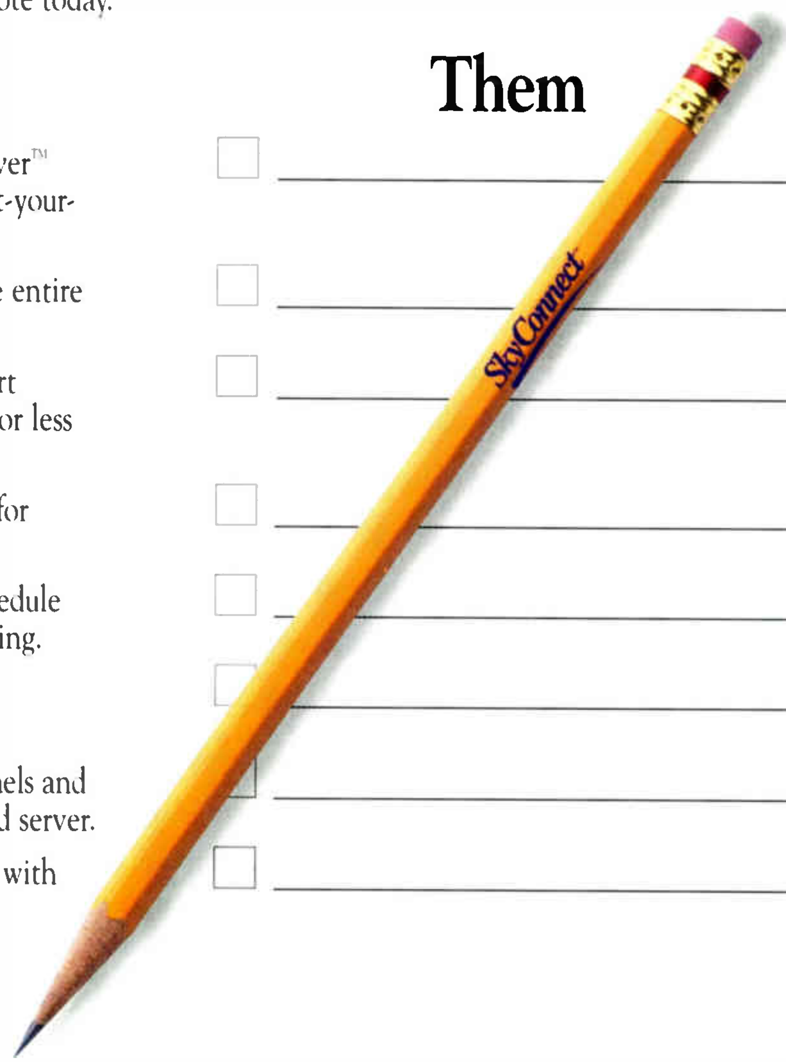

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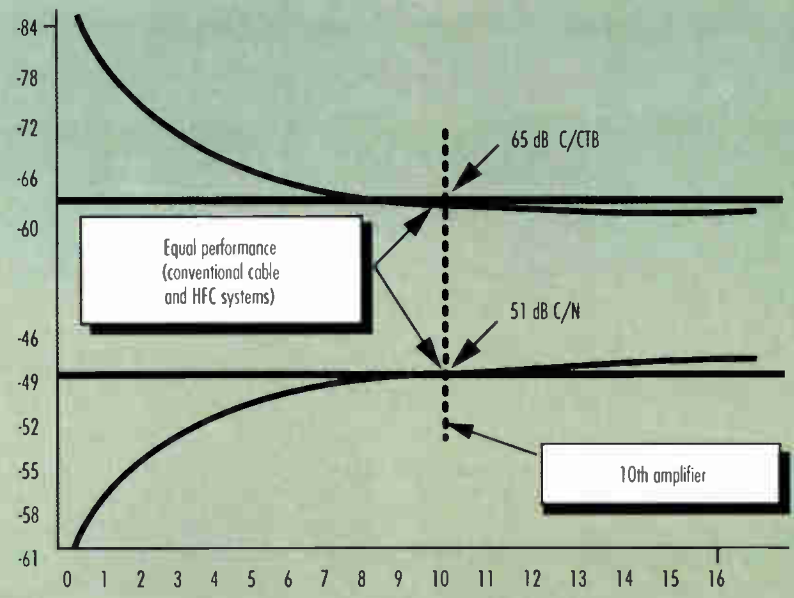
Reader Service Number 86

amplitude and phase modulated, any variations caused by mismatches will have an effect on the reception of the correct information. This is the reason the Multimedia Cable Network System (MCNS) modem has a specified input return loss of greater than 6 dB. The better the match, the fewer problems you will have with data, and the better your operating margins will be.

3 *How do I find the "X" value when balancing the return path?*

The first concept you must understand has to do with the reverse active node. Each manufacturer has a recommended power level that must be supplied to the amplifier feeding the laser for best carrier-to-noise ratio (C/N) versus distortion/clipping performance. This varies among suppliers and their models. Most test equipment manufacturers recommend aligning the return path with a signal at least 10 dB below this level to prevent any additional load on the lasers.

Figure 3: Carson Curve



Once this alignment power level is determined, the internal losses between the amplifier and the return path alignment injection point must be calculated

These two values determine the proper level to be injected into the return path test point for alignment. This is not the "X" value since we do not know the loss from the node to the headend. A measurement of the RF power out of the optical receiver (See Figure 2 on page 132.) is the first step in determining the "X" value.

A note on measurement technique: It is a good idea to check the optical power that feeds the receiver to assure the path loss is within the design specification. If the power is too low or too high, the receiver may not be operating in its linear region. The receiver supplier will specify the required power and limits into the device. This must be

BOTTOM LINE

Return Path Questions Answered

Why filter out forward path signals when measuring return path noise? Since the input attenuator on a spectrum analyzer is set low for noise measurements, the forward path carriers may overdrive the mixer, causing distortion in the analyzer.

What is return loss, and how does it affect performance? Return loss is the power reflected from a mismatched load relative to the power delivered. Reflected power from a mismatch has varying amplitude and varying phase. Since digital information is both amplitude and phase modulated, any variations will affect reception.

How do I find the "X" value when balancing the return? Measure each of the return receivers and record the output power when the proper alignment signal is inserted at the optical node. The lowest level of all the measured outputs becomes the "X" value.

How can I sweep through active digital carriers and not cause interference? If the duration of the swept carrier is short enough, the impact on the transmitted data will be negligible. Some data may be lost if the TDMA carrier is on during the sweep pulse, but interleaving lets it be saved.

Why do I still need sweep alignment when there are only five amps in my cascade? The flatness performance of the optical portion of the plant acts like the first 10 amplifiers in an all-coaxial network. The last five amps still require good alignment to provide the best performance to the subscriber.

Why is automatic gain control (AGC) not used in the return path? It would require a pilot carrier from the last sub of each leg in the plant. Also, the actives would need the electronics to use the pilot carrier to control the AGC. Lastly, the basic level control of return carriers, including the MCNS cable modem, would make it difficult.

done before attempting to align the coaxial portion of the plant.

Measure each of the return receivers and record the output power when the proper alignment signal is inserted at the optical node. The lowest level of all the measured outputs becomes the "X" value. To arrive at this level, each of the higher level outputs should be adjusted to the "X" value, either by adjusting the output level, if this adjustment is available, or by adding inline attenuation. The goal is to have all inputs to the combining network at or close to the same level.

As each return amplifier is aligned, moving toward the subscriber, the pad and equalizer of each return amplifier is adjusted to re-establish the "X" at the headend.

"An ideal return path test point would have perfect isolation from the forward path signals, but this is not the case in the real world."

Reader Service Number 90

4 *How can I sweep through active digital carriers in the return path and not cause interference?*

Forward and reverse data information is very fragile, and some people are concerned that the alignment and test of active carriers will cause interference. If the duration of the swept carrier is short enough, the impact on the transmitted data will be negligible.

Does this mean that there is no effect on the digital information with small pulse duration? Absolutely not. Some data bits may be lost if the time division multiple access (TDMA) carrier happens to be on during the sweep pulse, but the data interleaving built into the data transmission protocol allows these lost bits to be reconstructed, preventing loss of service.

When the pulse duration becomes a significant part of the data frame size, this correction is impossible. If the pulse duration is in the millisecond region, the correction mechanisms cannot recover the loss of data. If there are specific carriers that may be affected, no matter how small the pulse duration, then placing a guard band around them will prevent any sweep at those selected frequencies.

5 *Why do I still need sweep alignment when there are only five amplifiers in my cascade?*

This seems like a valid question since the amplifiers are flat and there are so few of them. The problem is that the flatness performance of the optical portion of the plant acts like the first 10 amplifiers in an all-coaxial network. (See Figure 3 on page 134.) Therefore, these last five amplifiers still require good alignment to provide the best performance possible to the subscriber. This is more thoroughly discussed in "Sweep Testing for Improved System Operations," a paper presented at the 1995 Society of Cable Telecommunications Engineers Cable-Tec Expo by Syd Fluck and Jerry Green.

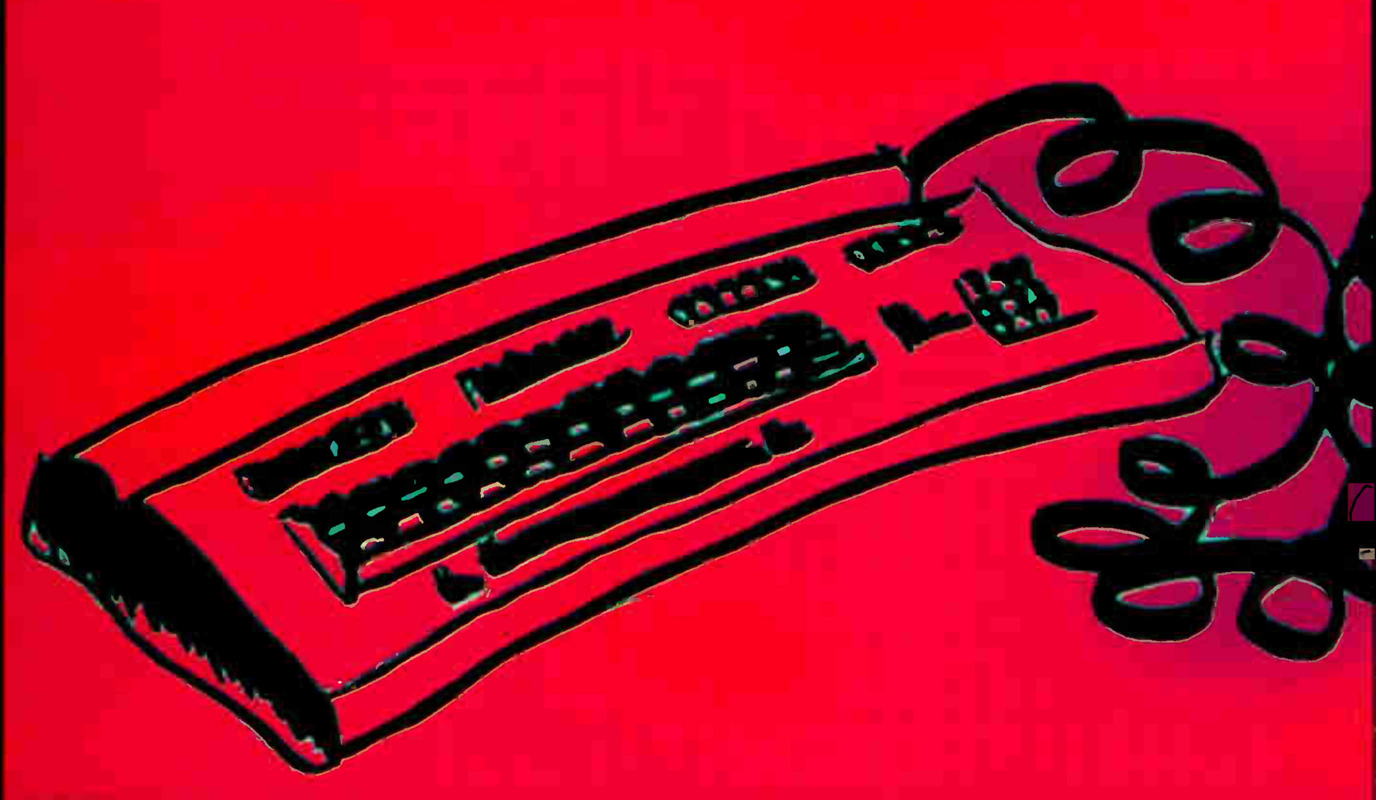
6 Why is *automatic gain control* (AGC) *not used in the return path?*

First, AGC in the return path would require a pilot carrier from the last sub of each leg in the plant. Second, the actives would have to have the electronics to utilize this pilot carrier to control the AGC. In addition to these two reasons, the basic level control of return carriers, including the MCNS cable modem, would make it difficult. A level control called "Long Loop AGC" is used to control the output power of the modems. The headend controller commands the modem to adjust its power level to be within specified limits. If the actives enabled AGC, the potential would exist for these two control loops to fight each other. CT

> "Most test equipment manufacturers recommend aligning the return path with a signal at least 10 dB below this level to prevent any additional load on the lasers."

Dan Kahn is a solutions architect for cable TV applications with Hewlett-Packard and is based in Newfoundland, PA. He can reached at dan_kahn@hp.com or (800) 477-6111 ext. 5651.

IP Telephony Over Cable— The Logical Solution



By André J. Danis

Cable companies are overwhelmed by the plethora of new service possibilities facing them today, but telephony services likely will be in the forefront. It is expected that the cable industry could be offering local telephony services later this year, with service expanding to residential areas in 1999.

Why telephony? Telephones are ubiquitous, and the business of carrying voice represents tens of billions of dollars a year. But the main reason that cable companies will enter the telephony business will be to effectively compete with the service offerings of the telephone companies, who soon will be offering broadcast services to their base of customers.

How do you provide telephony over cable? There are a number of options. The first choice would be through fiber directly into the home. A second route would be through frequency translation devices, which pick a frequency channel as a return path over cable.

The option of choice, however, would be Internet protocol (IP) technology, which would bypass many of the costs and make use of an already existing infrastructure. If a cable company offers IP telephony over cable, it would be able to offer more services than just voice and fax—including high-speed Internet service, e-mail and so forth. Furthermore, IP quickly is being recognized as the *de facto* transmission protocol. Millions of users currently surf the Internet on a regular basis and enjoy the benefits of IP. As a packet-based protocol, IP facilitates the convergence of voice and data and enables the maximization of all multimedia.

Telco limitations

The phone network has evolved very little over the past 100 years. The subscriber local loop consists of two-wire copper feeds that carry a 3 kHz voice band. As changes have occurred and new telephone services have been implemented over time, the 3 kHz voice band has not varied. In contrast, cable networks have the capacity to deliver substantial bandwidth to the subscriber via a coax infrastructure. Whereas analog modems operate at speeds below 100 kbps, because the transmission occurs over a copper pair, a coax cable terminating with a cable modem easily can accommodate speeds of 10 Mbps or faster.

Capable of transmitting several Mbps in either direction, a cable modem is not restricted by the inconsistent nature of copper cable when faced with delivering real-time multimedia such as voice. A cable modem can carry voice effectively at high speeds over long local loops. The modem's physical interface to the customer premises equipment consists of an Ethernet connection, making personal computer (PC) interaction with the network simple and straightforward.

A standard analog telephone does not interface to 10BaseT or transmission control protocol/Internet protocol (TCP/IP). Despite technical evolution, the telephone still is omnipresent in the telephony world. It is available worldwide, is easy to use, and most importantly, customers feel a certain familiarity with the telephone that they don't with new competing technologies. People have invested in their telephones and are—today—reluctant to give them up.

Gear considerations

Because consumers are reluctant to abandon their comfortable traditional phones, cable companies must be prepared to offer new telephony service using existing home equipment. Companies today are developing analog telephone

BOTTOM LINE

Use IP for Telephony

Cable is growing daily. Deregulation and new infrastructures let cable compete with traditional telephony carriers. While telcos struggle with recurring bandwidth problems, cable companies see telephony differently.

Why telephony? Telephones are ubiquitous, and the business represents tens of billions of dollars a year. Mainly, though, cable companies will offer telephony to compete with telcos who offer broadcast service.

IP works well. When running telephony over cable, the option of choice is Internet protocol (IP) technology, which bypasses many costs and uses existing infrastructure. By offering IP telephony, a cable company can offer more than just voice and fax—including high-speed Internet service, e-mail and so on. Further, IP is becoming *the* transmission protocol. As a packet-based protocol, IP facilitates the convergence of voice and data and helps maximize all multimedia.

Fewer constraints. Cable networks lack many technical constraints faced by telcos. Hybrid fiber/coax (HFC) infrastructure makes high-quality voice carriage possible, and the cable industry is expected to deploy telephony soon. With potential for high speed, multiple channels and ample bandwidth, telephony over cable likely will prosper. The most efficient transport method is IP, which could help provide quality value-added services.

adapters to allow a plain old telephone to communicate with an IP network. These new devices convert the analog signals from the telephone into IP packets and transmit the packets to the cable modem via Ethernet. In addition, some of these devices provide multi-line capability.

Some companies also are developing IP telephones that connect directly to cable modems. As Ethernet becomes more affordable, these types of devices will become more economical, and their inherent strengths will take center stage. These strengths include centralized applications and applets, including directories such as the yellow pages, advanced features such as automatic call distribution, or full-blown feature bundles for general business usage. At this point, IP telephones and the servers that bring them to life will be marginalized to the business world, competing with more rigid and less compelling services such as Centrex.

IP phones could open up numerous new opportunities for cable companies. Physically, an IP phone would not be constrained by elements such as the dial pad. Tomorrow's phone will browse, surf and talk in a way that is technically unique compared to current applications, allowing cable companies to establish their own communications signatures, as the telephone company did with the analog phone.

> "The cable network is not bound by many of the technical constraints of the public switched telephone network (PSTN)."

Operating environment

The public telephone network represents the ultimate client-server environment. A telephone company has centralized equipment that sends signals out to other facilities, which in turn reach customers. The telco central offices act as physical hubs that terminate cable from the customers' premises and interconnect with other offices. This network-centric approach has served the phone industry well but may not benefit the cable world. For the cable structure to evolve into a scalable, multi-purpose carrier network, operators will need to develop a distributed server environment, rather than replicating the hierarchical toll network that exists today.

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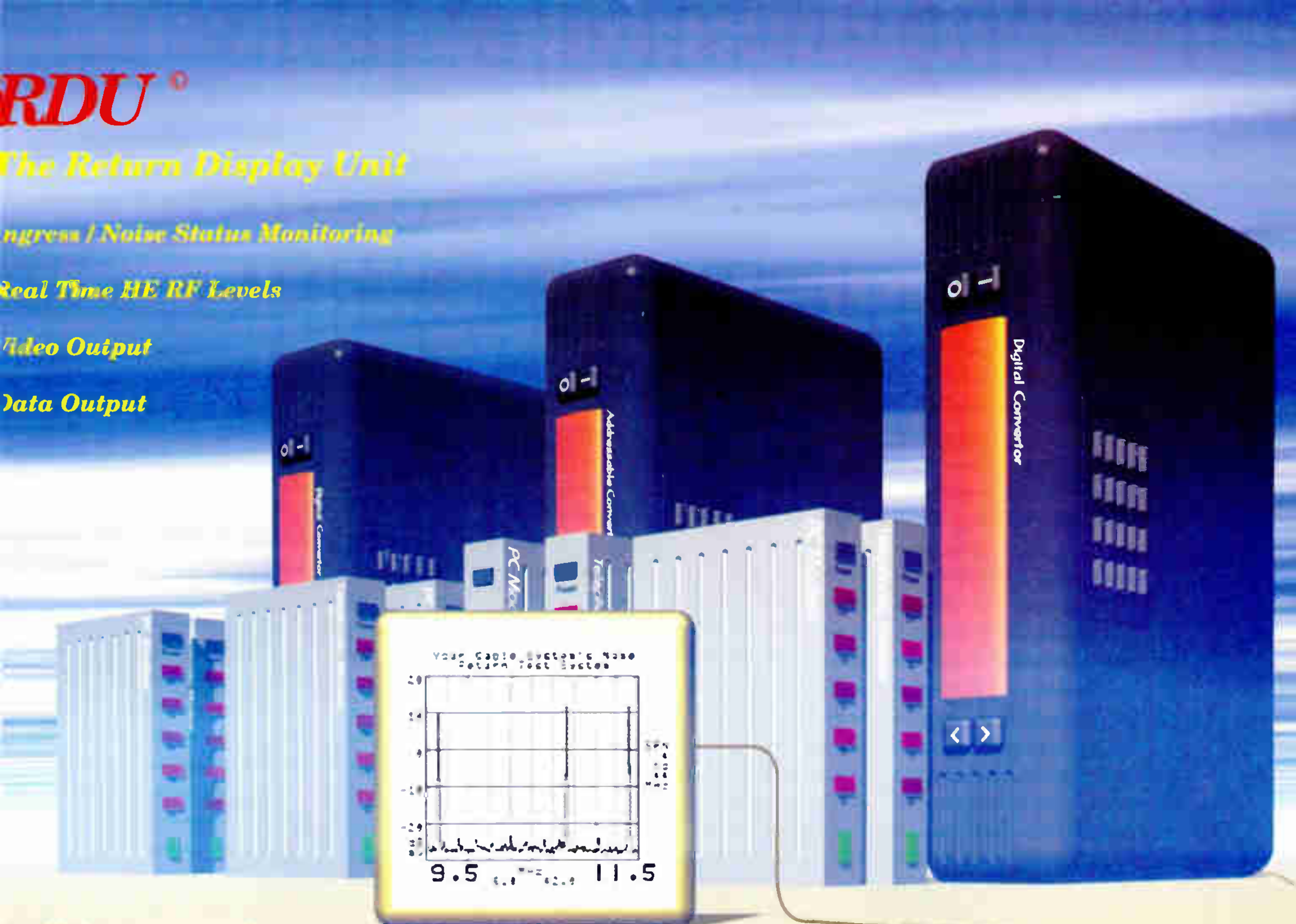

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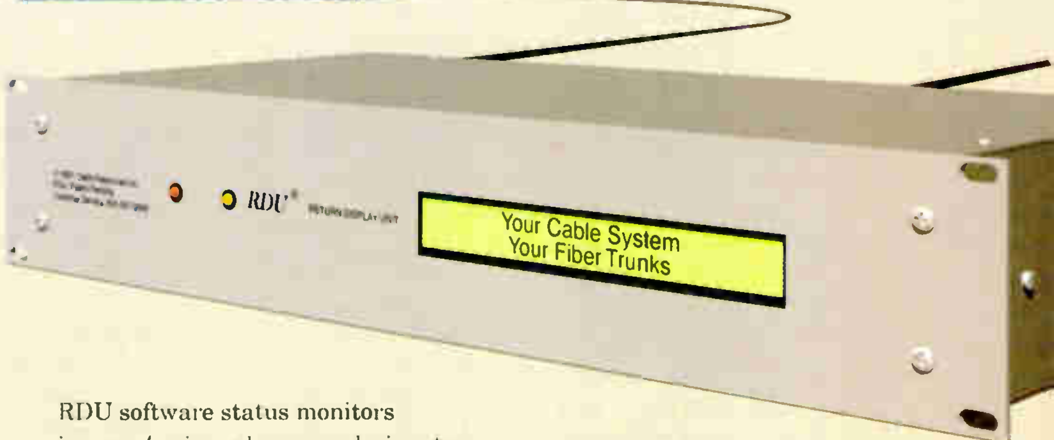

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Voice services are being carried over IP networks today. A question still to be addressed is whether services can be delivered while maintaining quality of service. To develop a resilient, scalable network that can achieve toll-quality service, a number of competing standards must be considered. These standards address voice compression, bandwidth reservation, interoperability, network signaling and a number of other elements. While some of these standards still are in the evolutionary stages, they nonetheless are important and deployable in today's networks.

In the future, customers ultimately will have to contend with two distinct networks delivering voice services: the cable network and the public switched telephone network (PSTN). IP/PSTN gateways provide a link to the PSTN from IP networks by converting analog, T1 and integrated services digital network (ISDN) traffic to IP and vice versa.

Unlike servers, which are based on the network, gateways reside throughout geographic locations, ready to process traffic at local and regional levels. The gateway's success resides in its ability to provide a link to the PSTN at the local loop's level, such that calls originating from one area can be transported over the cable network to another destination. This method of toll bypass has become an industry unto itself, with numerous service providers offering this alternative calling method to customers worldwide.

The cable network is not bound by many of the technical constraints of the PSTN. Cable companies are about to prove their ability to deliver toll-quality voice over a hybrid fiber/coax (HFC) infrastructure. The cable industry is expected to start deploying telephony services quickly. With the potential for faster speeds, multiple channels and ample bandwidth, it seems inevitable that telephony over cable will prosper. The most efficient transport method obviously is IP, which would open a number of doors in the provision of quality, value-added services. CT

André Danis is director of business development for Vienna Systems Corp. and can be reached via e-mail at adanis@viennasys.com.

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Lower Your HFC Upgrade Costs

Heterojunctive Amps Eliminate Actives, Cut Power Demands

By Chris Day

To be successful in the ongoing contest for delivery of cost-effective information services to the home, hybrid fiber/coax (HFC) operators will need to successfully manage the total costs of upgrading their networks.

Some of these costs include:

- New forward and reverse opto-electronics and RF electronics
- Fiber installation
- New powering architectures to handle increased consumption

Now more than ever, customers expect networks to provide near-perfect uptime with no disruption of fragile digital content. This necessitates upgraded powering architectures with uninterruptible power (UPS) and standby supplies.

When considering the cost of upgrading network power designs to provide these improvements, it is easy to overlook the fact that the most direct way of minimizing these costs is to reduce the consumption requirements of the active hardware.

For example, more efficient amplifiers would allow power supplies and their backups to be smaller, cost less and be easier to install at central locations.

Drop-in upgrading of actives (with minimal resplicing) would be more plausible, since incremental loading from return path activation is offset by lower consumption in the forward electronics. This would help alleviate the often troublesome task of obtaining local government approval for new power supply locations. If needed, any new power supply enclosures would be smaller and easier to locate. System downtime during upgrades also would be minimized.

Alternatively, lower consumption in the actives could be used to extend the backup run-time of the system—without resorting to larger capacity batteries and generators. In this case, network uptime and customer satisfaction would be improved.

Improvements in the efficiency of the actives would provide the system designer valuable degrees of freedom, which could be put to use a number of ways depending on the particular network. Whatever the situation, reduced consumption would directly provide much-needed flexibility to cost-effectively upgrade the network.

High-performance heterojunction devices

Fortunately, a family of next-generation device technologies now is available, which reduces the power consumption in forward path amplifiers by more than 50%. These devices originally were developed for wireless applications where high efficiency is critical for prolonged battery life.

The common trait of all the devices in this family is that they each use heterojunction in the active structure. In simple terms, a heterojunction is a diode formed by bringing together "n" and "p" type materials, where the intrinsic materials are different. The heterojunction can be applied to bipolar transistors to make heterojunction bipolar transistors (HBTs), or to field-effect devices to make pseudomorphic high electron mobility transistors (PHEMTs).

Other device constructions utilizing

BOTTOM LINE

A New Take on Amps: Heterojunction

To compete on a level playing field with alternate delivery technologies, hybrid fiber/coax (HFC) operators will need to enlist the capabilities of an emerging family of semiconductor devices known as heterojunction amplifiers.

Amplifiers based on new heterojunction devices have demonstrated the ability to reduce the power consumption in forward path amplifiers by as much as 50%, while offering increased RF output levels.

This combination of a reduction in power consumption and an increase in RF output level means system architects will face a much easier task in upgrading their networks to have both battery backed-up power and return-path capability. Power supply locations are more easily centralized, and potentially fewer actives will be needed since each amplifier can output higher signal levels.

In short, amplifier designs based on next-generation heterojunction devices will enable HFC operators to spend less on system upgrades and to compete on an even playing field against alternate delivery systems.

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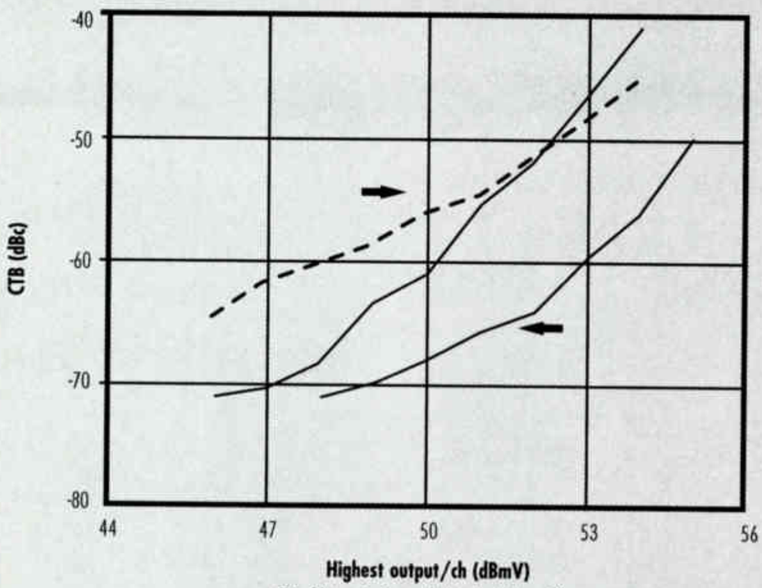
Comparative CTB of silicon power hybrid doubler with two heterojunction amplifiers.



CTB of heterojunction and silicon hybrid amplifiers
(110 channels NTSC with 10 dB slope)

one or more heterojunctions also are possible. Invariably, what results are devices with major advantages over their older silicon bipolar and gallium arsenide metal semiconductor field effect transistor (GaAs MESFET) counterparts including:

- Improved high-frequency response
- Higher gain
- Lower noise
- Better linearity
- Higher efficiency

Recently, there has been interest in using GaAs MESFET devices in cable TV amplifiers. GaAs MESFET devices have been successful in microwave and wireless applications for quite some time and generally are regarded as a baseline technology. However, the next step forward in device technology currently is taking place with heterojunction devices.

An increasing number of reputable companies is offering discrete and RFIC products based on heterojunction devices. Additionally, other companies now provide a full range of foundry services to outside customers. The size of this investment by microwave semiconductor companies is evidence that heterojunction devices are viewed as the technology of choice in performance applications.

It's often said that heterojunction devices are more expensive than older device technologies. In HFC applications, however, the savings in direct utility power costs alone easily will pay back this small difference in a very short period of time. These operating cost savings are in addition to the described savings in upgrading costs.

> "Now more than ever, customers expect networks to provide near-perfect uptime with no disruption of fragile digital content."

It's also sometimes believed that heterojunction devices are not reliable. While early reliability studies showed poor results, many fabricators have fixed the problems and now demonstrate solid reliability. Many types of heterojunction devices currently are being shipped in large volumes into a number of critical wireless applications where their superior performance often provides a decisive advantage.

Designing with heterojunction devices

The same characteristics that make heterojunction devices so attractive in wireless applications also can be put to work in numerous HFC applications. The improved gain-bandwidth of these devices provides the amplifier component designer valuable latitude, making it possible to employ amplifier topologies not feasible with older devices.

The most obvious application for these devices is the familiar cable TV output hybrid amplifier. The accompanying figure compares the composite triple beat (CTB) performance of two prototype heterojunction output hybrid amplifiers with that of a familiar silicon power hybrid doubler (PHD). Even though the two heterojunction amplifiers consume 50% and 25% less power, for a -65 dBc CTB budget they respectively provide 2 dB and 4 dB higher RF output level than the silicon PHD.

Both heterojunction amplifiers have higher gain than the silicon PHD; flatness, noise and match are similar. By scaling the device sizes, similar power savings can be achieved in input (push-pull) hybrid amplifiers. These results demonstrate the ability of heterojunction devices to cut the power consumption of all forward path amplifiers by more than one-half while at the same time providing for an increase in output level.

Higher output capability also can be used to lower the cost of upgrading. Depending on the particular system, higher output amplifiers make it possible to eliminate some active elements altogether, resulting in a direct savings in capital costs. Alternatively, the improved output performance provides valuable margin in the noise/distortion budget, which can be used to ease the requirements on other parts of the system, such as the optical link. In either instance, the cost of upgrading is reduced. CT

Chris Day is president of Linear Circuit Innovations Inc. in Santa Rosa, CA. He can be reached at (707) 579 2676 or at cbday@sonic.net.

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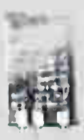

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CableLabs Turns 10

A look back

By Robert Wells

Richard Leghorn

Today, CableLabs is a high-profile player in the cable/computer communications scene with Data Over Cable Service Interface Specification (DOCSIS), its PacketCable program, OpenCable (its digital set-top initiative) and its high-speed data project.

Many who are affected directly by these current activities, cable engineers, technicians, and vendors—allies and competitors—know little of what CableLabs' founders envisioned when they formed the organization 10 years ago.

Hindsight reveals the set of guiding principles behind the concept that drives the organization today and focuses on one man, Richard S. Leghorn.

In 1984, Leghorn first articulated the need for a cable research and development consortium and defined the core principles that continue to drive CableLabs today.

"If CableLabs has a George Washington, it's Dick Leghorn, who was CableLabs' first president during its organizational phase," says Tom Elliot, the veteran Tele-Communications Inc. technology executive who was CableLabs' first visiting executive and today is its senior vice president of technical projects.

Leghorn's distinguished career includes pivotal roles in high-stakes U.S. Air Force programs such as U-2 spy planes, ICBMs and the first reconnaissance satellites. He later went into the cable business, where an avocation grew into a substantial operation, based in Cape Cod, MA.

After selling his cable holdings to TCI and others in the early 1980s, "I wanted to use my background in technology innovation to give something back to the cable industry," Leghorn said during a recent interview at CableLabs, where he remains an active board member.

In 1984, Leghorn's first drum-beating efforts for a research and development consortium were met with polite interest, but the attention of cable executives was focused elsewhere, he says.

Undaunted, Leghorn paid $50,000 in September 1987 to hire Rand Corp. economist Leland Johnson to examine the issues and options of structuring a cable research and development entity, drawing on the experiences of other such consortia in the industry.

The timing was right for such an endeavor in the industry. The National Cooperative Research Act, passed in 1984, required compliance with antitrust laws, while minimizing the antitrust exposure of companies within an industry coming together to conduct research and development. It also eliminated the treble damages aspect for antitrust violations by such consortia.

"By 1987, the Japanese were coming with high definition, the telcos were coming with fiber, the top cable executives were less focused on their turf battles and battles with Congress. We were able to get their attention," Leghorn says. ➤

In October, the National Cable Television Association voiced its support and lent start-up money but agreed with Leghorn that, while the two organizations should be affiliated, the consortium should not be an arm of the lobbying organization.

"After that," Leghorn says, "things went awfully fast. We had a decision to go ahead in Fall 1987, a first committee meeting chaired by Dr. John C. Malone, chairman and CEO of TCI, in January 1988 and were off and running by that summer."

By September 1988, operators serving 85% of North American subs agreed to pay 2 cents per sub, per year, for a minimum of three years. This is the funding formula still in effect today.

Careful attention went into a search for a CEO. Eventually, Dr. Richard R. Green was lured from the top technology and operations post at Public Broadcasting Service, after some initial hesitation, Green says.

"What brought me on board was reading those early documents. I was struck by the powerful concept they expressed and how thoroughly these guys had thought everything through," says Green, who still is the CEO of CableLabs. Startup offices in Washington DC, and Cambridge, MA, were followed by a painstaking choice of making a permanent home in Colorado.

A systems approach to cable's technological future was among the core ideas that attracted Green. To Leghorn, this meant employing techniques that were being used at the time only in hush-hush military projects, where he learned them, and at Bell Labs, where they juggled numerous sub-projects so they all would come together on time.

A second part of Leghorn's vision was to focus on the innovation phase in the process of technological change. Here, he drew from the writings of economist Joseph Schumpeter, who conceived the process in three phases: invention, innovation and diffusion of technology.

"What we were not going to do was spend money on invention. There was enough ongoing invention out there in industrial and other laboratories," Leghorn says. He similarly argued that the labs should be excluded at the diffusion stage, when operating-company engineers are making their deals with vendors, and many varieties of products are being shipped in volume.

In between lay the critical innovation phase, which Leghorn defines as, "the phase where you marry technological 'push' to market 'pull' and apply your financial and operational strengths to get into the marketplace."

As Leghorn is fond of saying, "Innovation is a business function." Thus, Leghorn and others agreed the consortium must be run by the top CEOs of cable operating companies, who, to this day, hold seats on the board. "CableLabs is unabashedly a user-driven and business-driven organization," he says.

Having CEOs at the helm means

BOTTOM LINE

Looking Back on 10 Years

CableLabs, at age 10, continues to employ the techniques envisioned by founding father Dick Leghorn, including:

- A systems approach to managing big projects, which Leghorn learned while designing ICBMs and spy satellites
- A focus on nurturing innovation, an imperative Leghorn learned from economist Joseph Schumpeter

Innovation, as practiced at CableLabs, means joining the "push" of new technologies to the "pull" of demand that is created when MSOs together decide what they want to buy.

It means putting the chief executive officers of cable operating companies in charge of CableLabs, so they can move decisively and reach out to peers in other industries.

Employing these techniques, CableLabs has taken on challenges from hybrid fiber/coax (HFC) to digital video compression and used them to develop interoperable products for high-speed data and digital set-tops.

decisions are made fast. It also makes high-level confabs possible with CEOs in other industries.

These meetings have been crucial to recent alliance-building in the "convergence" era, Green says. For example, a mid-1997 meeting of CableLabs board members with Microsoft's Bill Gates sparked a $1 billion Microsoft investment in Comcast that has been credited with reversing Wall Street's dour appraisal of cable stocks.

"CableLabs is unabashedly a user-driven and business-driven organization."

The CableLabs technique for focusing market demand is bringing together the chief technical operators of MSO companies, all of whom sit on a technical advisory committee and influence their companies' future technological investments.

Through subcommittees, or *ad hoc* groups, these executives cooperatively develop a set of technical specifications for new products they intend to deploy on cable networks. Input for this spec-defining and market-creating process comes from vendors through a two-stage process involving request for information (RFI) and request for proposal (RFP).

"That is not a new technique. It's a classic technique, but it has been extremely effective for scouring the landscape, finding out what neat ideas are out there and then shaping them into actual business between operators and vendors," Leghorn says.

"One of our goals from the outset," says Green, "was to change the industry's business model because we'd outgrown the old one, which was based on individual vendors' supplying proprietary technology to subsegments of the industry.

"While this model had worked for a long time, the difficulty with it was that it didn't enable you to become a telecommunications industry. To do that, you need the scale-economics of many cable operators buying into the same basic requirements—in other words, interoperability." Green says that as cable networks become interconnected, interoperability is crucial.

CableLabs' first RFI/RFP process for electronic program guides got an indifferent vendor response. But, over time, an increasing number of vendors has come to see the value of participating. Vendors haven't always loved the drive toward interoperability, Green says, but most have come to see that it means a bigger and potentially worldwide equipment market.

CableLabs' 10-year history, says Elliot, has been one of going forth, armed with the founders' methodology, and responding to whatever are the most pressing technological demands. The early focus was on the deployment of fiber, with CableLabs playing a key role in defining cable's hybrid fiber/coax (HFC) topology.

"We were addressing many day-to-day, in-your-face reliability issues, things like standardizing cables and improving connectors," Elliot says.

The more recent shift of attention to digitization is an inevitable outgrowth of the evolving cost/performance of microprocessors and memory, Elliot says. Even more recently, the explosion of the World Wide Web is forcing CableLabs to react to opportunities and challenges.

"What's going to happen is the world is going to figure out how to embed television into the Internet. We, being TV-centered, are inclined to want to figure out how to imbed the Internet into television. We've got to be careful," Elliot says.

Thus, the story returns to DOCSIS, PacketCable, and OpenCable, the latest examples of CableLabs' role in helping MSOs join together to deploy interoperable products. In this case, it means products that display television, but do a whole lot more.

The problems to be solved change frequently, but the methodology put forth 10 years ago still provides tools that, used deftly, should keep cable in the game. CT

This article was written especially for "Communications Technology" by Robert Wells on behalf of Cable Television Laboratories Inc. (CableLabs), of Louisville, CO. Wells can be reached via e-mail at wells@rmi.net.

A Digital Video Primer

Learn the Basics For Successful Implementation

By Kenneth H. Metz

Digital video is here. Millions of people already have experienced the multitude of programming choices, each providing crystal-clear pictures and CD-quality sound. This primer provides an overview of the basic concepts behind digital video technology and addresses some of the key considerations underlying its successful deployment.

Analog vs. digital

Digital signals differ vastly from analog signals due to their robustness against the impairments of storage and transmission media, allowing excellent picture quality to be maintained for multiple generations of copying and over long transport distances. The common impairments of cable TV systems affect digital signals quite differently and only indirectly.

Moreover, errors that do occur frequently can be detected, corrected or "masked" using processing techniques that exist only in the digital domain. Any analog video signal can be represented in digital form with an arbitrary degree of precision. Still, there is a price that must be paid in terms of signal transport capacity and perceived service quality.

Analog to digital

The process of analog to digital signal conversion is briefly reviewed here. A more comprehensive discussion can be found in my June 1997 *Communications Technology* article, "Going Digital? Think Bit Error Rate."

Most digital video signals are created directly from analog video signals through a process of sampling, quantization, encoding and multiplexing. Unlike the continuous analog video waveform, the resulting digital video signal consists of a sequence of numerical values representing sampled measurements of the original waveform. This representation is suitable for digital processing, storage and transmission techniques that are fundamentally different from their analog counterparts. In particular, digital video compression algorithms are capable of dramatically increasing the overall program carrying capacity of a cable TV system by allowing multiple programs to be transported within a single 6 MHz channel.

Although several different digital video formats have been defined, the one most suitable for video compression is defined by the international standard CCIR-601 and is derived from a baseband analog video signal consisting of a single luminance component and two chrominance components. These analog signals are "sampled" (measured at regular time intervals) at rates that must be at least as great as twice their bandwidths in order to avoid certain errors known as "aliasing."

In the case of CCIR-601, the respective sampling rates have been chosen to be

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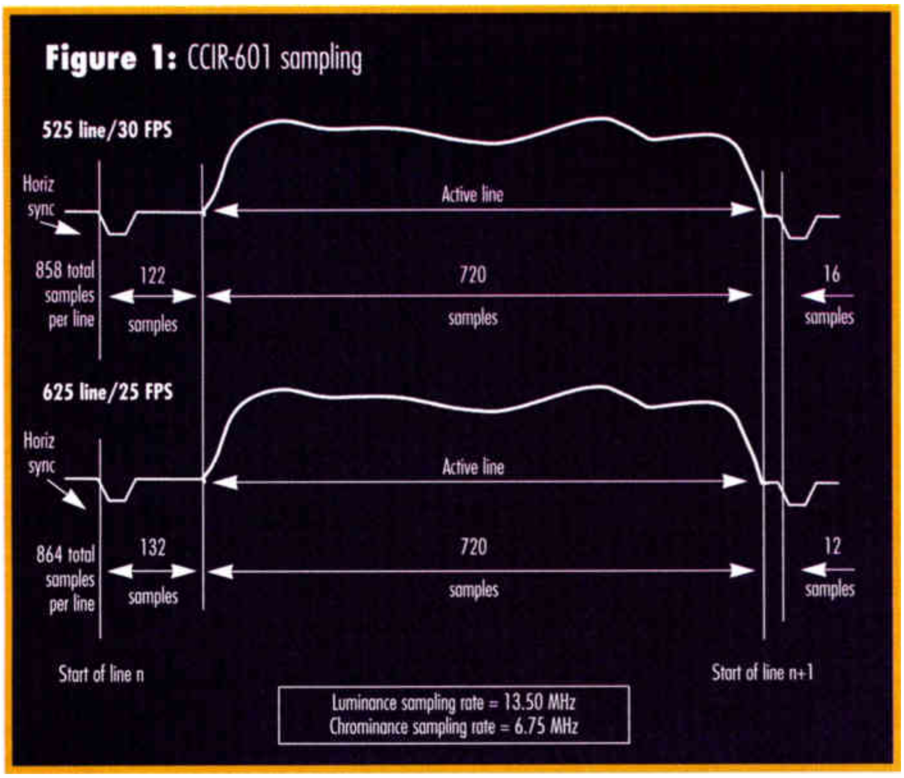


Figure 1: CCIR-601 sampling

13.5 Msamples/sec and 6.75 Msamples/sec, well in excess of the NTSC luminance bandwidth of 4.2 MHz and a maximum bandwidth of 1.5 MHz for the chrominance components. These sampling rates were chosen to maximize the compatibility between the digital counterparts of the standard NTSC and phase alteration line (PAL) analog TV systems. (See Figure 1.)

Quantization is the process that limits the precision of the measured samples of the analog waveforms to values that provide acceptable subjective quality. In the case of digital video, this typically is taken to be one part (plus or minus) in 512 of the peak-to-peak value of the analog video waveform. Thus, the resulting digital signal representation consists of a sequence of samples that can assume any of 256 discrete values. The quantization stage is irreversible. Figure 2 (on page 164) illustrates the quantization levels specified by CCIR-601. The amplitude of synchronizing pulses falls below the minimum waveform value that is represented. This is due to the fact that synchronization information is transported using special digital code words rather the actual sync pulse signal level.

of redundant timing information per 8-bit sample to ensure accurate signal recovery at the receiver.

The overall bit rate is (8+1) bits/sample x 27 Msamples/sec=243 Mbits/sec, of which 8 bits/sample x 27 Msamples/sec=216 Mbits/sec of digital video information is contained for all three components. The details of these signal formats and interfaces are described in the international standard CCIR-656.

Digital transport

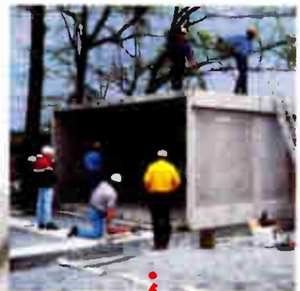
Digital signals can be transported over broadband networks, such as hybrid fiber/coax (HFC) systems, by modulating radio frequency carriers much as in the case of analog video signals. However, the two differ markedly in that digital signals can assume only a discrete number of possible values, unlike analog signals, which vary continuously over time. These discrete signal values are used to modulate the carrier among a similar number of states, including amplitude, phase or a combination of amplitude and phase.

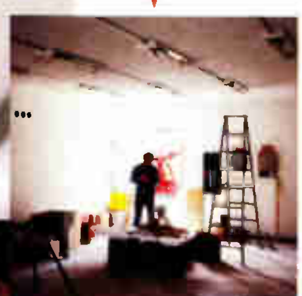
Discrete amplitude modulation (AM) involves keying the carrier level between a fixed set of allowed amplitudes, typically a number equal to the number 2 raised to some power. For example, in the simplest case, $2^1=2$ possible states, each representing a single bit of information. In this case, the carrier level must be switched between these two states at the same rate as the digital bit rate. Similarly, with $2^2=4$ possible carrier levels, each

> "Most digital video signals are created directly from analog video signals through a process of sampling, quantization, encoding and multiplexing."

representing two bits of information, and the carrier state must change at a rate of 1/2 the digital bit rate. In general, the use of "n" bits per carrier state (also known as a "symbol") allows for 2^n states among which the carrier level must switch at a rate of 1/n times the digital bit rate.

It was noted earlier that an analog signal can be represented in digital form if it samples at a rate at least twice as great as its bandwidth. A similar principle applies to transporting multilevel digital signals over an analog transmission channel. In theory, such signals may vary at a rate not exceeding twice the channel bandwidth in the case of baseband transmission (carrier frequency of zero) or ideal single sideband (SSB) transmission. Thus, for





pure SSB it would be possible to modulate a carrier at a rate of twice its bandwidth or 12 Msymbols/sec for a 6 MHz cable TV channel.

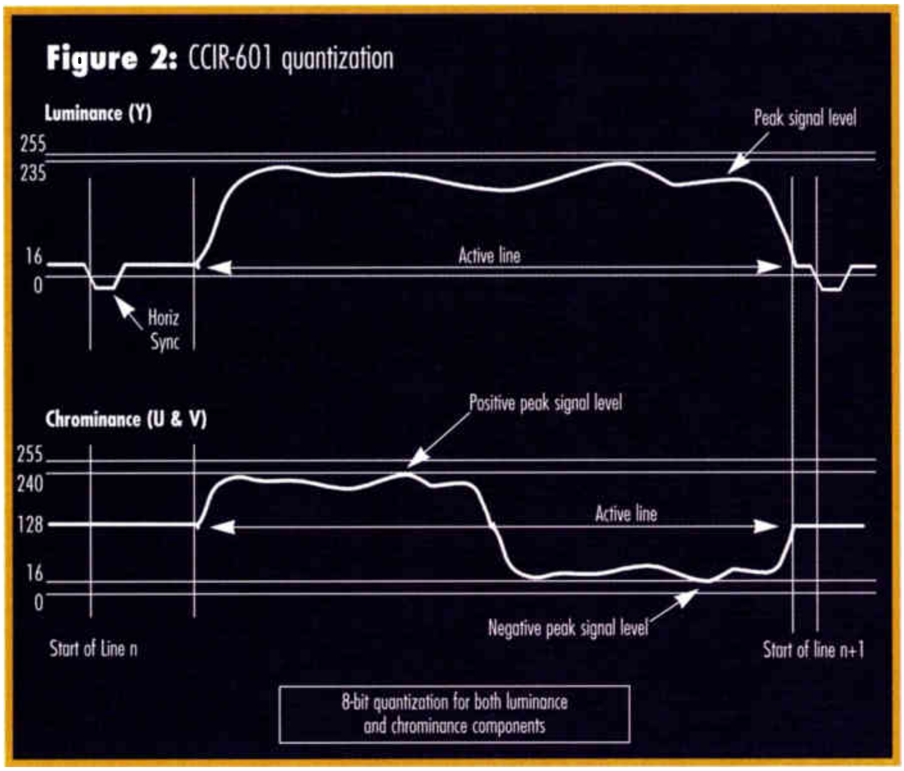
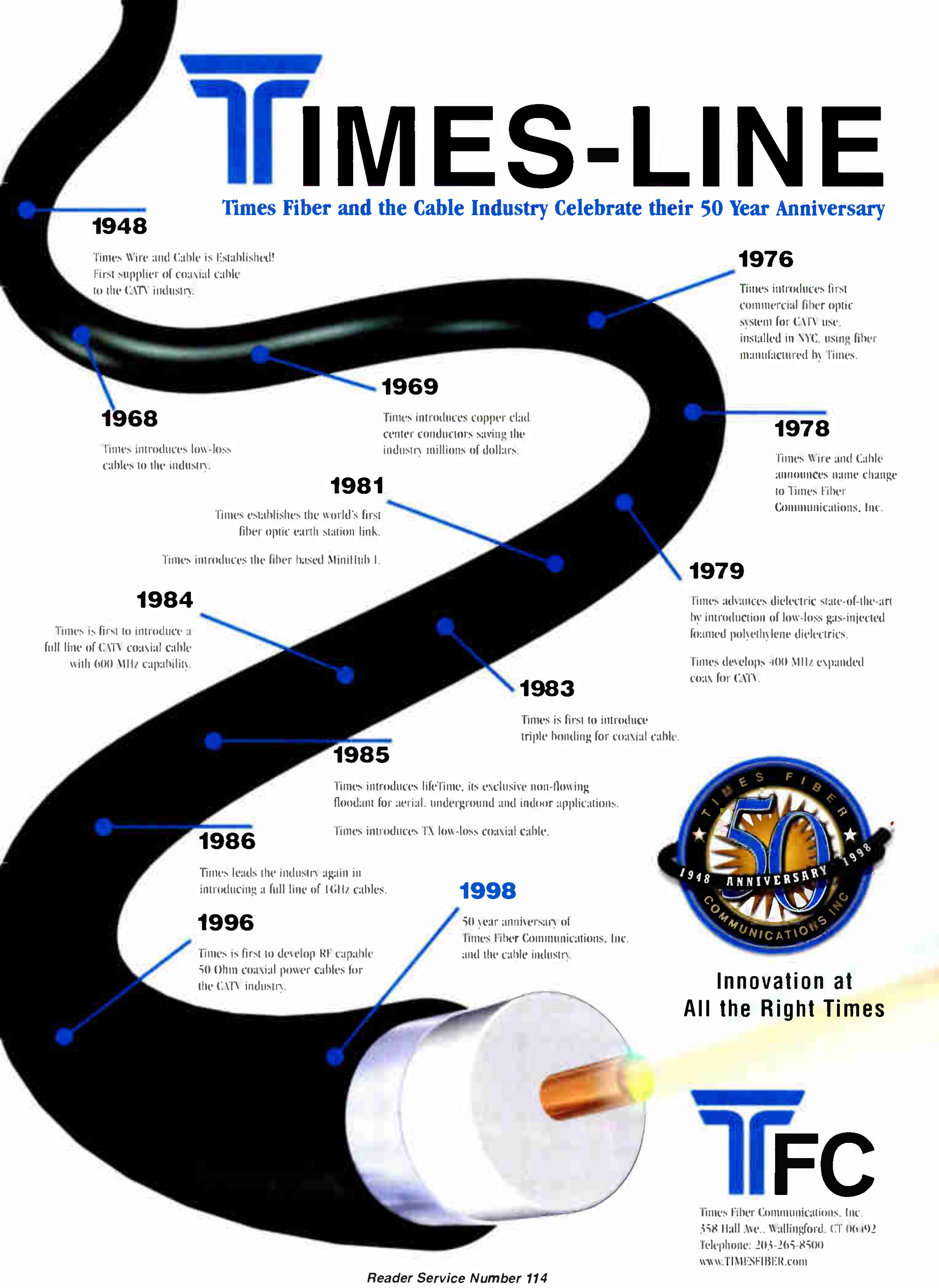


Figure 2: CCIR-601 quantization

However, the theoretical maximum symbol rate requires the use of filters possessing roll-off characteristics with vertical slopes that cannot actually be achieved. In practice, waveform-shaping filters have gradual roll-off characteristics, thereby reducing the rate of change of digital symbols that it will support. A practical symbol rate for amplitude modulation-vestigal sideband (AM-VSB) modulation is slightly more than 10 Msymbols/sec. Thus, with 3 bits per symbol, corresponding to eight possible carrier levels, the maximum bit rate supported by AM-VSB is approximately 3 bits/symbol x 10 Msymbols/sec=30 Mbits/sec. Digital AM-VSB is the modulation technique sanctioned by the Federal Communications Commission for advanced TV systems (ATV), including high definition TV (HDTV).

It also is possible to transport digital signals over analog transmission channels using double sideband modulation. For example, a common scheme used in satellite transmission is quadrature phase shift



TIMES-LINE
Times Fiber and the Cable Industry Celebrate their 50 Year Anniversary
1948
Times Wire and Cable is Established!
First supplier of coaxial cable
to the CATV industry.
1976
Times introduces first
commercial fiber optic
system for CATV use,
installed in NYC, using fiber
manufactured by Times.
1969
Times introduces copper clad
center conductors saving the
industry millions of dollars.
1968
Times introduces low-loss
cables to the industry.
1978
Times Wire and Cable
announces name change
to Times Fiber
Communications, Inc.
1981
Times establishes the world's first
fiber optic earth station link.
Times introduces the fiber based MiniHub I.
1979
Times advances dielectric state-of-the-art
by introduction of low-loss gas-injected
foamed polyethylene dielectrics.
Times develops 400 MHz expanded
coax for CATV.
1984
Times is first to introduce a
full line of CATV coaxial cable
with 600 MHz capability.
1983
Times is first to introduce
triple bonding for coaxial cable.
1985
Times introduces lifeTime, its exclusive non-flowing
floodant for aerial, underground and indoor applications.
Times introduces TX low-loss coaxial cable.
1986
Times leads the industry again in
introducing a full line of 1GHz cables.
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and the cable industry.
1996
Times is first to develop RF capable
50 Ohm coaxial power cables for
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Table 1: Digital capacity of 6MHz channels with various modulation schemes

Modulation scheme	Theoretical bps per Hz	Practical Mbps in 6 MHz
QPSK	2	10
16-QAM/4-VSB	4	20
64-QAM/8-VSB	6	30
256-QAM/16-VSB	8	40

keying (QPSK), where four combinations of two bits are used to switch the carrier phase among four possible states at constant amplitude at a rate of 1/2 the digital bit rate. Combinations of amplitude and phase modulation also are possible, the most common being quadrature amplitude modulation (QAM). Examples include 16-QAM and 64-QAM, which correspond to 4 bits per symbol and 6 bits per symbol, respectively, corresponding to symbol rates at which the carrier is varied at 1/4 and 1/6 the digital bit rate.

Because double sideband effectively doubles the transmission bandwidth without changing the signal content, it follows that the theoretical maximum symbol rate is reduced to the channel bandwidth, or 6 Msymbols/sec for a 6 MHz cable TV channel. Practical filter designs limit this to approximately 5 Msymbols/sec. Thus, 64-QAM can support a total digital capacity of 6 bits/symbol x 5 Msymbols/sec=30 Mbits/sec. Table 1 summarizes the theoretical and practical digital transport capacities of several different modulation schemes.

It would seem that there is no limit to the digital capacity of an analog channel because digital modulation schemes with ever-increasing numbers of carrier states could be used.

Unfortunately, additional capacity does not come for free. Digital signals are subject to noise and distortions associated with the transmission medium. Unlike analog signals, the effect of such impairments is not felt until a critical threshold is reached, at which point the digital receiver makes errors in determining the exact state of the received carrier. The greater the number of possible carrier states, the more sensitive the digital signal becomes.

An error made in the determination of the carrier state may cause one or more bits to be received in error. The bit error rate, the ratio of errored bits to total received bits, is the standard measure of digital transport performance. Digital compressed video can withstand bit error rates up to approximately one in a million before any noticeable signal degradation can be perceived visually.

The actual threshold of error visibility in a particular implementation is a complex function of compression ratio, modulation method, error detection/cor-

Table 2: Digital video compression programs per 6 MHz

Compressed program bit rate	Digital modulation technique		
[Mbps]	QPSK (9 Mbps)	16-QAM (18 Mbps)	64-QAM (27 Mbps)
9	1	2	3
6	1+	3	4+
4	2+	4+	6+
3	3	6	9
2	4+	9	13+
1.5	6	12	18

Assumptions: 5μ/sec signalling rate with 10% net overhead

rection approach and the effectiveness of error masking techniques.

Digital compression to the rescue

If you compare the nominal bit rate of the CCIR-601 digital video signal with the carrying capacity of the 6 MHz cable TV channel using practical modulation schemes, the conclusion is quite revealing: More than eight channels would be required to transport a single digital video signal using 64-QAM! This is the single greatest problem to overcome for the practical digital transport of video signals.

Fortunately, recent developments in video compression techniques and standards in combination with advances in digital processing technology have made it economically feasible to dramatically reduce the digital bit rate required to represent a video signal while providing acceptable subjective quality.

Video compression algorithms take advantage of two major factors affecting the required bit rate. First, it must be recognized that all video signals consist of a sequence of frames that frequently differ only slightly on a frame-by-frame basis. Thus, there is considerable temporal redundancy in most video signals. Also, each video frame likely contains many objects with gradually (spatially) varying luminance and chrominance values, representing another form of redundancy. Moreover, much of the time the motion of these objects from frame to frame constitutes the major contributor to temporal redundancy.

These characteristics permit the contents of sequential frames to be predicted from previous frames with a high degree of accuracy. Instead of sending all the bits associated with a particular frame, it is possible to transmit certain prediction parameters along with the prediction error signal using a much smaller number of bits. Certain values of these parameters have been found to occur more frequently than other values, permitting the use of even fewer bits to represent these situations as a means of lowering the average number of bits required. (This is similar to the manner in which the Morse code uses shorter symbols to represent those letters of the alphabet that are most frequently used and longer symbols for infrequently used letters.)

The second factor facilitating video compression is the imperfect nature of human vision. Errors in luminance or chrominance are not visible below certain threshold values. It also is true that errors are more difficult to detect in fine details and in rapidly changing scenes. This permits small differences to be either ignored or represented with reduced accuracy with little or no visual consequence.

The net effect is a dramatic reduction in bit rates required to transport video with acceptable subjective quality. In fact, it is practical to provide multiple video programs within a single 6 MHz channel, as illustrated in Table 2, for various fixed compressed bit rates and different modulation schemes.

Today, as few as six programs per 6 MHz (or equivalent satellite bandwidth) have been deployed successfully, and as many as 24 have been proposed. The actual number chosen is a function of several factors, including the desired visual quality, the amount of movement (for example, action scenes vs. "head and shoulders") and the specific details of the compression algorithm.

Compression algorithms generally are devised such that advances in algorithmic approaches can be implemented through changes in compression hardware ("encoders") with no impact upon the existing base of decompression hardware ("decoders" implemented within set-top terminals). This is particularly true of systems based upon the Moving Pictures Experts Group (MPEG-2) standard, which contains many options that can be employed with increasing complexity as integrated circuit technologies continue to advance and associated costs decrease over time. CT

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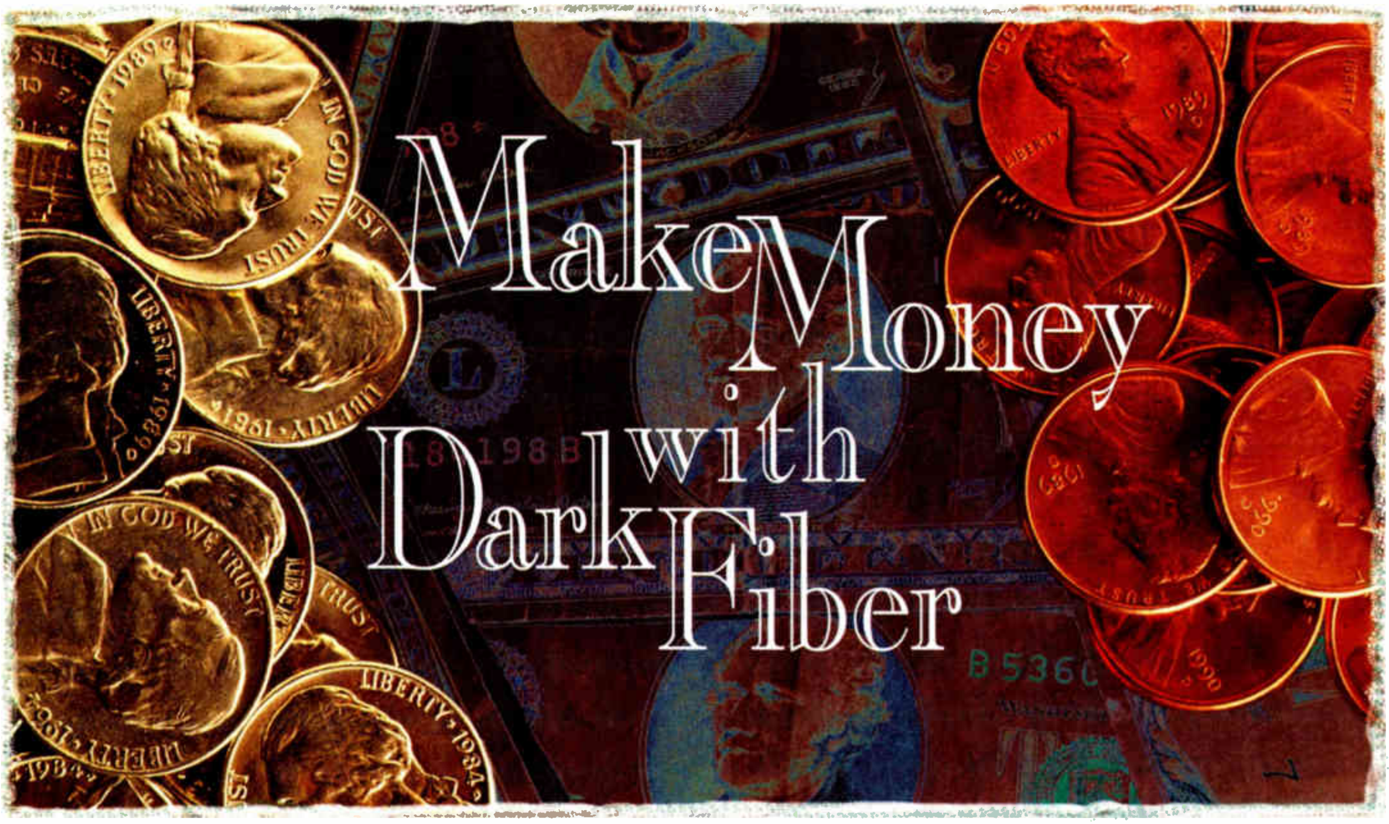


Make Money with Dark Fiber

By Mike Thaw

This is an article about money! Specifically, this article discusses how a cable TV system can use its excess fiber to generate revenue from non-traditional applications.

First, some definitions: The standard or traditional method for generating revenue for cable TV companies is by delivering broadband service to the home. Thus, all other ways of generating income will, for the purposes of this

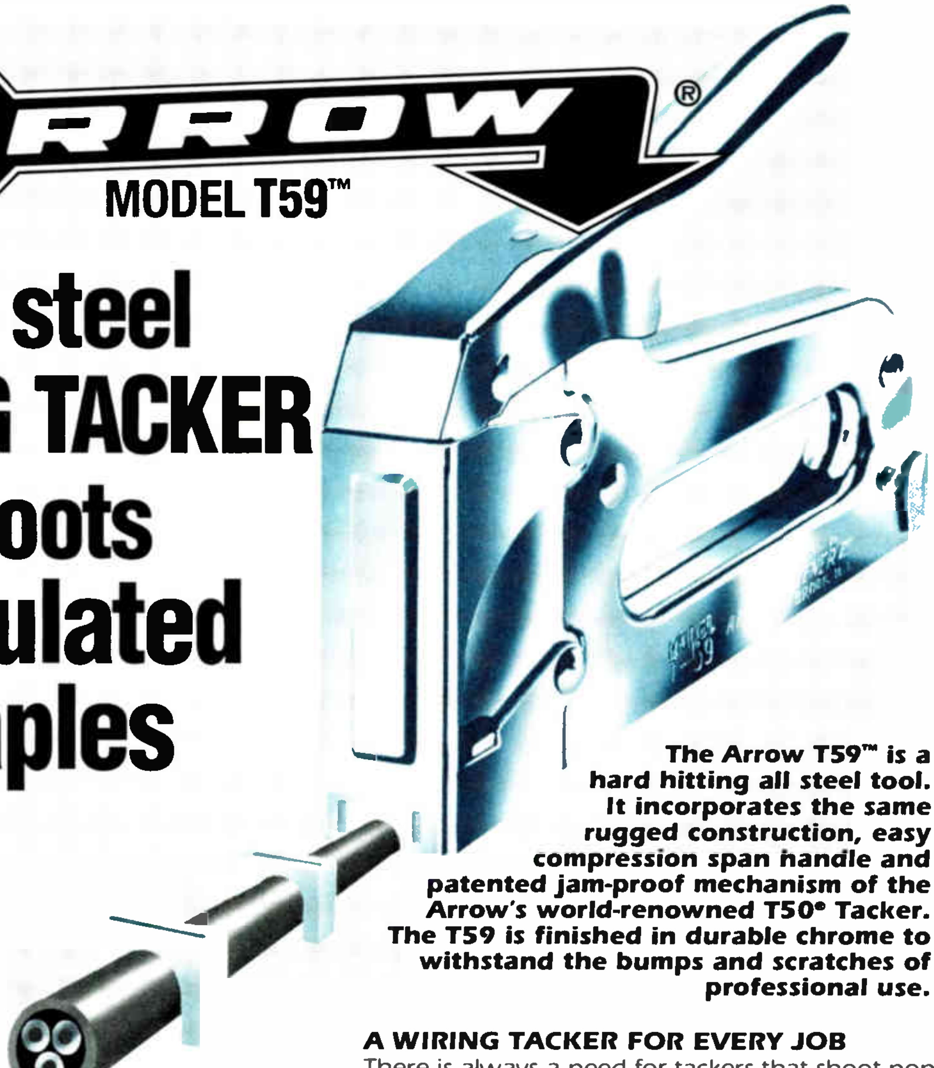
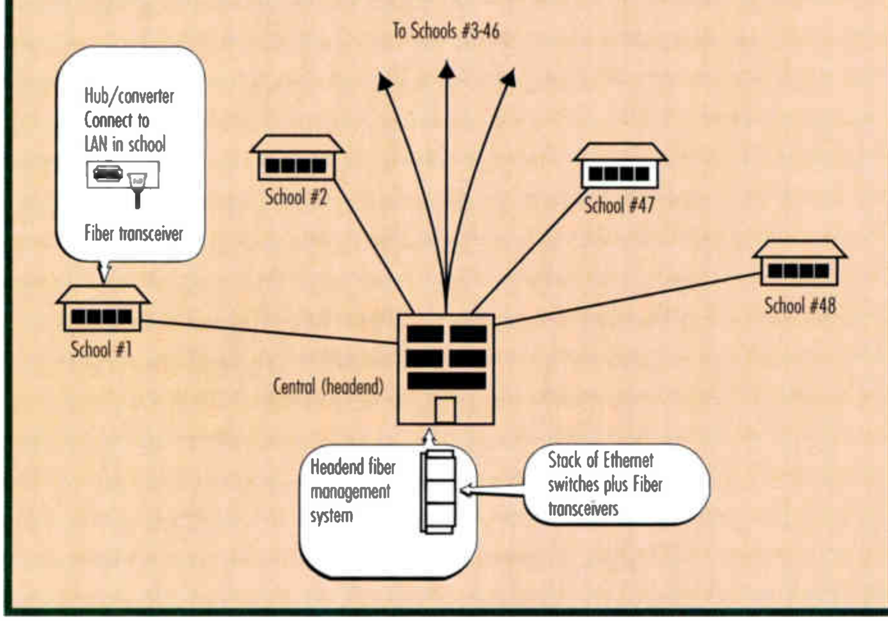


Figure 1: Typical system design



article, be considered non-traditional applications. Two that will be touched upon only briefly are home-delivered telephony and Internet access.

We will focus instead on other types of customer applications. Each application will include typical system designs, costs, customer charges and return on investment (ROI).

> "This opportunity for generating revenue from customers other than homes is in its infancy."

The big picture

Why should cable TV systems bother with anything other than delivery of services to the home (including broadband and Internet access)? Why devote precious resources—time, money and people—to chasing other types of customers? The reason is simple: Lots of money can be made—at a higher rate of return, with higher profit and much more money going to the bottom line.

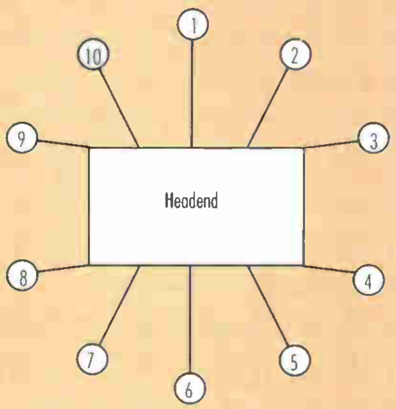
How much more? Let's look at a typical midsize upscale suburban system with 20,000 subscribers. Below I've illustrated the revenue stream from the traditional cable TV application—delivery of broadband service to the home. A customer base of 20,000 subscribers, each paying $40 per month, equals $800,000 per month in gross revenues. At a 10% profit margin, you get $80,000 per month before taxes. You can quibble with some of the figures that I use throughout this article, but I do not believe the overall result can be disputed.

A typical community also may have 10 schools, five municipal buildings, two hospitals, one college campus, one courthouse, one prison and 30 businesses that are realistic candidates for some type of service. Table 1 (on page 174) shows the potential revenue that can be generated by these types of customers.

Is that kind of revenue typical? Maybe not for all the systems in one community. However, I have personal knowledge of each type of application where that type of customer is paying that amount of money (or more) for those types of services. It also is a fact that the rate of return is significantly higher for these types of applications.

And you ain't seen nothin' yet! The types of services available (and the

Figure 2: Mid-range video/T1/data system



demand for them) will only increase in the coming years. This opportunity for generating revenue from customers other than homes is in its infancy. It is at most 3 to 5 years old. Imagine what the future will bring.

Delivering data service

If noone in your organization is calling on school districts in your territory, shame on you. With the new Superfund, there is money available for all types of distance learning. Almost every school building has an Ethernet local area network (LAN). Some of the most common types of applications are requests by school districts to interconnect all the LANs in each school together in a wide area network (WAN). Today, more than 500 school districts are interconnected via cable TV fiber across the United States. Some vendors ship at least three fiber-optic Ethernet systems for schools each week. Business, hospitals, municipalities and universities also are potential customers.

The Ethernet system design shown in Figure 1 (on page 172) can be accomplished using either one or two fibers to each school, at either 10 Mbps or 100 Mbps (Fast Ethernet). Gigabit Ethernet also is available now for long distance transmission. Typical costs, charges and ROI are contained in Table 2 (on page 174).

Impressive? These are very realistic figures. This application is a real moneymaker.

One fiber vs. two fibers

Why use two fibers when single-fiber transmission is available? This is simple economics. The difference in equipment (transceiver) costs typically is \$500 to \$1,000. So two single fiber transceivers cost approximately \$1,500 more. The typical cost of a single fiber (in a multifiber cable) is \$300 per kilometer including installation, right-of-way and so on. By using only one fiber instead of two in a 20 km run, the total savings would be \$4,500. The

BOTTOM LINE

Money-Making Possibilities

Are you getting the most revenue from your system? Using dark fiber capacity to sell services to non-traditional customers may be a good way to get additional cash and offset the cost to upgrade, build or rebuild the system.

If this idea sounds good to you, here are a few things to remember:

- Offer good value, and don't max out a customer's budget. If your salespeople propose a system that is too costly, your customer will not be able to afford it. Multimedia systems in particular vary in cost and performance among vendors.
- Consider Gigabit Ethernet. As prices begin to drop, you'll find this system is better for carrying data than ATM; soon you'll also see options for carrying video and voice (T1, T3). Quality of Service (QOS) will be added shortly to improve voice and video transmission. You may get similar (or better) performance than ATM at half the price.
- Make sure you sell the right package. Some cable TV systems are leasing the fiber only and having their customers buy the equipment. They may not have the manpower to properly address this market. When bottom line profits can be increased by 25% to 50% (or more), how can you not justify additional personnel?

Table 1: Revenue stream generated from non-traditional

#	Customer	Type of service	Monthly charge Unit	Total
10	Schools	Video, data, T1	$2,000	$20,000
5	Minicipal bldgs	Data & T1	$1,000	$5,000
2	Hospitals	Video & data from hospital to doctor's offices (MRI & CAT scan)	—	$15,000
1	Court/prison	Video arraignment	$600	$600
1	College	Video, data, T1	—	$10,000
1	Municipality	Traffic signals plus CCTV	—	$5,000
30	Business	Data & T1	$1,000	$30,000
		Total cash flow per month		$85,600
				x 45%
		Total monthly profit before taxes		$38,520

Table 2: Financial details for ethernet WANs

Costs	10Mbps	100Mbps	*Gigabit
All equipment (per remote location using single fiber transmission)	$4,500	$7,000	$25,000
10km fiber x $300/km	$3,000	$3,000	*$6,000
Total cost (per location)	$7,500	$10,000	$31,000
*Two fiber transmission			
Typical customer charges (per month)			
Schools	40%-50+%	50+%	unknown
All others	Higher	Higher	unknown

savings would be even greater for longer distances.

Multimedia systems

Here's where it really gets interesting. Many types of multimedia systems can deliver video, voice and data over fiber. They range in price from $4,000 per location to $80,000 per location (and maybe more). It all boils down to three questions:

• What does my customer want?
• What will he pay?
• What will we (cable TV company) provide and what will he provide?

What does $4,000 bring? If an Ethernet over fiber system already exists, $4,000 will buy a video codec. This device can be installed in any computer to add video and audio to any digital network. A video codec installed in any two computers on the network will enable them to videoconference.

What does $80,000 or more buy? Asynchronous transfer mode (ATM) or synchronous optical network (SONET), drop and repeat broadband, T1 and data (Ethernet)—plus a lot of additional bells and whistles. As a compromise, details are included for a mid-range system to interconnect all 10 schools with video, T1 and data. (See Figure 2 and Table 3.)

Table 3: Financial details

Equipment required	
Each remote location	
(1) Single fiber supermux	
(1) Ethernet converter	
Central location	
(10) Single fiber supermux	
(1) Ethernet 10/100 switch	
(1) Digital T1 cross connect	
(1) Video matrix switch	
Cost	
All equipment (prorated per location)	\$20,000 - \$25,000
Fiber 10km x \$300/km	\$3,000
Total cost (per location)	\$23,000 - 28,000
Typical charge (per location per month)	\$90 - \$1,400
ROI (per location per year)	50%

Doing it right

As mentioned earlier, this market is in its infancy. If your organization does not have people dedicated to sales for these types of customers, you are losing money. Even companies that have salespeople calling on schools and businesses are discovering they don't have enough salespeople. This market is very lucrative, and the opportunities are expanding monthly.

> "If your organization does not have people dedicated to sales for these types of customers, you are losing money."

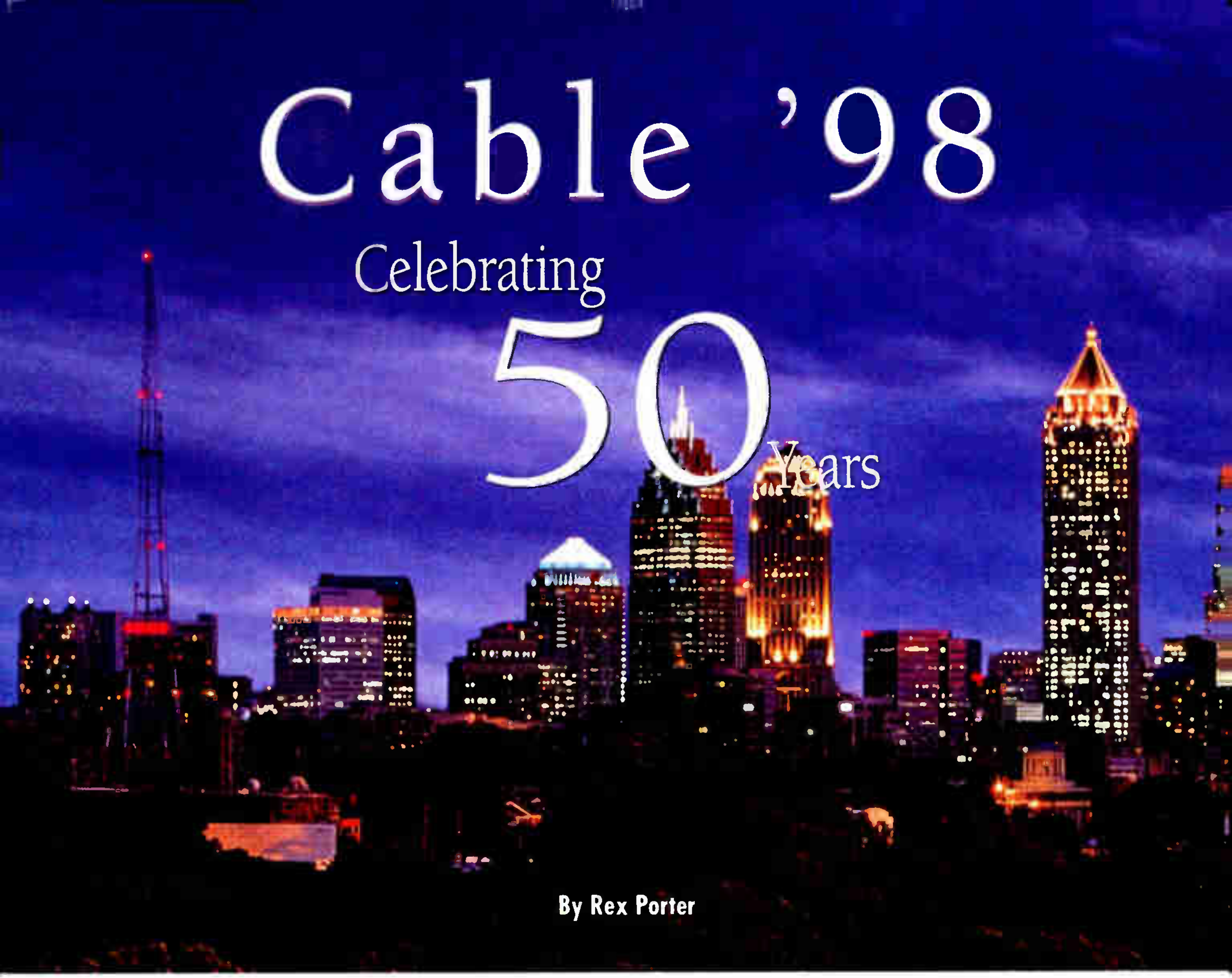
New technology and the demand for it are creating these opportunities. However, before this article ends, there are three other important points to be made.

1. It is important to get the most bang for the buck. Your customers have budgets—particularly school systems. If your salespeople propose a system that is too costly, your customer will not be able to afford it. Multimedia systems, particularly, have the most variance in cost and performance among vendors. There is no sense in proposing a champagne system to a customer with a beer budget.

2. One of the exciting new technologies that is emerging rapidly is Gigabit Ethernet. Usage is going up, and prices will begin to drop rapidly. It is better for carrying data than ATM, and very shortly there will be many options for carrying Video and Voice (T1, T3). Quality of Service (QOS) as a feature will be added shortly to improve voice and video transmission. If your company is busy building ATM rings, you may want to take a close look at Gigabit Ethernet. You can get similar (or better) performance at half the price.

3. Lastly, there is a right way and a wrong way to sell these services. Some cable TV systems are leasing the fiber only and having their customers buy the equipment. They may not have the manpower to properly address this market. However, this market is too lucrative. When bottom line profits can be increased by 25% to 50% (or more), how can additional personnel not be justified? CT

Mike Thaw is president of Radiant Communications in South Plainfield, NJ. He can be reached at (908) 757-7444.



By Rex Porter

What a show. Kudos to Bob Miron, John Wynne and Decker Anstrom! With more than 30 National Cable Television Association conventions under my belt, this is the first one I have witnessed with so many standing-room-only meetings, sessions and crowded booths. According to my records, 20 years ago the 1978 NCTA convention in New Orleans had a total attendance of 5,397, and only 1,811 of those were system operators. I don't know what the official attendance was at this extravaganza; I never got to stop long enough to ask!

From the minute we arrived in Atlanta, there were activities at the Center, Saturday through the final day, Wednesday. On Sunday, the National Cable TV Center and Museum and CableWorld opened their exhibits, "50 Years of Cable." These showcased the early years of cable, highlighting the pioneers' vision and dedication from 1948 to 1998. In the afternoon, Alex Best defined digital TV (DTV) with "Digital for Dummies."

Cable Pioneers

On Sunday evening, Cable Pioneers and their guests met at the Fox Theater for the 32nd Annual Pioneer Dinner and Cable Television Hall of Fame Inaugural Ceremony. Inducted into the Pioneers were Don Anderson (DIVA Systems), Richard Barnes (Scientific-Atlanta), Neal Barrington (Cox Cable), Andrew Brilliant (Speedvision and Outdoor Life Networks), Charles Broomfield (Missouri Cable TV Association), Diane Christie (Comcast), Steve Dyche (NPG Cablevision), Don Edelman (Passive Devices), Jim Farmer (ANTEC), Donne Fisher (TCI), Michael Fleming (Games Show Network), Paul Gemme (Time Warner), Jim Hall (GTE Main Street), Tommy Hill (Cable One), C.J. Hirschfield (California Cable Association), Bob Johnson (BET Holdings), John Kurpinski Sr. (ICS), Jerry Lindauer (Prime Cable), Ron Marnell (Multimedia Cablevision), Michael Reynolds (RayStay Co.), Diana Riley (Jerry Conn Associates), Gene Robinson (ANTEC), Andy Szegda (PPC), Pat Thompson (Daniels and Associates), Ernesto Tinajero (Television por Cable del

Atlanta—Home of Cable '98

Estado de Mexico), Stan VonFeldt (Times Fiber) and Richard Wallace (Cox Cable).

Following the induction ceremonies, six members were inducted into the Cable Television Hall of Fame. These first members are George Barco, Bill Daniels, Irving Kahn, Bob Magness, Martin Malarkey and Milton J. Shapp.

Bill Gates

On Monday morning, an overflow crowd gathered to hear Bill Gates speak. As seats filled, one question floated among operators, engineers and vendors attending: "What will his message be?" The best answer seemed to be: "He will have to address two subjects. First, he will speak about Web TV. That's his biggest concern about companies such as WorldGate. Then, he must assure the cable industry that its alphabet has only two letters: 'C' and 'E.' " And that was pretty much his message. Gates is quite the speaker and entertainer. I probably would pay to sit through another presentation if I knew I would enjoy it as much the second time around.

Tech sessions

Monday's technical sessions featured "Bigger and Longer Fiber-Optic Pipes" moderated by David Large with Dogan Atlas (ANTEC), Robert Harris (ADC Broadband Communications), Edouard Taufflieb (Guided Wave Optics) and Shinji Tsuji (Sumitomo) as speakers on dense wave division multiplexing (DWDM) and improved optical amplifiers.

Michael Aloisi (Viacom) moderated "Digital TV's Special Delivery" with speakers Ralph Brown (Time Warner), Walt Ciciora (technology consultant), Mukta Kar (CableLabs) and Rich Prodan (CableLabs).

John Caezza (Philips Broadband) moderated "Optimizing Operational Measurements" with speakers Ron Katznelson (MCSI), Kerry LaVolette (Philips Broadband), Shlomo Ovadia (General Instrument) and Raymond Schneider (ComSonics) presenting papers on test and measurement techniques.

Richard Shimp (ComSonics) moderated "Return Solutions for Two-Way Success." Dean Stoneback (General Instrument) and Charlie Williams (Com21) spoke of shaping reliable reverse paths and cable modems in the home.

On Tuesday, Andy Scott (NCTA) moderated "Navigating the Last Mile and the Last Six Inches." Speakers were Claude Baggett (CableLabs), Mark Eyer (General Instrument) and Robert Zitter (HBO).

Nick Hamilton-Piercy (Rogers) moderated "What Makes a Digital Set-Top Work?" with Richard Annibaldi (Pioneer New Media), Ralph Brown (Time Warner) and Abhijit Chatterjee (General Instrument) speaking on how to implement and manage the extensive software content in advanced set-top terminals.

Dan Pike moderated "60 Minutes—A Cable Technology Newsmagazine" with Mark Laubach (Com21), Robert Rast (General Instrument) and David Reed (CableLabs) speaking on top technical concerns such as advanced TV (ATV), packet topologies and structured data networking. Bill Kostka (CableLabs) moderated "High-Speed Applications @CABLE" with Robert Harris (ADC Broadband Communications), Bill Kostka (CableLabs) and Shlomo Rakib (Terayon) presenting overviews on how best to support residential and business subscribers' data transport and cable modem needs, with an update on Multimedia Cable Network Systems (MCNS).

And finally on Wednesday, Tony Werner (TCI) moderated "Network Architecture" with Robert Howald (General Instrument), Dan Pike (Prime Cable) and Oleh Sniezko (TCI) speaking about modern system design.

Alex Best (Cox Cable) moderated "New Design Techniques for MDUs and Digital Headends" with Paul Harr (Scientific-Atlanta), Jim Mabry (Philips Broadband) and Adam Tom (Imedia) speaking about choices in designs.

"I don't know what the official attendance was at this extravaganza; I never got to stop long enough to ask!"

These outstanding papers can be ordered directly from the NCTA headquarters offices if you were unable to attend the show. Call (202) 775-3550.

All in all, it simply was an outstanding conference. But what were the technical buzzwords during the show? Well, at last year's NCTA, the hot topic was data via modems. By the Western Show and the Society of Cable Telecommunications Engineers' Emerging Technologies conference, the topic had changed to DTV. And now, at this Cable '98, during almost every press conference or conversation in the booths, Internet protocol (IP) seemed to be the thing. Apparently, ongoing research is discovering that within IP may lurk some answers for data transmission and DTV—not just IP telephony. Perhaps we should be prepared to see technology come full circle and close the loop to have all three technologies fall into one category. Anyone want to come up with a new name for all three, combined? CT

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Wallingford, CT 06492
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www.timesfiber.com
(203) 265-8477
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Fax:(215) 675-7543
www.tonercable.com
Info@tonrcable.com
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Irvine, CA 92618
(714) 461-4654; Fax: (714) 583-3597
www.internet.toshiba.com
webmaster@toshiba.com
Steve Rasmussen (714) 587-6631
Toshiba offers MCNS modems and MCNS gateway solutions, plant and market analysis, system design, installation and maintenance. Toshiba's systems are operating in 6 major markets actively servicing over 12,000 cable subscribers.
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9202 East 33rd St.
(800) 344-2412; Fax: (317) 895-3613
www.trilith.com
Bob Jackson (317) 895-3600, ext. 152
bjackson@trilithic.com
Trilithic designs and manufacturers: Portable HFC test equipment; ingress monitoring systems; EAS compliance systems; RF and microwave components.
Reader Service #53, 54, 57, 137, 177

Trilogy Communications, Inc.
2910 Hwy. 80 East
Pearl, MS 39208
874-5649, (601) 932-4461
Fax: (601) 939-6637
www.trilogycoax.com
Scott Nelson (601) 932-4461
info@trilogycoax.com
Manufacturer of MC2, the first low-loss, exceptionally high quality trunk and feeder coax, which is ideal for CATV hybrid fiber coaxial (HFC) networks. Trilogy also offers a full line of quality MVP drop cables. ISO-9001 certified.
Reader Service #97

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31186 La Baya Drive
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(818) 707-2020; Fax: (818) 707-0190
www.trompeter.com
Dale Reed
dale.reed@trompeter.com
Established in 1960, Trompeter is a USA manufacturer of high value wireline coax, triax, and twinax transmission line connectors, cable, and the tools required for assembly. In addition, the company has a broad line of patch panel insertion-controlled interconnect modules and a rapid response cable assembly business. The firm is ISO-9001 and enjoys an international presence in the Telecommunications, Broadcast and Mil/Aero markets.
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Broken Arrow, OK 74012
(800) 331-5997; Fax: (918) 251-1138
Mark Schumacher and David Chymiak
Tulsat is a distributor for Drake, Blonder Tongue and California Amplifier. 70,00 square feet of complete repair facility and warehousing. Refur bished headend and line equipment, taps, traps, pin connectors and cable.
Reader Service #71, 83

Videotek, Inc.
243 Shoemaker Road
Pottstown, PA 19464
(800) 800-5719, (610) 327-2292
Fax: (610) 327-9295
David C. Hirsch
dchirsch@videotek.com
Located in Pottstown, Pennsylvania, Videotek, Inc., is a leading manufacturer of test and measurement equipment, video demodulators, routing and production switchers, color correctors and processors, and related equipment for the professional video and television broadcast markets. Videotek is committed to Zero Defects and is ISO-9001 certified.
Reader Service #78, 178

Viewsonics Inc.
6454 E. Rogers Circle
Boca Raton, FL 33487
(561) 998-9594; Fax: (561) 998-3712
viewsonics.com
viewson@ix.netcom.com
Cynthia Ackerman
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(800) 951-4401; Fax: (650) 813-2447
www.wj.com
Ann Latham (650) 813-2256
wireless.info@wj.com
Watkins-Johnson designs and manufactures high performance RF signal conversion components, sub-assemblies, and systems. Markets include wireless telecommunications infrastructure, CATV headend and distribution, WLAN, and others requiring high dynamic range RF products.
Reader Service #37

Wavetek Corp.
5808 Churchman Bypass
Indianapolis, Indiana 46203
(317) 788-9351; Fax:(317) 782-4607
www.wavetek.com
Gary Culbertson
Wavetek Corp. designs, manufactures and markets worldwide a broad line of electronic test and measurement instruments for the cable television, telecommunications, wireless communications, radio, video, LAN, ATE and metrology markets. Wavetek offers signal level, analysis, leakage and home wiring meters, sweep systems, headend monitoring, and bench sweep equipment.
Reader Service #1, 2, 179

Blast Dust

Dust Blaster, from American Polywater Corp., is a high-pressure aerosol spray with maximum cleaning power. Its inert gas is nonflammable, ozone-friendly and will not abrade or degrade surfaces, including plastic. It effectively dusts a variety of electronic devices.

Reader Service #312

Safety Labels

New safety labels from VIP Products scream "WARNING FIBER OPTIC CABLE" in black on telecommunications orange and also are effective for identifying innerduct or conduit. The labels come in two sizes, and they are made of durable vinyl with permanent adhesive backing that can withstand temperature extremes from -25° to 165°. A slit liner simplifies removal. Custom labels may be ordered in various sizes, colors and legends.

Reader Service #310

High-Speed Optoelectronics

A new range of optoelectronic components from Lucent Technologies' Microelectronics Group helps system manufacturers use low-cost automation assembly processes. High optical output power, low-profile footprints and high-level on-board integration are standard to the new components, developed last year by Bell Labs. Lasers, photodetectors, transceivers, transmitters and modulators foreshadow the future in microelectronics technology. These products are designed for a variety of data and telecommunications transmission applications.

Reader Service #311

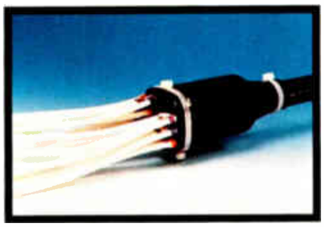
Set-Top Box

An innovation from Texas Instruments and Integrated Systems. facilitates differentiated digital signal processor-based set-top design and gets the plan to market fast.

The kit combines TI's TMS320AV7000 series of single-chip set-top digital signal processor (DSP) solutions with ISI's pSOSystem, real-time operating system (RTOS) and networking products into a pRISM development environment to facilitate the design process. This integrated approach provides the developer with a complete platform for focus on building the application-specific software that can make the set-top a real stand-out.

The AV7000 single-chip architecture integrates a 32-bit, 40 million instructions per second (MIPS), ARM7TDMI reduced instruction set (RISC) processor, transport/decryption module, traffic interface manager, MPEG-2 video decoder, graphics accelerator and an NTSC/PAL encoder. The AV7000 series is specifically targeted to digital satellite system and digital video broadcast applications.

Reader Service #309



Plenum-Rated Tubing

Chicago-based Richco Inc. has introduced new optical fiber bend-limiting tubing (OFBLT). The plenum-rated material complies with National Electrical Code 770-53A and is rated for temperatures up to 320°. Its superior crush protection limits the bend radius to 30 mm. It's intended for routing fiber in ceilings equipped with plenum spaces.

Reader Service #308

Software Time-Saver

A tool set from Renaissance Systems, scheduled for release this quarter, cuts application development revision time. The framework's key features include: an MDI application "wizard," which hastens personal computer (PC) applications prototyping with modules such as Connection, Database, Distributed Program Call and Remote Command; quick SQL interface that allows programmers to test SQL grammar immediately while connected to the AS/400; ability to handle data type conversion between any native OS/400 data type and the corresponding Visual Basic data type; and Database and Distributed Program Calls, which execute faster than ODBC calls, and the latter's interface that is compatible with any native AS/400 ILE or non-ILE programming language.

Reader Service #306

DWDM Tester

Optical fiber testing solutions from PK Technology tutor telecommunication service and test providers with a new optical channel analyzer (OCA) and data acquisition system.

The Model 790 OCA module for the Model 700 mainframe offers wavelength meter accuracy and optical spectrum analyzer functionality. Because it's designed specifically for emerging dense wavelength division multiplexing (DWDM), it can completely characterize optical carrier performance by measuring wavelength, power, signal-to-noise ratio (S/N), channel spacing and drift. Deliveries are scheduled to begin in July.

The7600 ISA bus-based data acquisition system enables telecommunication system developers and providers to easily integrate optical fiber characterization and measurement functionality into their communication systems. Modules for high dynamic range remote optical time domain reflectometer (OTDR) applications are available now, and DWDM transmission measurement applications are coming soon.

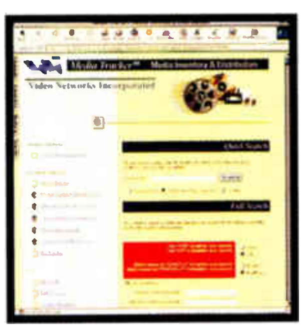
Reader Service #307

Lift Repair

Mobile Tool International has expanded its Fleet Support Division to include servicing its competitors' lifts. MTI Fleet Support reps will perform repairs, maintenance and safety inspections on aerial lifts made by Altec, Versalift and Terex-Telelect, as well as MTI's own lifts—Telsta aerial lifts, Holan insulated aerial lifts and MTI Access trailer-mounted lifts. "If you need it repaired, we'll work on it," MTI says.

Reader Service #301

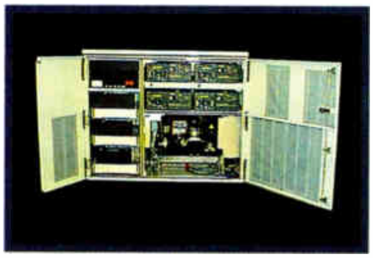
Video Management Service



Video Networks Inc. has introduced Media Tracker, a service to automate scheduling and delivery of video media. The system lets operators store, schedule and transport digitally encoded media for immediate, same-day or next-day delivery over VNI's nationwide terrestrial and satellite network. Media Tracker combines an interactive, secure Web-based interface with Managed Network Services for receipt verification and real-time reporting status.

The system also can be combined with VNI's Electronic Commerce service to provide such transaction-based video clipping services as news-on-demand or commercial video distribution.

Reader Service #303



Powering System

Exide Electronics has enhanced its Lectro Powernode centralized powering system—it now includes the ZTT/Plus (zero transfer time) standby power supply module. The ZTT/Plus and DC generator combination offers powering capabilities up to 5.2 kW and the ability to handle 100% step loads without output waveform degradation.

The DC Powernode accommodates up to five Lectro ZTT/Plus modules in a 4+1 configuration, with one unit in "hot-standby" mode. The unit also features "battery-friendly" charging topology to maximize battery life by adjusting charging levels according to environmental conditions.

Reader Service #302

Detectable Conduit

Pyramid Industries has developed a detectable HDPE conduit, called Toneable Duct. It's manufactured with either single or multiple copper conductor wire within the wall of the duct so that it can be located using conventional toning and transmission equipment. The duct is intended for direct-bury and directional-bore applications and locating dielectric fiber cable systems. It comes in a variety of wall thicknesses and can be spliced. The conductor wire is 22-gauge solid bare copper of 300V maximum voltage and 16.2 ohms resistance per 1,000 feet.

Reader Service #297

Passive Combiners

R.L. Drake Co. has added the Dracom 1201PC and 1601PC passive combiners to its line of commercial headend equipment. The units can combine outputs of up to 12 or 16 audio/video modulators and/or channel processors onto a single coaxial cable.

Both the 1201PC and the 1601PC boast directional coupler design to ensure high port-to-port isolation and low insertion loss. Both use standard 19-inch rack-mount panels and are 1.75 inches high. They also feature 20 dB monitor outputs on their front panels and have a frequency range from 5 MHz to 600 MHz.

Reader Service #305

Fiber-Optic Switching System

Physical Optics Corp. has introduced its POC912 fiber-optic 1:2 bypass switching system. The fiber route protector switch allows automated switching of primary and secondary fibers while protecting against faulty fibers or the loss of return data links from a primary source.

The POC912 operates in either multi-mode or single-mode without modification of existing fiber equipment. An alarm connection is included to signal the user when the system switches to a secondary path.

Reader Service #304

Cable Modem

The Networks division of Samsung Telecommunications plans to make the InfoRanger cable modem available to MSOs in July. The unit is expected to meet Data Over Cable Systems/Interoperability Specification (DOCSIS) certification from CableLabs in June.

The modem incorporates remote diagnostics, remote downloading of software, and light emitting diode (LED) displays to indicate readiness status, incoming e-mail messages and network traffic load.

Reader Service #300

Curing Oven

Fiber Instrument Sales' Connector Heat Oven is available in 110 or 220 volt models and allows for even heat distribution, minimizing connector heat loss. The unit will cure up to 24 connectors at once, and it accommodates FC, ST, SC, D4 and SMA style connectors. It also features temperature control and indicator lights for "power on" and "heat on." The oven is portable and operates from standard plug outlets. A stand for placing cords during the curing process also is available.

Reader Service #299

Surge Protection

The Surge/Gard from Performance Power Technologies protects against the effects of random surges that blow fuses and cause system failures. The unit automatically resets itself after 60 seconds, eliminating many power supply-related shutdowns and unnecessary truck rolls.

The device is packaged in a coaxial housing for installation between a power supply's output and the power inserter. It also can differentiate between short circuits and system overloads, responding accordingly.

Reader Service #298

The following is a listing of some of the videotapes currently available via mail order through the Society of Cable Telecommunications Engineers. The prices listed are for SCTE members only. Nonmembers must add 20% when ordering.

- *Regulation and The Cable Industry* — Featuring Steve Ross, John Wong and Alan Stilwell from the Federal Communications Commission, Dave Large and Wendell Bailey. The program covers topics such as regulations for compatibility between cable equipment and subscriber-owned equipment, short-and long-term compatibility requirements, single channel vs. simultaneous access, decoder interfaces, alternatives being negotiated with consumer electronics industry including disagreements, how the rules being developed can be carried out, anti buy-through and must-carry arrangements, rate regulation rules, broadcasters' petition for second channel, and on-screen violence and how it affects cable. (90 min.) Order T-1150, $45.
- *Advances in System Architectures* —Featuring moderator Jim Ludington, J.R. Anderson, John Mattson, Karl Poirier, Don Gall and Doug Wolfe. This is the video for anyone interested in creating designs that will stand the test of time. Issues discussed include: how deep fiber should go into the network, how many fibers should go to the node, hybrid fiber/coax (HFC) architectures, fiber-rich design, fiber deep design as an alternative, the current status of system architectures, the addition of switched and interactive services, the impact of digital networks, evolution toward a future architecture, radial distribution node and how to control the costs of fiber splicing and testing. (90 min.) Order T-1151, $45.
- *Convergence* —Larry Lehman serves as this videotape's moderator, with speakers Ken Matz, Chuck Merk and Andy Paff. The program provides an overview, plus trends in telephone and video systems, characteristics and distribution networks. Also discussed is the evolution of services, distribution architecture and trends toward regional interconnects. (75 min.) Order T-1153, $45. CT

Note: The videotapes are in color and available in the NTSC 1/2-inch VHS format only. They are available in stock and will be delivered approximately three weeks after receipt of order with full payment.

Shipping: Videotapes are shipped UPS. No P.O. boxes, please. SCTE pays surface shipping charges within the continental U.S. only. Orders to Canada or Mexico: Please add $5 (U.S.) for each videotape. Orders to Europe, Africa, Asia or South America: SCTE will invoice the recipient for additional air or surface shipping charges (please specify). "Rush" orders: a $15 surcharge will be collected on all such orders. The surcharge and air shipping cost can be charged to a Visa or MasterCard.

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

June

3: Bluegrass Society of Cable Telecommunications Engineers Chapter technical seminar, Holiday Inn, Elizabethtown, KY. "Fiber Issues" with Max Henry of Time Warner Cable and representatives from Siecor and FONS. Contact Max Henry, (502) 435-4433.
7-11: SuperComm, Atlanta. Call (202) 326-7300.
7-11: IEEE International Conference on Communications (with SuperComm), Atlanta. Call (212) 705-8248.
9:Wheat State SCTE Chapter testing session, Wichita, KS. Broadband Communications Technician/Engineer certification examinations to be administered. Contact Joe Cvetnich, (316) 262-4270.
10-13 SCTE Cable-Tec Expo, Convention Center, Denver. Contact SCTE national headquarters, (610) 363-6888.
11: SCTE Satellite Tele-Seminar Program, Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Topic: "Digital Systems Deployment". Contact SCTE national headquarters, Janene Martin, (610) 363-6888, ext. 220.
18: New England SCTE Chapter technical seminar and testing session, Holiday Inn, Boxborough, MA. BCT/E and Installer certification exams to be administered. Contact Brian Bedard, (413) 562-9923, ext. 228.
19: Oklahoma SCTE Chapter testing session, Edmond, OK. BCT/E, Service Technician and Telephony certification examinations to be administered. Contact Tom Heddlesten, (405) 348-5750, ext. 312.
24: Badger State SCTE Chapter technical seminar, Holiday Inn, Fond du Lac, WI. Topic: "Annual Safety Seminar" with speakers to be announced. Contact Robert Shugarman, (608) 238-9690.
25-26: 1998 Forum on Cable/Telco Franchising & Competition, Embassy Row Hilton, Washington, D.C. Call (212) 302-1800. CT

Planning Ahead

July 8-10: Wireless Cable Show, Philadelphia. Call (202) 452-7823.
July 20-23: New England Cable Television Association, Newport, RI. Call (617) 843-3418.
July 27-31: Fiber U & Wire U, Boston. Call (800) 537-8254.
Sept. 22-24: Great Lakes Cable Expo, Chicago. Call (317) 845-8100.
Sept. 30-Oct. 1: Private & Wireless Show, Dallas. Call (713) 975-0030.
Oct. 13-15: Mid America Show, Kansas City, MO. Call (913) 841-9241.

CABLE TRIVIA

Our history guru (aka Editor Rex Porter) has provided these trivia questions on the cable industry. Answers to the last set of questions appear first. (The last "Cable Trivia" ran on page 118 of the May issue.) The person supplying the most correct answers will be awarded a special Trivia T-shirt. You may win only once per calendar year.

To be in the running for a prize, your answers need to be postmarked or faxed to us by the 20th of the month of the issue date in which the specific trivia test appears. Good luck! Send your answers to: The Trivia Judge, *Communications Technology*, 6565 E. Preston, Mesa, AZ 85215 or fax: (602) 807-8319.

Trivia #22 answers

1) On Monday, July 8, 1997, Bill Gates met with top cable executives to demonstrate MicroSoft's new set-top box. The software that MicroSoft's system would use is: Windows CE

2) The 1994 Society of Cable Telecommunications Engineers' Cable-Tec Expo was held in: St. Louis

3) The 1995 SCTE Conference on Emerging Technologies was held in: Orlando, FL

4) In 1994, these two giants scrapped their $4.9 billion deal, citing changes in Federal Communications Commission rate rules as the reason. They are: Cox and Southwestern Bell

5) The FCC has selected, as the cutoff date for TV stations transitioning from analog to digital broadcasting, the year: 2006

6) The word "bit" is so named because: It is a contraction of binary and digit

7) The Japanese word "Karaoke" means: empty orchestra

8) The digital encoding of the amplitude of a signal is known as: PCM

9) A byte contains: 8 bits

10) In digital systems, a technique that re-arranges the data in a specific way, usually to cause bursts of transmission errors to be spread out in the data, is called: interleaving

Trivia #23

1) In a SAW filter, the acronym "SAW" stands for:
A) standing audio wave
B) second area warp
C) surface acoustic wave
D) synchronously active wave

2) In June, 1990, a San Diego-based division of this major company announced an industry "first"—its all-digital system for transmitting a full high-definition TV (HDTV) signal in original format over a standard 6 MHz TV channel. This major company is:
A) Zenith Corporation
B) Philips Consumer Electronics
C) General Instrument
D) Thompson Consumer Electronics

3) Gary Shapiro is:
A) president of the Citizens For HDTV
B) counsel for the National Cable Television Association

C) chairman of the FCC
D) president of the Consumer Electronics Manufacturers Association

4) Since 1993, all TV sets manufactured or distributed for sale in the United States with screen diagonals of 13 inches or greater must:
A) provide stereo sound
B) provide closed-captioning capability
C) provide Automatic Volume Control
D) provide color pictures

5) In 1992, Philips (Magnavox) began offering a product named Vector. Its function was:
A) cancellation of ghosts
B) providing interactive TV
C) providing stereo music
D) noise filtering

6) The SCTE changed its name from the Society of Cable Television Engineers to Society of Cable Telecommunications Engineers in the year:
A) 1990
B) 1992
C) 1994
D) 1995

7) General Instrument held the first successful field tests of advanced 256-QAM transmission over hybrid fiber/coax (HFC) networks in 21 different systems owned by:
A) Time Warner
B) Continental Cablevision
C) Rogers Cablesystems
D) TCI

8) In 1996, an experimental trillion-bit asynchronous transfer mode (ATM) switching technique was tested around a 20 gigabit per second ATM switch manufactured by:
A) Lucent Technologies
B) Motorola
C) Hewlett-Packard
D) Tektronix

9) A digital error protection code based on blocks of data with added redundancy capable of correcting burst errors up to a limit set at design time is the:
A) Hamming code
B) Reed-Soloman code
C) Time code
D) Aliasing code

10) In order to allow NTSC to be interoperable with HDTV signal sources, alternate frame rates will be available, at least during the transition period, based on the NTSC field rate of:
A) 60 Hz
B) 24 Hz
C) 30 Hz
D) 59.94 Hz

And the winner is...

At press time, there was no winner for Cable Trivia #22, which ran in the May issue. The winner will be announced in an upcoming issue. CT

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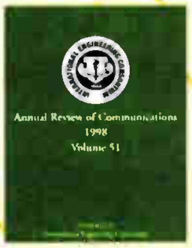

Annual Review of Communications 1998
This 1,100-page resource chronicles the most recent advancements in telecommunications business and technology. Over 200 papers cover topics such as business strategy, marketing, and regulations; multimedia, the Internet, and on-line services; network technology and applications; computer/telecommunications developments; wireless communications; ATM; intelligent networks; operations and quality control; and much more. The book features an exclusive CEO Reports section. *Forthcoming June 1998*

The Future of Wireless Broadband Local Access
For many service providers, terrestrial wireless broadband is perhaps the least costly of all the alternatives for providing broadband local access service to U.S. business customers and residences. This new research report examines the full implications of terrestrial wireless broadband as a service delivery vehicle and presents a detailed analysis of the market, suppliers, customers, vendors, products, and the future outlook of this emerging local access architecture. Topics covered include growth scenarios for wireless broadband, prospective market demand, current deployments and growth strategies, current regulations, technology/ cost comparisons with wireline options, etc. *Forthcoming July 1998*

The Future of ATM and Broadband Networking: 2000-2010
Based on extensive industry interviews and in-depth surveys, this research report examines the technology, markets, strengths, and limitations of key broadband networking architectures, including ATM, 100-Mbps Ethernet, FDDI, Gigabit Ethernet, ADSL, frame relay, and satellite distribution systems. The study examines broadband networking within various contexts, including business campus backbones, metropolitan areas, college campus networks, residential markets, wide-area networks, and global high-bandwidth links. The pros and cons of each technology option are evaluated, and strategies for deploying and utilizing each are offered. *February 1998*

The Satellite Revolution: The Shift to Direct Consumer Access and Mass Markets
This new report examines the cost, technical performance, and service competitiveness of emerging satellite systems. Special attention is given to how new satellite systems will compete with each other and with alternative terrestrial telecom services. Satellite markets that are covered include fixed satellite services, the new high data-rate multimedia satellites, and mobile satellite services. The report projects key market developments for satellites over the next five to seven years. The relative growth of each market segment is analyzed on the basis of space segment technology, ground segment developments, service range and flexibility, and costs. *February 1998*

Intelligent Networks: Technologies, Applications, and Business Challenges, Volume 3
This new comprehensive report covers the latest developments and practical experiences in implementing intelligent network technology. Designed for decisionmakers responsible for network management and business planning, this volume reviews the present business climate for IN services and operations and offers concrete advice for successfully developing IN services. Topics covered include integrated platform strategies, small business and residential IN opportunities, regulation vs. market-based drivers for IN, mass-marketing AIN services, billing and security issues, optimizing IN architectures, and more. This is Volume 3 in the IEC's annual series on Intelligent Networks. *February 1998*

Telecommunications Engineering and Operations: Network Challenges, Business Issues, and Current Developments
The road to telecommunications survival rests upon successful navigation of the open competitive environment mandated by the FCC. Service providers must reconsider how they deliver and manage services end-to-end and may even have to redetermine the nature of their customers. This comprehensive report helps companies meet this challenge by sharing the experiences and insight of key industry professionals in areas such as local number portability, local loop unbundling, network integration and interoperability, customer service management, operations support, TMN, migrating to broadband infrastructures, and more. *January 1998*

Broadband and Multimedia: Current Developments, Applications and Technologies, Volume 2
This comprehensive report examines the state of broadband/multimedia applications in the information industry today and the future direction of multimedia developments, opportunities, and technologies. It provides the perspective of key industry leaders on developments in the area of multimedia applications over existing and future communications networks as well as emerging opportunities over the next years. This is Volume 2 in the IEC's annual series on Broadband and Multimedia.

For more information on any of these new publications, check the appropriate box(es) below:

- ❒ **Annual Review of Communications 1998**
- ❒ **The Future of Wireless Broadband Local Access**
- ❒ **The Future of ATM and Broadband Networking: 2000-2010**
- ❒ **The Satellite Revolution: The Shift to Direct Consumer Access and Mass Markets**
- ❒ **Intelligent Networks: Technologies, Applications, and Business Challenges, Volume 3**
- ❒ **Telecommunications Engineering and Operations: Network Challenges, Business Issues, and Current Developments**
- ❒ **Broadband and Multimedia: Current Developments, Applications and Technologies, Volume 2**

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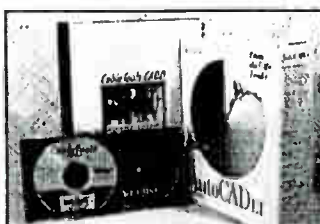

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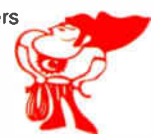

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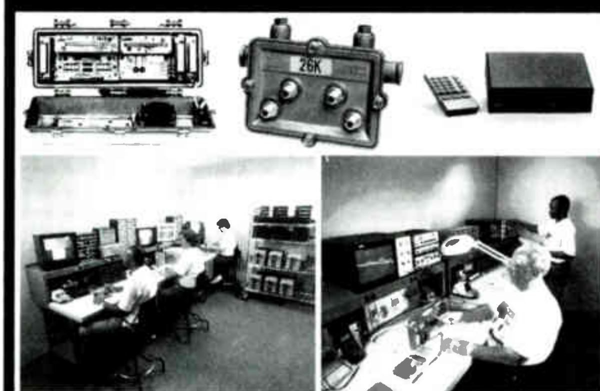

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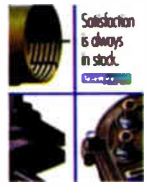

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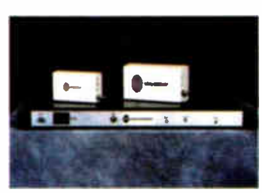

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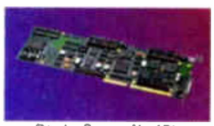

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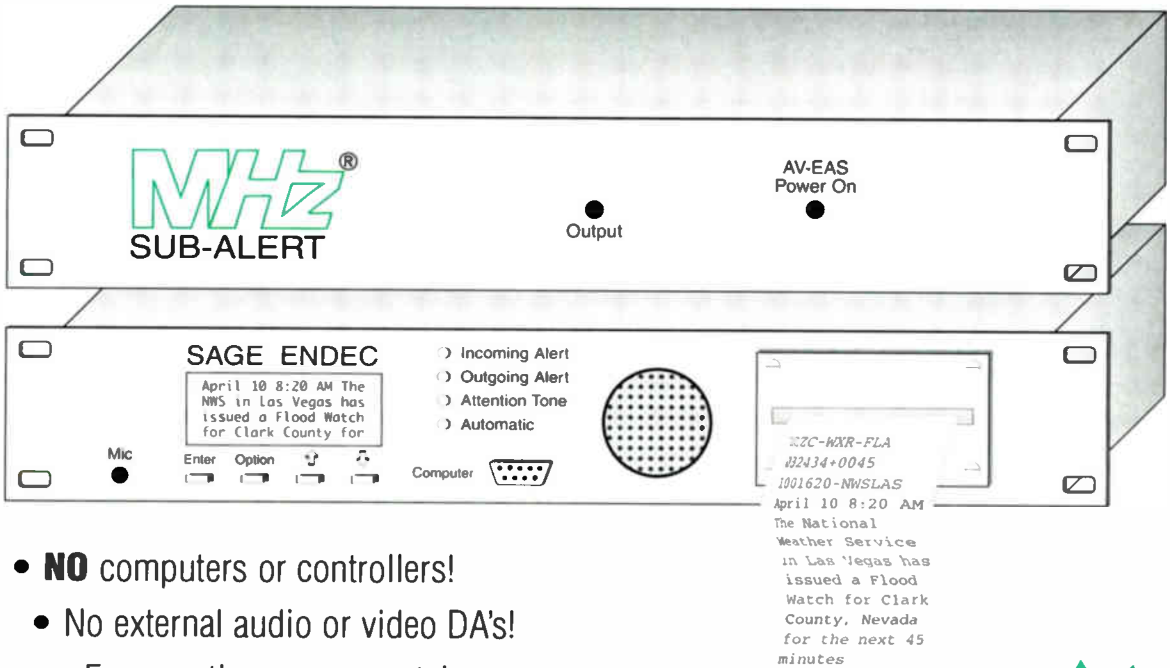

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TRAINING

By the NCTI

Troubleshooting Tap Problems, Part 1

This month's installment begins a series on troubleshooting tap problems. The material is adapted from a lesson in NCTI's Installer Technician Course. © NCTI.

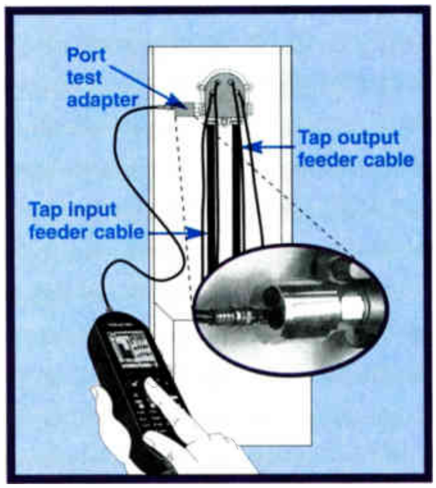
RF taps are passive devices used throughout the feeder portion of the distribution system. They "tap off" a specific amount of RF signal from the feeder line and direct it into one or more customer drops. Some of the service-related problems found at customer taps are: 1) incorrect tap port levels, 2) a backward spliced tap, 3) loose seizure screws, 4) feeder cable contraction, 5) water/corrosion and 6) broken or cracked tap ports. Any of these conditions can cause snowy pictures, ingress, signal leakage and other picture distortions to one or more customers. The accompanying table lists typical problems at the tap.

Improper RF signal levels

Low RF signal levels and snowy pictures at the customer's TV set can be caused by low or no RF signal levels at the tap port. To verify that the tap port is delivering a proper signal level, connect a short coaxial jumper between the tap port and the RF input connector of a signal level meter (SLM). Measure and record the levels of the highest and lowest available frequencies. Perform the same measurement for the other tap ports. Finding higher RF signal levels at another tap port on the same tap indicates a defective tap faceplate that requires replacement. If there is no measurable RF signal level or if an RF signal level is below the system's recommended specs at any of the tap ports, check the RF signal levels at the tap's input.

To measure the tap's input level, thread a port test adapter into the tap's input seizure screw port opening as shown in the accompanying figure. Connect a coaxial jumper from the SLM to the adapter's -20 dB test point and measure the RF input level. Add 20 dB to the SLM measurement to compensate for the adapter's test point loss. Measuring abnormally low or no signal level at the tap ports and a normal signal level at the input to the tap indicates either that the tap's faceplate is defective and needs replacement or that the tap was spliced in backward and should be respliced.

Caution: Inserting the SLM cable's F-connector directly into a tap input port may produce a 3 dB error in your RF signal level reading. Also, feeder cables carrying AC power could be accidently shorted to sheath by the F-connector and blow a fuse in the feeder system, resulting in a loss of broadband cable signal to many customers. It is more accurate and safer to use a port test adapter for measuring the input and output port levels at the tap.



Port test adapter connected to tap's input seizure screw port opening

Hands-on performance training

Proficiency objective: Successfully troubleshoot improper RF signal levels at a tap.

Ensure that you have enough SLMs, test port adapters and workstations for the students to practice troubleshooting on. Each workstation should have a live broadband signal feeding a tap. If possible, install different value taps with known defective faceplates in selected/all workstations and have students rotate among workstations.

Give each student manufacturer specs for the taps used and system specs for tap input and tap port signal levels at the highest and lowest available frequencies.

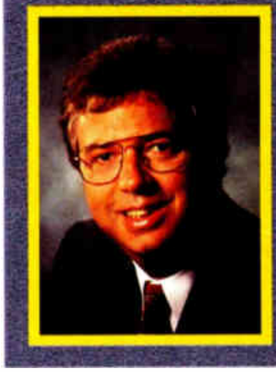
Demonstrate how to perform measurements at customer tap ports and using a port test adapter at tap input port. Explain how to compare measurements to manufacturer and system specs to troubleshoot tap problems.

Have students practice troubleshooting RF signal levels at customer tap ports and tap input ports.

Verify that each student can troubleshoot improper RF signal levels at a tap. CT

Typical problems at the tap

Signal level problems	Picture problems	Hardware problems
Low RF levels	Snowy pictures	Broken ports
High RF levels	No pictures	Unused ports not terminated
No RF signal	Beats	Improperly installed tap
Low RF in high-/super-bands	Hum bars	Cracked housing
Low RF in low-/mid-bands	Ghosts	Physical damage
Ingress	Scrambled pictures s on scrambled system	Corroded and/or loose connectors
Egress	Flashing pictures Ingress	Loose or missing port caps Feeder cable cracked, broken or chewed Wrong value tap faceplate installed



By Bill Riker

Learning by Doing

By now you probably are aware that I have resigned my position as president of the Society of Cable Telecommunications Engineers. Though this move closes a chapter on nearly 14 years of my professional life, I do not see this choice as an ending, but rather as another beginning. Cable TV once again has offered me the opportunity to serve the industry by supporting professional organizations that are key to the future growth and development of our business.

On June 15, following the Cable-Tec Expo, I will join the ranks of the Denver-based National Cable Television Center and Museum as vice president of operations and engineering. I look forward to participating in the construction of the Cable Center because, when it is completed, it will bring international recognition to our industry's contributions—something I have always strived for through my work with the Society.

In my new role with the Cable Center, I will oversee the development of a $20 million construction project, as well as the operation of the 45,000-square-foot facility. I also plan to help create educational programs for the industry, much as I did as SCTE's president.

Looking back on my career, I made my first big change more than 13 years ago when I left my position as director of engineering for the National Cable Television Association. My goals were to help SCTE out of financial hardship and to develop it into an organization that would provide much-needed technical training programs to its members for the benefit of the entire industry. With the support of thousands of individuals throughout that time, I feel that I have accomplished those goals.

As you can imagine, the decision to leave my post here has been very difficult. I spent a lot of time thinking not only about what I have contributed to the Society but also, and more importantly, what SCTE has done for my own professional growth.

Since joining the Society in 1977, I have experienced firsthand the value of SCTE as a career-enhancement tool. Throughout my own career, I have held many technical positions in the cable TV industry. In addition to my time with NCTA, I served as director of engineering for Showtime Networks, headend engineer for McLean Hunter LTD, and chief engineer for AmVideo Corp.

Even as I worked my way up through the industry ranks, I learned early on that utilizing the Society's many programs and services made me even more valuable to both current and prospective employers. Through SCTE's multitude of educational resources, I was able to build upon my existing knowledge base by staying current on new technologies and industry trends.

> "If knowledge is the doorway to the future of cable telecommunications, then SCTE is the key that unlocks it."

The entities that make up the Society's mission, "Training, Certification, Standards," are ingredients for professional success for all levels of broadband personnel. I've said it many times, but it's worth repeating: If knowledge is the doorway to the future of cable telecommunications, then SCTE is the key that unlocks it. The Society has opened many doors for me.

I encourage all of you to take advantage of the information available through the SCTE. Join your local chapter, enroll in one of the technical certification programs, or read through the latest issue of *DigiPoints*. The Society's value lies in its unique way of meeting everyone's learning needs.

SCTE also has prepared me to forge ahead in less-obvious ways. For example, the interface between operators and manufacturers at Cable-Tec Expo has enlightened me on this multi-faceted industry for years. The sheer networking potential of the Society's 72 local groups demonstrates that peer support is one of the most powerful tools you can have in the competitive environment of telecommunications. As president of this member-driven organization, I've learned that 13,500 minds clearly are better than one.

So, even as I step down from my post and move on with my career, I see that the Society has prepared me for the challenges ahead. I give thanks to all of those individuals who have led, guided and shaped SCTE throughout its nearly 30 years, especially those who have served on the national board and its committees.

A special "thank you" goes out to members of the current national board. I appreciate the support you have shown me throughout this transition. I also would like to thank SCTE's professional staff, both as a member and as a former president. Over the years, they have worked hard to ensure that this association remains member-driven.

As I start out on this new beginning, I'll leave you with a bit of advice. Join SCTE—it will be the best connection you'll ever make.

I wish all of you continued success. CT

Bill Riker is president of the Society of Cable Telecommunications Engineers.

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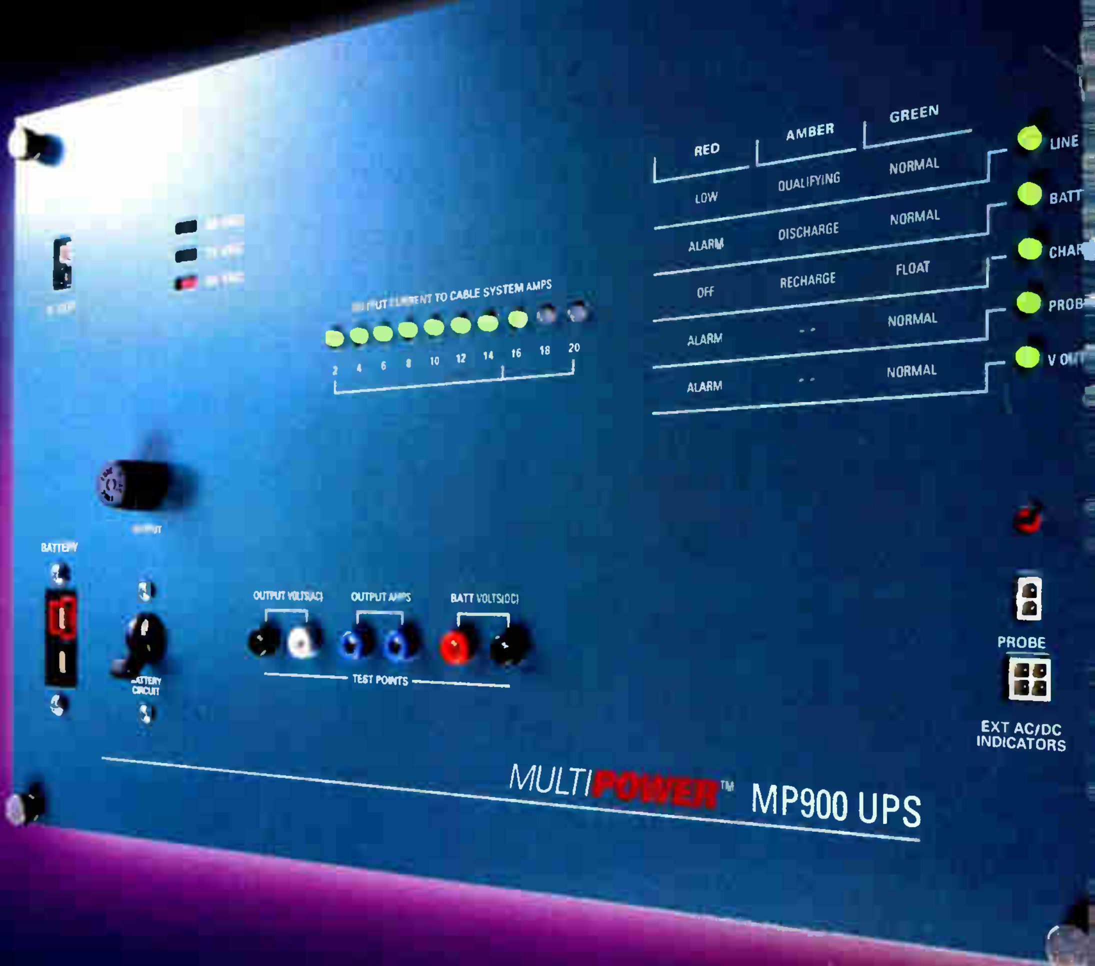

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