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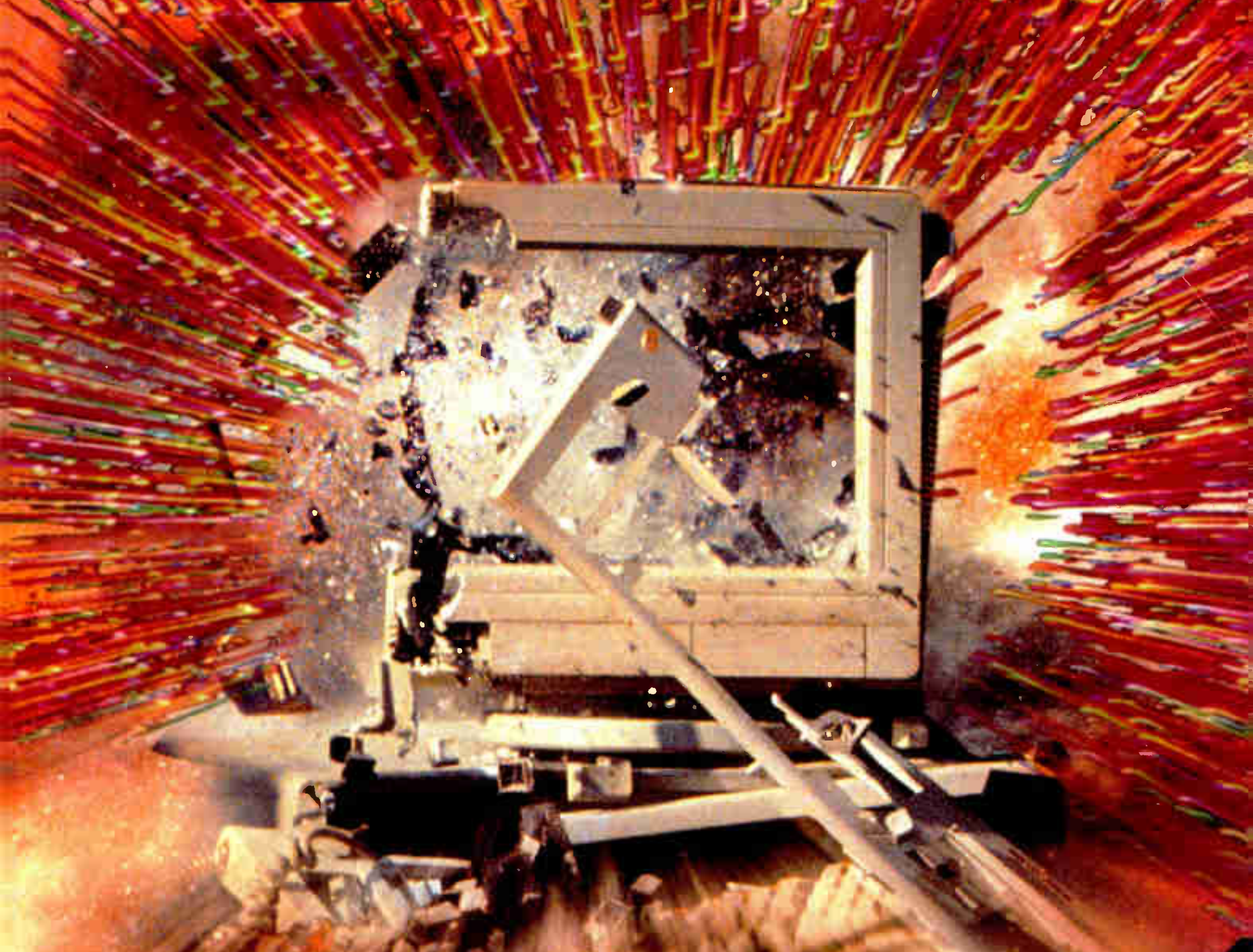

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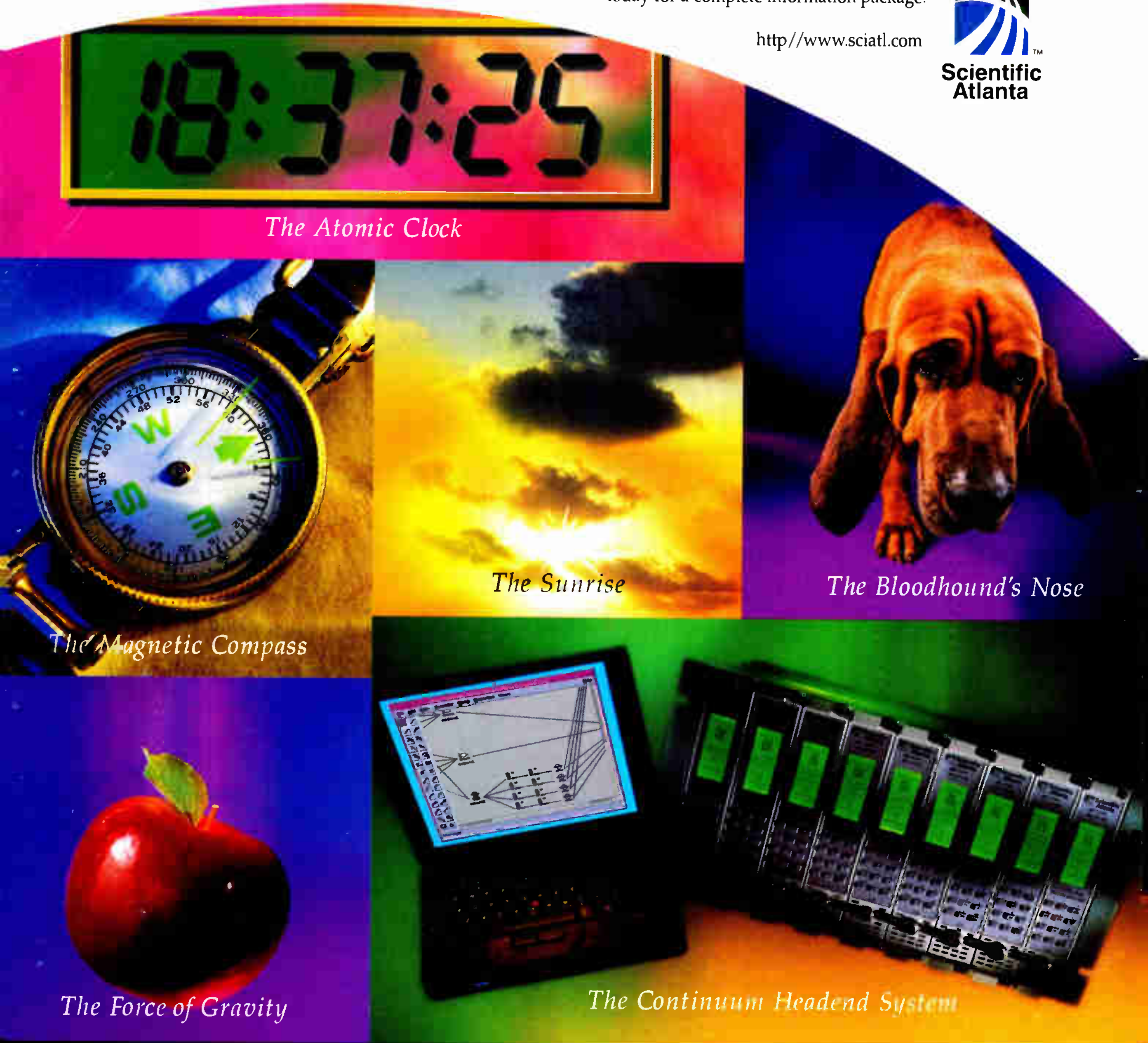

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—Tom Elliot
Senior Vice President,
Technical Projects, TCI

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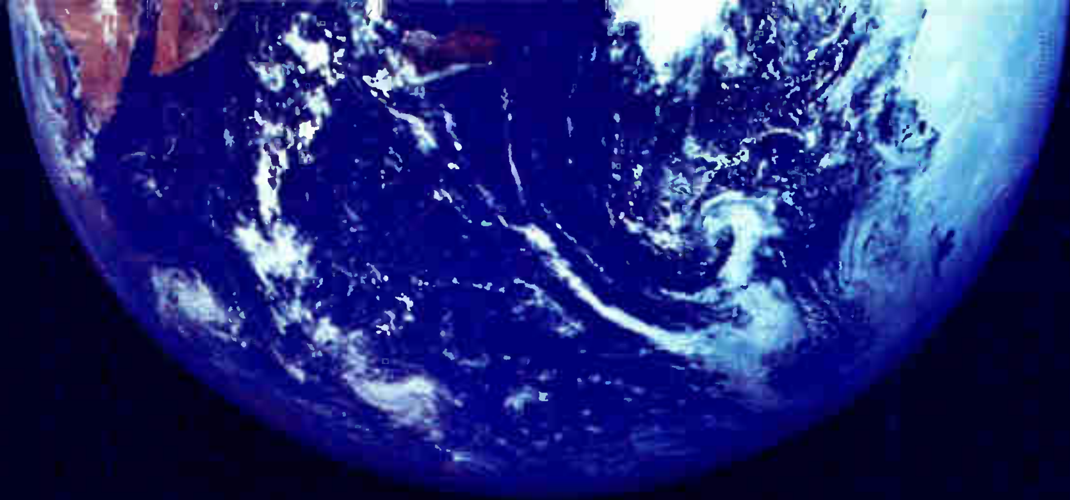
 Communications Technology™ (ISSN 0884-2272) is published monthly, except twice in July, by Phillips Business Information Inc., 1201 Seven Locks Road, Suite 300, Rockville, MD 20854, USA. Editorial and sales offices located at 1900 Grant St., Suite 720, Denver, CO 80203 USA, (303) 839-1565. July 1997, Volume 14, Number 7. Periodicals postage paid at Rockville, MD, and additional mailing offices. POSTMASTER: Send address changes to *Communications Technology*, P.O. Box 3230, Northbrook, IL 60065-9647.



By Rex Porter

Cable Tec Expo '97

It Just Keeps on Going & Going

As I departed from Orlando last week, I overheard, "Well, the best Expo, ever, has ended and I'm sorry it's over."

The SCTE Expo never ends. Yes, the booths are removed and we all go back to our work routines whether we sell, buy, or maintain the equipment. But the experiences at this and former Expos change our work routines like no other show or convention. Friendships are renewed and new opportunities between companies are developed at this show. This Expo offers the launch of new ventures, the sharing of new technical breakthroughs, awards for excellence in engineering, competition in "the cable games," and technical workshops define work patterns and provide technical knowledge for the next twelve months.

Have you noticed what's been happening while we were busy in Orlando? Cable leaders continue to involve cable telecommunications in replacing the infrastructure for high-speed online access. A year ago, I wrote an editorial in which I complained about the reluctance to upgrade, rebuild or replace the telephone infrastructure used by the Internet. I discussed the role I believed Bill Gates' Teledesic Corporation and its system of hundreds of low-orbiting satellites would play in replacing our present slow and problem-riddled infrastructure.

Now Comcast's Brian Roberts and Microsoft's Bill Gates have begun the first of what I believe will be many such agreements between Teledesic and cable MSOs. Every cable system has the ability to uplink as well as downlink information. We have to put that ability to work for high-speed delivery to complement the use of high-speed cable modems. And we will.

Then, from the financial side of the business, I see TCI agreed to sell 10 New York cable systems for 33% of Cablevision Inc. Coupled with a flurry of buy/sell activities between many of the smaller MSOs, the cable industry looks to be "shaking out" in preparation for accelerated financial growth during the rest of 1997. One investment firm reportedly purchased 2.95 million shares of TCI in the first quarter of this year because, "The stocks are terribly cheap"—I would say the same about the Expo. If you are a telecommunications vendor, you cannot spend your money more wisely than at the Expo. Other conventions may schedule their events during the week of Expo. But no show has the impact of the Expo. Consider it a "must event."

So much activity. So little time. I can hardly wait for our next 1998 Expo in Denver.

Rex Porter,
Editor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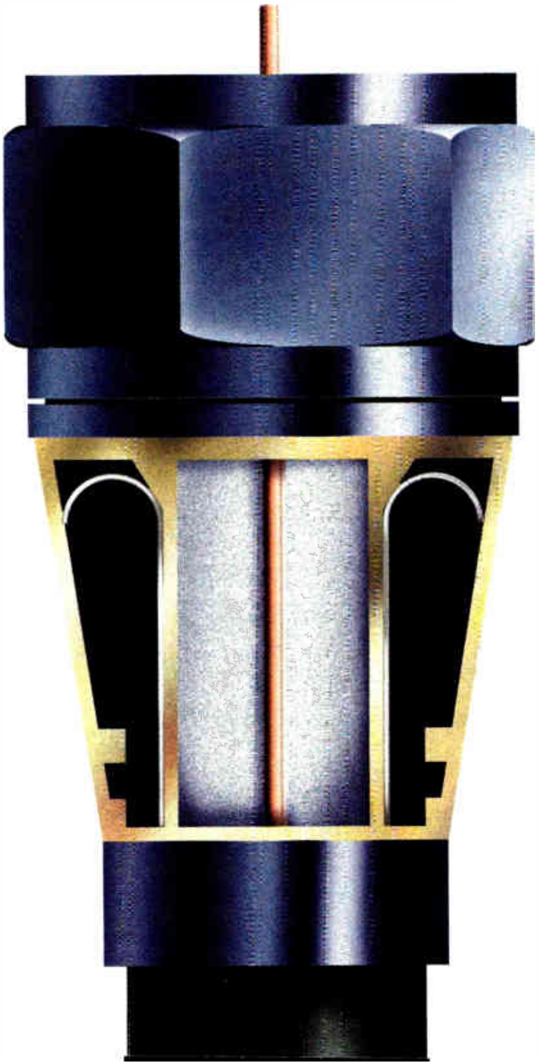

Communications Technology

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Reader Service Number 11

By Laura K. Hamilton

Expo '97: No Mickey-Mousing Around

Welcome to "Communications Technology's" coverage of the most important confab in the cable telecommunications engineering arena: the Society of Cable Telecommunications Engineers Cable-Tec Expo.

What follows is just a taste of Expo '97. Look for the industry's most extensive wrap of Expo's seminars, exhibits, social events, etc., including photos, in our August issue.

It didn't take a rocket scientist—or even a cable telecommunications engineer for that matter—to see what was on the cable engineering collective mind at SCTE's Cable-Tec Expo. It was obvious: Clean up that return path.

It seemed everyone was hungry for techniques and products that could reduce or point out ingress in the upstream. Expo reiterated what you've read in the pages of this magazine many times in the past year. That is, the industry's moves into future services like high-speed data delivery demand extensive attention to the return path.

Although Cable-Tec Expo '97 took place in early June in the Land of Mickey Mouse (Orlando, FL), it was far from being kids' stuff. As a matter of fact, that's one of the best things about Expo. While at other shows equipment vendors often must compete for space and shout over music being blasted by programmers' booths, at Expo, it's all technical, all the time.

This was your show.

About 4,600 attendees and 3,600 exhibitor personnel converged on the Orange County Convention Center to take advantage of SCTE's traditional commitment to a top-shelf Engineering Conference and hands-on technical workshops. This year's Expo also had expanded exhibit hours, requested by both exhibitors and attendees after last year's event.

Engineering Conference

SCTE President Bill Riker kicked off the Annual Engineering Conference pointing out many of the positive moves MSOs have made in not only serving Mr. and Mrs. Subscriber better, but changing any lingering negative perceptions they may have.

Riker highlighted SCTE's involvement in "The Future is on Cable" effort, the "On-Time Customer Service Guarantee," and how they can help please your ultimate bosses—who are, of course, Mr. and Mrs. Sub.

The conference then moved toward the digital realm.

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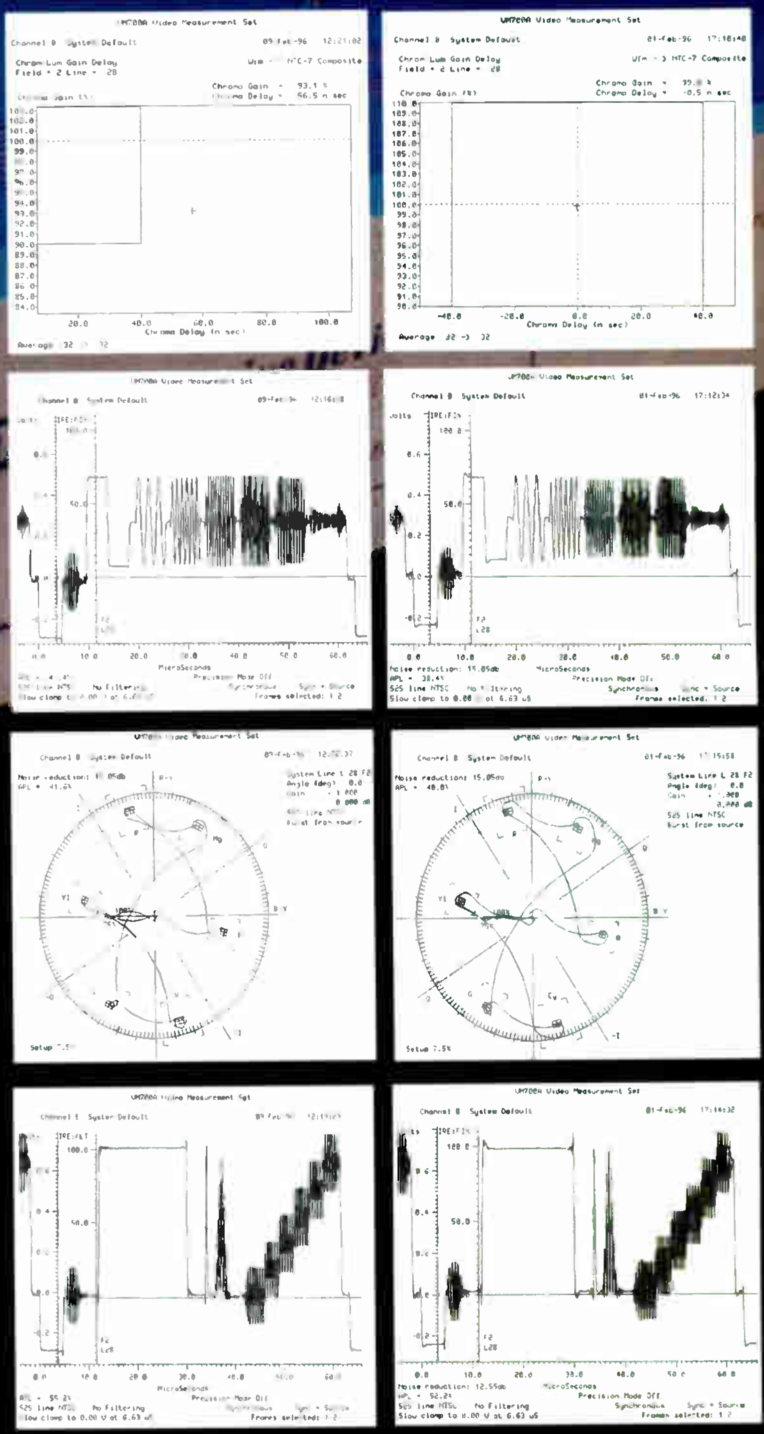

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sorry later. So went the underlying sentiment at the "Preparing for Digital Deployment" section of the conference.

Moderator Jim Ludington of INT2 pointed out that the technical arena is moving from being "hardware-centric" to "software-centric." That paradigm shift, which includes network management software systems, is changing the very way engineers collect, store and ultimately use technical data coming in from their systems. If you're not organizing that data in a smart way, you're losing a valuable tool for getting a digital system up and keeping it up.

As for the ever-present spectre of noise in the system, Ludington emphasized the noise battle should be "a day-to-day procedure, not a nightmare project."

ANTEC's Keith Kraeger took the podium next and offered digital "pre-engineering" tips including the issues of grounding, racking, powering and heat dissipation. Interfacing new digital equipment with your existing equipment is key, he emphasized.

Some "best-case scenario what-iffing" came from Todd Ortberg of ADC Telecommunications. "Keep in mind that there are killer applications that are yet to emerge," he said. Check out his paper in the Expo '97 proceedings manual for a digital data demand "explosion" scenario.

"The one true enemy is wild, unexpected growth," said Van Macatee of TCI Communications Inc. What if your digital customer base, whether it be for video, data or possibly telephony, doubled in a month? Would you be ready?

Macatee said mind-boggling growth in customer demand for services over digital networks is a very real possibility and said a "reactive to proactive" network management shift was necessary for cable systems serious about digital.

Yvette Gordon of Time Warner shared some real-world engineering experience she's gained as director of interactive technologies at the company's Full Service Network. Her bottom line? "Pay attention to system integration. It's the most important piece and it's the most overlooked piece."

The conference then shifted to focus to timing cable modem technology with product strategy.

In the second engineering session, "Cable Modem Technology and Product Strategy," Mark Coblitz of Comcast Cable Communications presented a paper titled, "New Product Models." Growth and new products should leverage skills, assets and relationships, Coblitz said. Infrastructure required to deliver new products involves an assessment of available technology, skill sets and capital.

Jamie Howard of @Home Network talked about the "chicken and egg dilemma": Which comes first, cable modem technology or the product strategy? Service providers need to develop a product plan that takes advantage of broadband opportunity and consumer demand, he said.

US West's Doug Jones compared three media access control (MAC) protocols for cable modems: random access, polling and reservation.

A MAC protocol controls access to the

return path of a cable TV network where multiple cable modems transmit on a single frequency channel. The MAC protocol controls how bandwidth is used among modems sharing the carrier, directly affecting data throughput for users.

Michelle Kuska of TCI, on behalf of MCNS, explained the Data Over Cable Interface Specification (DOCSIS). The DOCSIS working group is comprised of MCNS partners Comcast Cable, Cox Communications, TCI and Time Warner Cable; with Continental, Rogers and CableLabs.

Workshops

A quick glance down the list of this year's Expo workshops was like taking a peak into the future of cable telecommunications engineering. Some of the 10 workshops offered included: Assuring Data-Ready Cable Plants; Digital System Deployment and Measurements; Making Two-Way Work; Managing Your HFC Upgrade; and Return Path Problems and Their Solutions.

More details on those as well as all the other workshops can be found in next month's *CT*.

Awards Luncheon

With so many of SCTE's membership together in one place, Expo is a great place for the Society to honor its best and brightest.

Here's a rundown of a few of the accolades presented at the Society's Annual Awards Luncheon:

- David Devereaux-Weber of the University of Wisconsin won the coveted SCTE Member of the Year Award.
- A Special Recognition Award went to Wendell Bailey for his part in facilitating "the most cooperative period" in the history of the SCTE and the National Cable Television Association.
- John Vartanian, immediate past chairman, presented the 1997 Chairman's Award to MediaOne (the company formed by the merger of US West and Continental Cablevision).
- The gavel was passed to new SCTE Chairman Steve Johnson.
- *Communications Technology* magazine's Senior Publisher Paul Levine presented CableLabs and the SCTE with the Service in Technology Award.
- The winner of the Milton Jerrold Schapp Memorial Scholarship Fund was Erin Sandifer, who will receive $5,000 a year for four years.
- The SCTE's Field Operations Award was

won by Joseph Lanza for his volt meter design.

- New senior members were Jack Terry, Ray Fournier, Keith Hayes, Ray Rendoff, Victor Gates and Paul Gemme.
- Fellow members, nominated by the Society's executive committee, were Robert Dickinson, Wendell Bailey and Walt Ciciora.
- William F. Karnes and James Farmer were inducted into the SCTE Hall of Fame.

Social events

Of course, Expo is a great place to hobnob with your fellow engineering industry-mates and the show offered plenty of social events in the evenings. They included: the Welcome Reception and Cable-Tec Games, Expo Evening at the Rainforest Cafe, the Closing Night Reception, the SCTE-List Reception, and the Amateur Radio Operators' Reception. Coverage of all the fun is in next month's issue. T

Laura Hamilton is senior editor of "Communications Technology."

New SCTE Board Seated at Expo

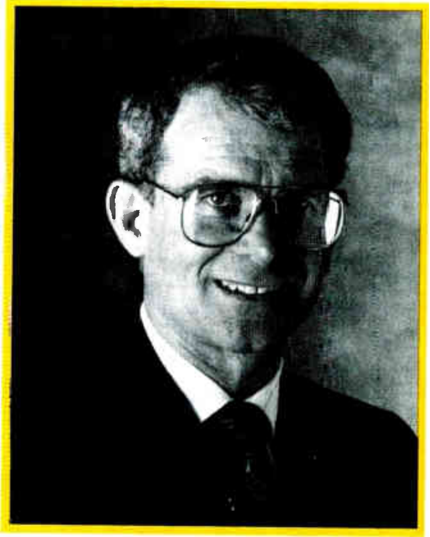
The Society's new board of directors took their seats at Cable-Tec Expo. Taking the open spots were:

- At-Large Directors: Andy Scott of NCTA, and Wendell Woody of Sprint (re-elected incumbent), representing the entire United States.
- Regional Directors: Region 1 Director Ralph Patterson of Patterson Communications, representing California, Hawaii and Nevada; Region 2 Director Steve Johnson of Time Warner (re-elected incumbent), representing Arizona, Colorado, New Mexico, Utah and Wyoming; Region 6 Director Robert Schaeffer of Technology Planners (re-elected incumbent), representing Minnesota, North Dakota, South Dakota and Wisconsin; Region 9 Director Hugh McCarley of Cox (re-elected incumbent), representing Florida, Georgia, South Carolina and the Caribbean; and Region 11 Director Dennis Quinter of Time Warner (re-elected incumbent), representing Delaware, Maryland, New Jersey and Pennsylvania.

They joined the following members currently serving 1996-1998 terms At-Large Director Ron Hranac of Coaxial International (entire U.S.); Region 3 Director Norrie Bush of TCI of Southern Washington (Alaska, Idaho, Montana, Oregon and Washington); Region 4 Director M.J. Jackson of Gilbert (Oklahoma and Texas); Region 5 Director Larry Stiffelman of CommScope (Illinois, Iowa, Kansas, Missouri and Nebraska); Region 7 Director Jim Kuhns of Comcast (Indiana, Michigan and Ohio); Region 8 Director Steve Christopher of Thomas and Betts/Augat (Alabama, Arkansas, Louisiana, Mississippi and Tennessee); Region 10 Director Maggie Fitzgerald of DAVI Communications (Kentucky, North Carolina, Virginia, West Virginia and District of Columbia); and Region 12 Director John Vartanian of Viewer's Choice (Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont).

By Rex Porter

TCI's Tom Elliot: Creating Cable Waves



Thomas Elliot

Thomas Elliot is senior vice president, technical projects for TCI. Following his graduation from Colorado Technical Institute in 1962, Elliot joined the weapons test engineering department of EG&G doing high-speed nuclear instrumentation, timing and firing. In 1964, he went to work for Bob and Betsy Magness as a microwave engineer. He was chief engineer of Western Microwave from 1966 to 1969, when he relocated to Denver as general manager where he was responsible for all phases of TCI's microwave operations in eight states.

In 1980, Elliot moved to TCI's CATV division as director of research and development to investigate the feasibility and reality of two-way interactive services. There he discovered the dominant problems with two-way were largely the same problems that were costing the industry time and money in the cable broadcast distribution of entertainment and worked with the vendors to develop a wide range of standards that address operational problems, including cable, power supply and converter specs.

He has been involved in building the first non-Bell network TV microwave distribution in the United States; the first commercial transportable video uplink in the world; the engineering, installation and operations of the first commercial fiber link for the U.S. Air Force at NORAD; worldwide consulting on microwave voice, data and video systems, and the building of TCI's National Addressable Center. From 1989 to 1991, Elliot served as vice president of science and technology for CableLabs, on loan from TCI.

A frequent speaker on both microwave and cable TV, Elliot has also published numerous papers on these subjects. He is a past chairman of the board and at-large director of the Society of Cable Telecommunications Engineers, founder of the SCTE Interface Practices Committee, and serves on the NCTA Engineering Committee and the Education and Training Committee for the NCTA Cable Center and Museum. In addition, Elliot is chairman of the CableLabs TAC Operations Subcommittee, the holder of a patent on F-fittings and was honored with the NCTA Vanguard Award for Science and Technology. *CT* Editor Rex Porter spoke with Elliot about his drive to implement industry standards and TCI's evolution as a major multi-media communications supplier.

Communications Technology: *One of TCI's latest moves has been to appoint you as senior vice president, technical projects. Knowing of your vast experience with the activities of CableLabs, SCTE, and NCTA engineering in the past, we at CT applaud that move. Care to comment on how you will be coordinating TCI's activities with those groups and others?*

Elliot: The cable industry is well served by the three entities you mentioned. CableLabs is a membership organization whose charter is to innovate, develop and disseminate technology on behalf of the cable operators. The NCTA engineering committee is a forum for the industry to exchange ideas and to support NCTA's lobbying efforts. The SCTE is a due process engineering society that focuses on training, certification and standards. Working together with these organizations, we can do our best to positively impact the issues we all face in today's rapidly changing world. There is so much to do and so many opportunities, that our biggest challenge is establishing priorities; in other words, figuring out what we are not going to spend time and resources on.

CT: *Although many of our readers may not be aware of it, I know that you personally led the efforts toward industry specifications and standards, even before the advent of "full-service networks." I believe we have success with specifications and standards, today, primarily because of your efforts as chairman of the original SCTE Interface Practices Committee. Looking back, how much impact do you feel that committee had with getting the manufacturers and suppliers to realize we needed standardization in equipment?* ➤

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Elliot: It was a great way to start. No one could argue the point. We were buying enough drop cable to replace every drop every other year. We were spending 3 to 8 cents on F-fittings and yet spending 50 cents per fitting per year maintaining them. There were no common sizes of either drop or aluminum cable, each manufacturer built to a different spec with different tolerances. While any standards effort generates some controversy, I thought working on interfaces and the components involved was a good way to get the industry engaged and supportive. Also, I felt we could show progress relatively quick, which is also quite important. These standards are something we all can be proud of, and have helped the cable business immensely.

CT: *You served as chairman of the SCTE board of directors when our industry first began to embrace data transmission, digital TV and telephony. How do you think we could do a better job of making the system owners and operators understand the importance of digital TV, telephony and data transmission training programs available from the SCTE and CableLabs? There has to be a better way to get technician and engineer attendance at the SCTE Cable-Tec Expo, the Emerging Technology Seminar and membership in CableLabs.*

Elliot: The SCTE has matured and risen to the challenges and opportunities that are within its scope. I am proud of the part I played in helping the SCTE success story to continue. However, for years now, one of the SCTE's biggest problems has been marketing our services and programs. Marketing remains a major challenge. There is no question that we should use the advent of digital and these new services for a major marketing push. We are engineers. Consequently we are not good at this. We need help from people and companies that are experts in the marketing field. We have a great story and offerings. We should be able to sell ourselves. Maybe we don't toot our own horn enough, or at least don't toot it in the right places.

CT: *Journalists outside the industry, and some within, have enjoyed portraying TCI in an unfair manner. As the industry's technical journal, we understand how hard it is to keep abreast of technology that changes daily and to have to introduce that technology immediately to the largest customer base in the world. We know your company has evolved from a basic entertainment cable TV company into a multimedia communications supplier. What will be the impact of your new digital TV services?*

Elliot: We have had a doubling rate of about nine years virtually since this business got started. In other words, we have doubled the number of services we offer the customers every eight to nine years, beginning back in 1950 with three channels and, today, approaching 100 channels in some markets. I expect this trend to continue. Clearly, we can not continue to double our bandwidth at the historic rate. We need a new horse to support this process, and that horse is digital compression.

"We need a new horse to support this process, and that horse is digital compression."

Cable got started as a "re-broadcast" service, moving or re-broadcasting the major markets into rural America. Using satellites, we evolved into a multichannel "add choice" business with movies, sports, new, etc., available any time, 24 hours a day.

We have changed the way the world perceives TV. Until recently, TV has been a social instrument controlled by the government virtually everywhere except North America. It is a very different experience to watch 30 to 80 channels of "add choice" TV vs. two or three channels of either network or government TV. Now, with digital compression, we are evolving to what I call "personal TV," where each member of the household will be able to watch what they want, when they want it.

CT: *When your new appointment was announced, TCI also announced the appointment of Tony Werner as senior vice president, engineering and technical operations. I know how highly you regard Tony's abilities as an engineer. How will Tony interface with your department?*

Elliot: Tony is an extremely capable guy as well as just being a good human being. We will work closely together on policy and strategic issues. His broad array of interests and knowledge will be of significant value to me in my new role. I also expect to take "acting" assignments in his shop where I can help and it's appropriate.

CT: *What advice would you give to technicians and engineers, especially those coming into our industry from other industries?*

Elliot: The same advice I give everyone. Get involved. Think. Ask "Why?" Hold yourself accountable for driving value in the customer's eyes. Challenge yourself and the system to do what's right. This is an industry with great challenges and therefore great opportunities.

CT: *And finally, as we move into becoming "full-service networks" and further away from traditional entertainment suppliers, what new products and services do you see lurking just over the horizon for cable telecommunications?*

Elliot: That's tough. Honestly, no one predicted the World Wide Web. No one. However, some things are predictable. The communications environment in the home is going to get more complicated. Homeowners are going to become willing to hire someone as their "integrator." I think we are well positioned to add value by performing the integration function. Consumers are intuitively beginning to understand this bold new world where they are in charge. The old days of the king, the tribal leader, or the government being in charge and developing technology (primarily for military purposes), to keep themselves in charge, are dead.

As an example, we now see technology developed for the game market trickling up to the military. Over time, this change in the human experience will have profound effects on society. However, the demands this evolving process places on communications, and the way people will demand individual choice in everything they do, will be good for us. With our entrepreneurial architecture the future is ours. Let's be sure we capture the opportunities we have worked so hard to gain. CT

Rex Porter is editor of "Communications Technology." He can be reached in Mesa, AZ at (602) 807-8299 or via e-mail at tvrex@earthlink.net.

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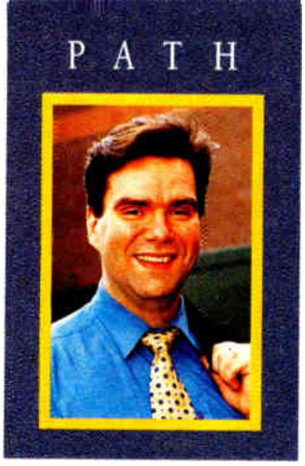
By Alex Zavistovich



Telecommunications Is Hard

At the SCTE Cable-Tec Expo '97, a couple of distinct themes emerged. The first could be expressed in one word: Return. The second was a little trickier to put into words, but—from my perspective, at least—the two themes are linked.

Return is self-explanatory. Too few cable engineering professionals have an intimate understanding of the return path, which was evident from the technical sessions and workshops at the Expo dedicated to the topic. Without this understanding, though, your chances of successfully launching telecommunications services are pretty slim.

As for the second theme, it was alluded to by US West's Doug Jones, in the second engineering session of the conference. He was talking about cable modem transfer protocols, but it cuts to the heart of the matter for cable engineering in general.

Jones' pearl of wisdom was succinct: "A couple years ago, we voted to change the 'T' in SCTE from 'Television' to 'Telecommunications'. Now it's payback time."

You don't have to dig too deep to get the concept here. Basically, it means that telecommunications engineering is hard. It's hard, and it demands commitment.

I'm not being sarcastic, either. Just sit in on a discussion of protocol layers for cable modems, and you'll know what I mean. MAC layer, PHY layer; it can make your head spin. Telephony and networking are just as confusing. With the alphabet soup of SONET, ATM, ADSL, and OS-1 sloshing in your noggin, it can be hard to know where to start when you're planning your network.

In fact, even planning itself can be a challenge for some old-school cable engineers making the transition to bidirectional cable networking. Remember, when

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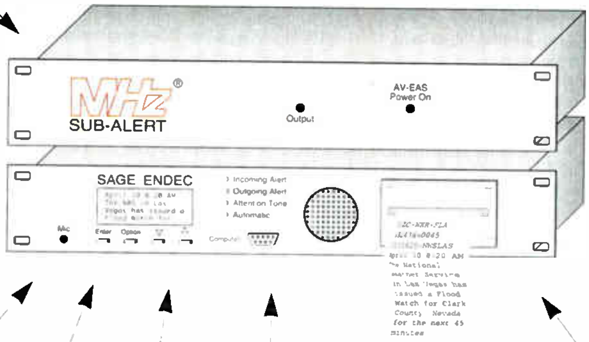

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many engineers started in the industry, they could fly by the seat of their pants, inventing ways of doing things as they went. There weren't too many problems that couldn't be patched with a MacGyver-style jerry-rigged combo of a bent paper clip, a penny and a wad of chewing gum.

Unfortunately, true telecommunications systems aren't quite so accommodating. Planning becomes critical, not only in the headend/central office but all the way down the line. For example, say you want to deliver all the nifty services that digital broadband technology can offer. Are you even sure the equipment you need will physically fit into your facility? And what about return amplifiers at the street node level? You can't just cram it all on the pole and hope for the best, after all. There are zoning ordinances in most communities that restrict that kind of clustering on utility poles.

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At a minimum, get your BCT/E certification. Read Digi-Points in *Interval*. When the telecommunications certifications are finalized, add them to your training plans. Sure, telecommunications is hard, but you're lucky enough to have great resources at your disposal, courtesy of the SCTE. It may be complicated, but you're up to the challenge. Good luck. CT

Alex Zavistovich is executive editor of "Communications Technology." He can be reached in Potomac, MD, at (301) 340-7788, ext. 2134.

EAS On Hold

Hot news at last month's Cable-Tec Expo was the FCC's extension of the deadline for implementation of the Emergency Alert System (EAS) by cable operators. The question is, who couldn't see that coming?

Cable operators with more than 10,000 subs were supposed to have converted to the EAS by July 1. By June, however, the FCC still had not prepared a second report and order on the matter, and operators were in no hurry to adopt the alert technology with the Commission still riding the fence. Even so, the FCC was unwilling—right up to the eleventh hour—to grant an extension.

At press time, FCC staff would give no time limit for the extension, even though operators will likely not do much to ready their systems for EAS until word comes down. Watch *CT* for more information as it becomes available.

By Ron Hranac

Subscriber Drop Wiring For Interactive Services

Got your attention with that title, eh? If you're planning to introduce some sort of two-way service in your system, then the following information will be helpful. Unfortunately, there will be little that you haven't heard before, because there really is no magic to having good quality drops.

Why do I spend so much time harping about drops, you ask? One of the important things to understand about two-way cable TV systems is that up to 95% of the problems occur in the subscriber drops: about 25% between the tap and the ground block, and the remaining 70% from the ground block to the in-home devices.

Some useful terms

Here are a few definitions that apply in the two-way world. Yeah, I know, some of these are pretty basic, but bear with me. They're not in alphabetical order either, but rather are grouped together by how they are related.

Two-way CATV system: A cable TV system that is capable of carrying signals in two directions simultaneously. Typically the downstream, or forward, signals (headend to subscriber) are in the 50-550 MHz range, and the upstream, or reverse, signals (subscriber to headend) are in the 5-40 MHz range.

Subscriber drop: The coaxial cable and other hardware that connects the subscriber's in-home equipment to the cable TV company's coaxial distribution network. It usually includes all wiring and components between the utility pole or pedestal and the TV set.

Signal leakage: When the cable network's shielding is inadequate for some reason, signals inside the cable can "leak" out and interfere with over-the-air signals. These leaks can occur at loose connections, points where the cable or connectors have been damaged, as well as from poorly shielded cable or from poorly shielded devices connected to the cable.

Signal ingress: The opposite of signal leakage. When over-the-air signals from two-way radio or pager transmissions, interference from electrical sources, etc., "leak" into the cable and interfere with the cable TV signals, you have ingress.

Impulse noise: Short duration, fast risetime pulses of noise caused by electrical arcing, electric motors, switches, hair dryers, automobile ignitions, neon signs, static from lightning, etc. When ingress occurs in a two-way cable TV system, some of the interfering signals may include impulse noise. Impulse noise can seriously disrupt data transmission on a cable TV system.

Tri-shield cable: Subscriber drop cable that has three layers of shielding. The first layer is a mylar-backed aluminum foil, which should be bonded (glued) to the cable's dielectric; the second is aluminum braid; and the third layer is aluminum foil.

Quad-shield cable: Similar to tri-shield cable, except the shielding comprises four layers—bonded foil, braid, foil, and braid.

Messengered cable: Coaxial cable with a steel support wire molded into the cable's plastic jacket. The steel support wire is called a messenger wire. The messenger wire provides structural and physical support, and prevents damage to the cable from wind flexing, stretch, and ice or snow buildup.

Drop passive device: Subscriber drop components such as signal splitters, directional couplers, ground blocks, isolators, filters, and impedance matching transformers. These devices do not contain active circuits such as amplifiers, hence the term "passive."

Home run wiring: Subscriber drop wiring technique where all cables are routed from a central signal distribution point to each outlet. Each outlet has a dedicated cable from the signal distribution point to the outlet terminal. Also called "star" wiring. This is the best way to install cable outlets.

Loop wiring: Subscriber drop wiring technique, especially common in multiple dwelling units (MDUs), where the outlets are wired in series. For example, one cable is routed from the signal distribution point to the first outlet; from the first outlet, a cable carries signals to the second outlet; from the second outlet a cable carries signals to the third outlet, and so on. This is the worst way to install cable outlets.

High pass filter: A passive device containing a filter that passes all signals above a certain frequency called the "cutoff frequency," and blocks all signals below the cutoff frequency. In North American systems, the cutoff frequency is usually around 50 MHz, so the filter will pass all signals above 50 MHz, and block all signals below 50 MHz. (Some filter manufacturers have available so-called "windowed" high pass filters. These function much like a normal high pass filter, except that a small portion, or "window," of the usually blocked frequency range below 50 MHz passes upstream signals from, say, impulse pay-per-view converters, but blocks the remainder of the upstream spectrum.) In two-way cable TV systems, high pass filters are commonly used in the drops of non-two-way subscribers to prevent ingress interference from getting into the network's upstream signal path. ➤

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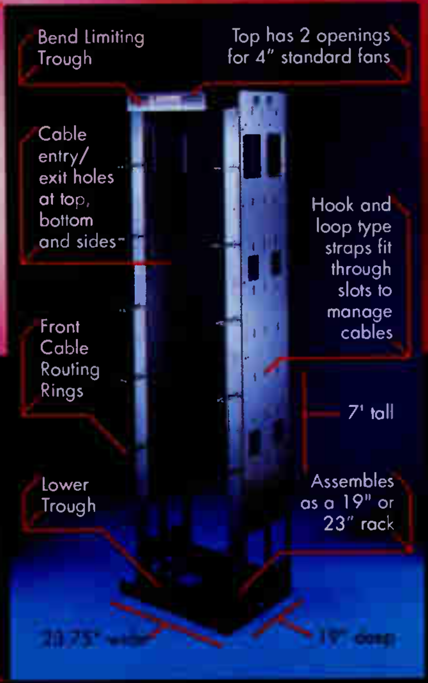

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High quality materials are important for two-way operation and the provision of interactive services. Let's start with the drop cable: The minimum recommended shielding configuration is tri-shield. In some cases quad-shield may be necessary. In all cases the cable must have the inner shield bonded to the dielectric. Nonbonded foil is too easily pushed back under the cable's jacket during connector installation, which will result in signal leakage and ingress.

I've said it many times before, and here it is again. Messengered drop cable must be used for all overhead drops, regardless of the length of the drop. The integral steel messenger wire provides physical and structural support to the cable. When nonmessengered cable is used, the cable's shield will eventually develop small radial cracks caused by flexing of the cable near the support grips at the utility pole and the house. These radial cracks (sometimes called "tiger striping") will result in signal leakage and ingress.

All underground drops should use cable that is manufactured with a flooding (filling) compound under the jacket. If the cable jacket is nicked or scratched during installation, the flooding compound will "flow" to fill the small abrasion, thus keeping water out of the cable. For extra protection against moisture and corrosion damage, cable with corrosion inhibitor compound should be used for the exterior portion of all overhead drops. Don't use either of these types of cable for indoor wiring, unless the cable manufacturer has specifically stated that is may be used for that purpose. Some protective compounds are designed to flow, and could drip out of the end of the cable at the connector interface. Murphy's Law says it will drip out on the subscriber's expensive carpet.

If you have any of the old style two-piece F-connectors (especially the ones with a separate 1/8-inch crimp ring), toss them in the dumpster. You should be using only modern one-piece connectors.

It is very important to use high quality drop passives. The physical design of some drop passives does not provide adequate RF shielding. Splitters are one good example. Better shielding performance is available with splitters that have crimped, press-fit, or soldered covers. The low cost splitter with a thin sheetmetal back cover that is merely glued in place is probably the worst design. The reason is the glue seeps under the cover during the assembly process, and prevents good cover-to-housing electrical contact.

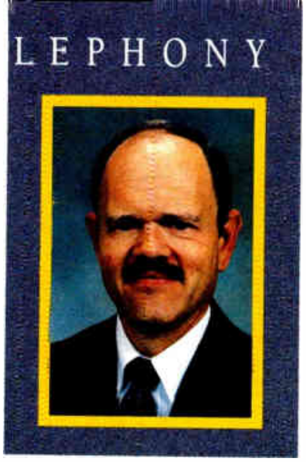
High pass filters are available with stop-band attenuation specifications of up to 60 dB or more. In most cases, the 40 dB versions will be adequate.

The use of good quality materials alone won't guarantee trouble free drops. If you don't install those materials properly, you're wasting your company's money and time.

Next month I'll continue this discussion with some thoughts about installation practices, quality control, signal leakage and ingress, grounding and bonding, and the use of high pass filters and common mode chokes.

Ron Hranac is senior vice president, engineering for Denver-based consulting firm Coaxial International. He is also senior technical editor for "Communications Technology."

By Justin J. Junkus



The Magic of Analog To Digital Conversion

Sometimes you luck out. Cable is going digital at the speed of light. Cable is also interested in telephony, or you wouldn't be reading this column. Telephony has been digital for years. Once you learn how one communications industry converts analog information to digital form, you can more easily understand how the other communications industry does the same thing. Let me explain further.

Converting information from its analog form to its digital form is a process with the same three steps, irrespective of whether it's cable TV or telephony. These three steps are called sampling, quantizing and encoding. Bringing digital data back to its analog form is simply called decoding. Soon after you put voice information into the telephone transmitter, it is converted into digital form for switching and transmission on the telephone network. Likewise, very soon after an image is captured by the TV camera, the video information it contains is coded into digital form. Once something is coded into digital form, it becomes a series of bits. It doesn't matter if it's a computer or a set-top converter receiving that bit, the equipment is still processing a series of ones and zeros.

Sampling

Because this is a cable telecommunications publication, let's first look at how a video signal is sampled. The camera is the first stop, because that's where a real life image is converted to information consisting of pixels on a grid. Photosensors at the pixel location capture the image light levels. This is analog information, since the light at each pixel can take on an infinite number of values to describe the color (chrominance) and the brightness (luminance). Because our eyes have different sensitivity levels to color and brightness, video information is separated into these two components as it is processed. The degree of sampling and coding is less for chrominance than for luminance, because of this difference in the way our eyes perceive color and brightness. To keep it simple, this column will discuss video digitization as a single operation for both chrominance and luminance. Just remember we are doing everything twice, once for each component.

The camera's photosensors convert the levels of chrominance and luminance into numerical voltage values representing the shade of the color or its brightness. This information is still an analog representation, since it can take on an infinite number of values. At this point, voice telephony isn't much different. Instead of a camera, we use a microphone of some type (a.k.a.: transmitter) to change sound pressure waves into electrical voltages. Just like video information, those voltages can take on an infinite number of values.

Our video signal has a much larger bandwidth than its voice telephony counterpart, however. For this reason, during the sampling step, the analog video signal is changed to its representation as a sum of sinusoidal frequencies in what is called the frequency domain. The way this is done is to use a mathematical relationship called the discrete cosine transform. The result is a grid, or matrix, of numbers representing the amplitudes of the individual frequencies that are contained in the total video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signal. This matrix is still an analog sample, since each of its coefficients can take on an infinite number of possible values.

Conversion of the video sample to the frequency domain is done because the frequency domain is a more efficient way to hold and compress high bandwidth information. The low bandwidth voice telephony signal doesn't have this problem, so once it is sampled, it is left in the time domain.

Now we're ready for the second step in A to D conversion, called quantization. For video, the input to this step is the frequency domain matrix. For telephony, the input is the set of sample values of the voice frequency signal.

Quantization

Quantization is a rounding process. A video signal is quantized by dividing the numbers in the frequency domain matrix by quantizing coefficients, and rounding to an integer. This is where video quantization has a different objective than telephony's voice quantization. The purpose of the rounding that occurs in video quantization is to generate a new set of numbers with only a few non-zero values. These non-zero numbers represent the most significant part of the video information. The zeros become place-holders of sorts, and when many of them appear in sequence, they can be replaced by much fewer characters in the encoding process. You probably recognize this replacement as a form of compression.

Errors from the video quantization process are minimized because the numbers which have been rounded to zero represent higher frequency components in the frequency domain, which add little to the information content of the signal.

Telephony voice signal quantization, unlike video quantization, is operating in the time domain, and is not looking to generate zeros in the rounding process. Sample values are rounded to "quantum levels," and most of the resulting numbers will be some value other than zero. Errors are kept to a minimum by making the quantum levels small relative to swings in the amplitude of the sampled signal. One of the most common quantization scales in voice telephony is the μ-255 scale, so called because it has 255 separate quantum levels.

Encoding

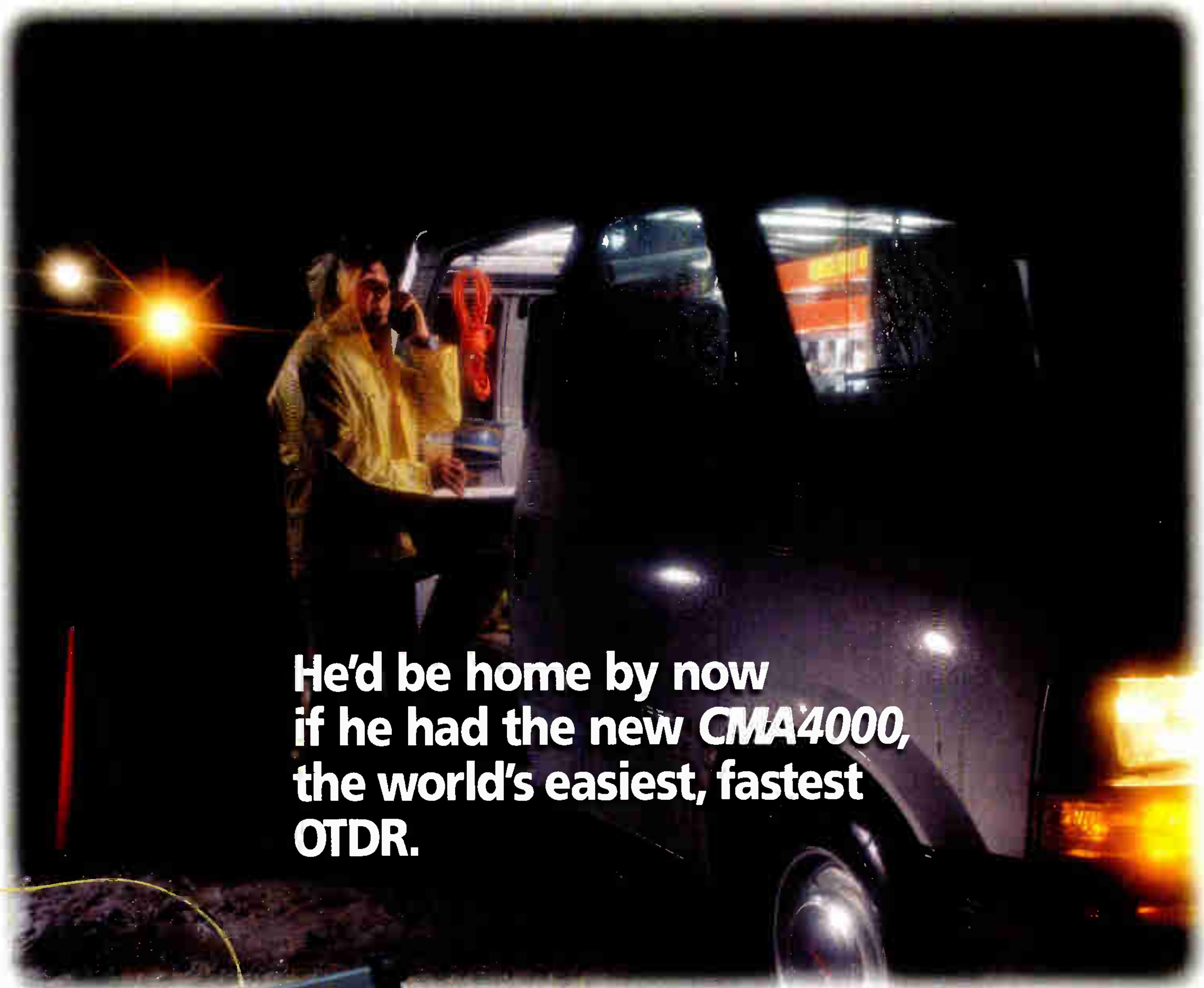
This final step in A to D conversion simply changes the representation of the numbers in the quantization step from base 10 (the way humans count) to base 2 (the binary system used by digital machines). In a video system, this is also the stage where one or more forms of compression may be applied by treating common patterns of strings of zeros or other characters as a shorter representation. The result for video will be a binary string of digits. If compression has been applied, the string does not correspond one to one with the original base 10 number, but contains patterns that will be recognized and reconverted in the decoding process.

Voice telephony encoding is simpler. Because the voice frequency signal is low bandwidth, compression may be completely omitted from this step. Typically, the 8 bit binary number which is the output of this step corresponds directly to the value from the quantization step.

Going from digital to analog is called decoding. For video, that means reconstructing a time domain signal from the strings of ones and zeros representing frequency domain information, and extrapolating data to account for anything that was dropped in the A to D process. For voice telephony, the reconstruction is simple. Since all the information remained in the time domain, it is only necessary to reconvert binary numbers to base 10. Filtering smoothes the transition between sample values to pick up the rounding errors. If the quantum levels were small enough, the human ear cannot detect any difference from the original signal.

No matter how complex the signal, there are only three basic steps to go from analog to digital form, and a decoding process which brings digital back to analog. Complex video signals require a change in the way they are represented as they are processed through the steps, but the steps remain the same. What started as a continuous waveform ends up as a series of ones and zeros, which a digital machine can understand, store and further process. When the information is returned to a human receiver, it must be decoded back to the analog form that humans understand. Once you realize there are only three steps, you can analyze the differences between video and telephony within the steps to the degree you need for your own work. CT

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



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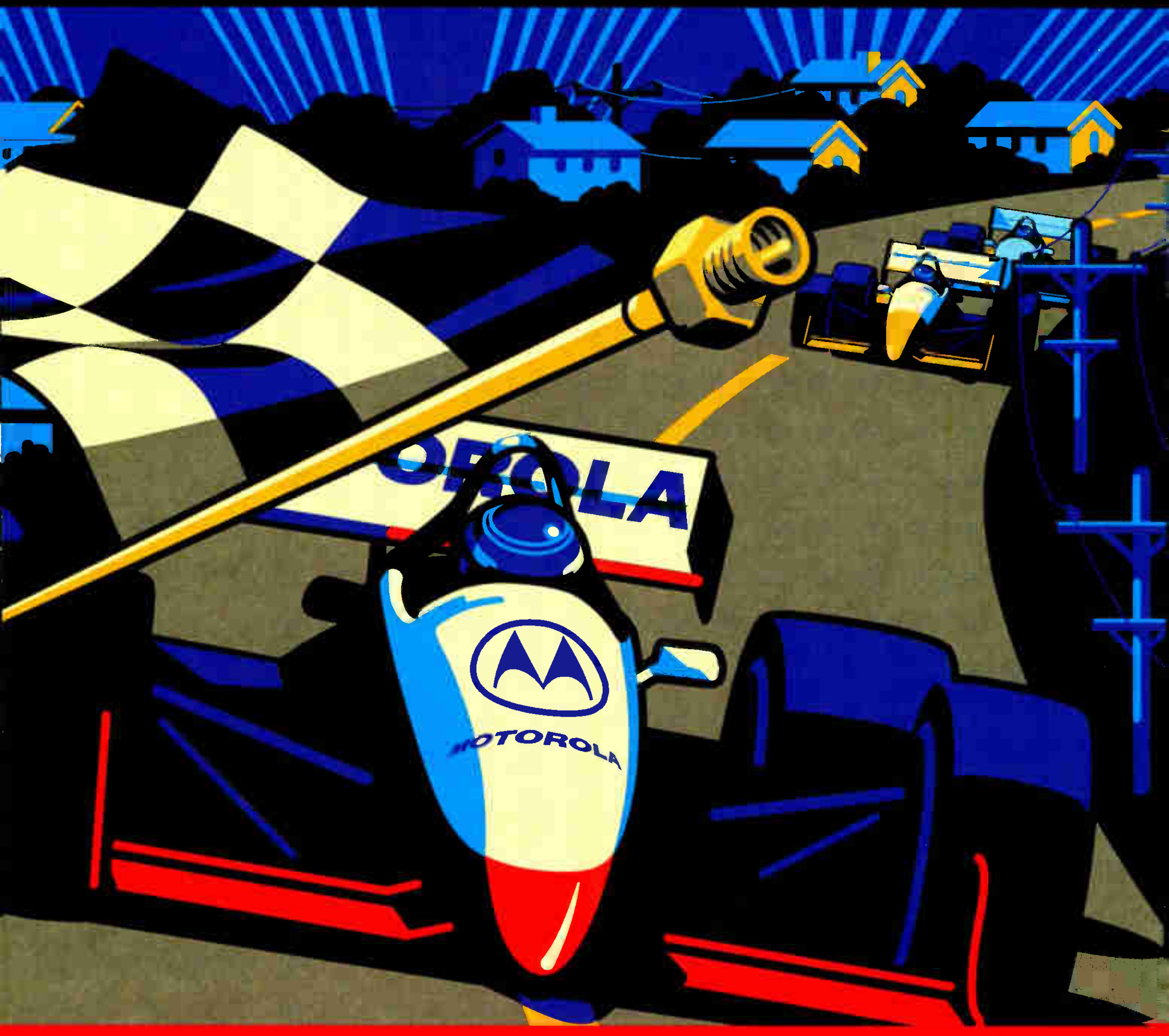

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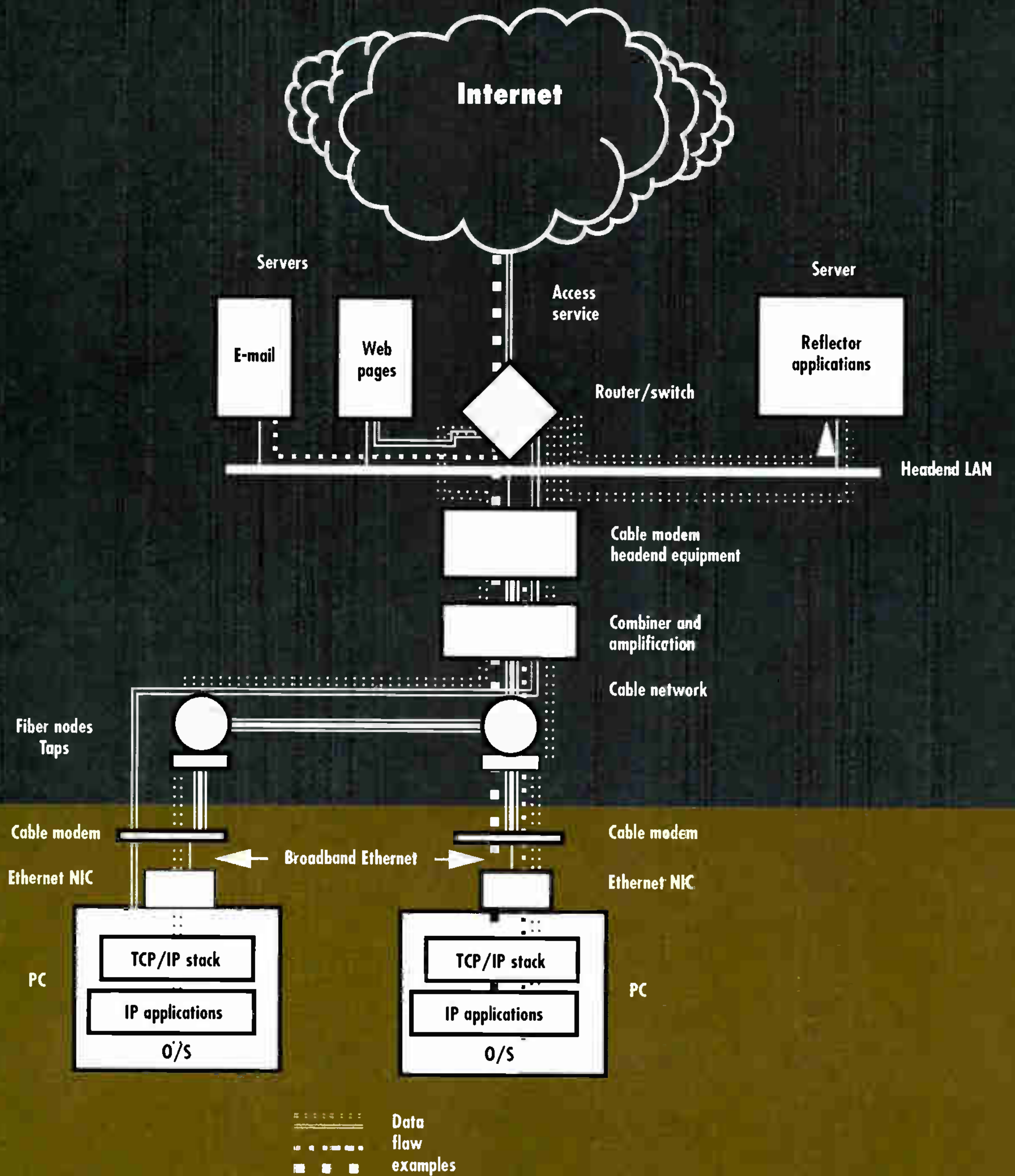

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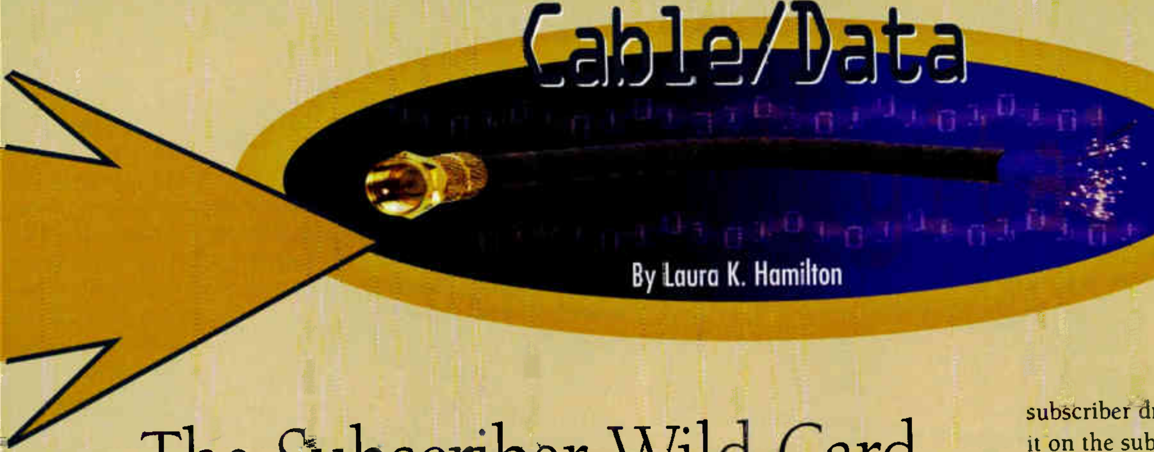


By Laura K. Hamilton

The Subscriber Wild Card

Trump Leakage by Tackling Dirty Drops

Let's say you could somehow neatly separate your system into three crisp and clean categories: the headend, the transmission system, and the customer premises. Obviously, it would be overly simplistic to explore each part in a perfect vacuum. It's a system after all, and a system by definition is a collection of interacting parts that form a unified whole—interacting being the key word.

However, for discussion purposes in this special "Communications Technology" report, let's use those three categories as a start for defining what should be done to get your cable system ready for the promises of high-speed data delivery. In the May issue, we took on the headend. Last month "CT" looked at the transmission system.

In this final installment of this series, we take on the customer premises (where the vast majority of upstream problems are bombarding the two-way network). Like your system, this three-part series is really a network made up of different parts, and each installment should be considered with the others in mind.

He's every cable engineer's nightmare. Not five minutes after your installer's truck pulls out of his driveway, he starts hacking away at the install with a butter knife. Maybe he'll run out to his local electronics store and buy a cheap, low-grade splitter. Or maybe his cute little puppy thinks your drop cable is a great doggie chew toy.

He may be a nightmare, but as the customer, he's the boss. And like it or not, the boss is an enormous reason why there's all that trash (namely, ingress) being dumped into the upstream portion of a two-way cable system.

You've heard the stats again and again, but they are worth repeating here. An estimated 95% of ingress and other problems affecting the upstream originate in subscriber drops. About 25% of the problems happen between the tap and the side of the subscriber's house (exterior drop wiring), 70% occur between the side of the house and the TV set (interior wiring), and only 5% are network-related.

So you've got return woes. You want to offer two-way high-speed data delivery in your system, but your upstream is less than pristine, to say the least. Judging from the previous statistics, a big part of your problem is your customer, over whom you have little to no control.

Where do you go from here?

Controlling what you can

First off, make sure you are doing everything you can to ensure a clean subscriber drop before you start blaming it on the subscriber. Ron Hranac, senior vice president of engineering at Coaxial International, suggests the following subscriber drop checklist:

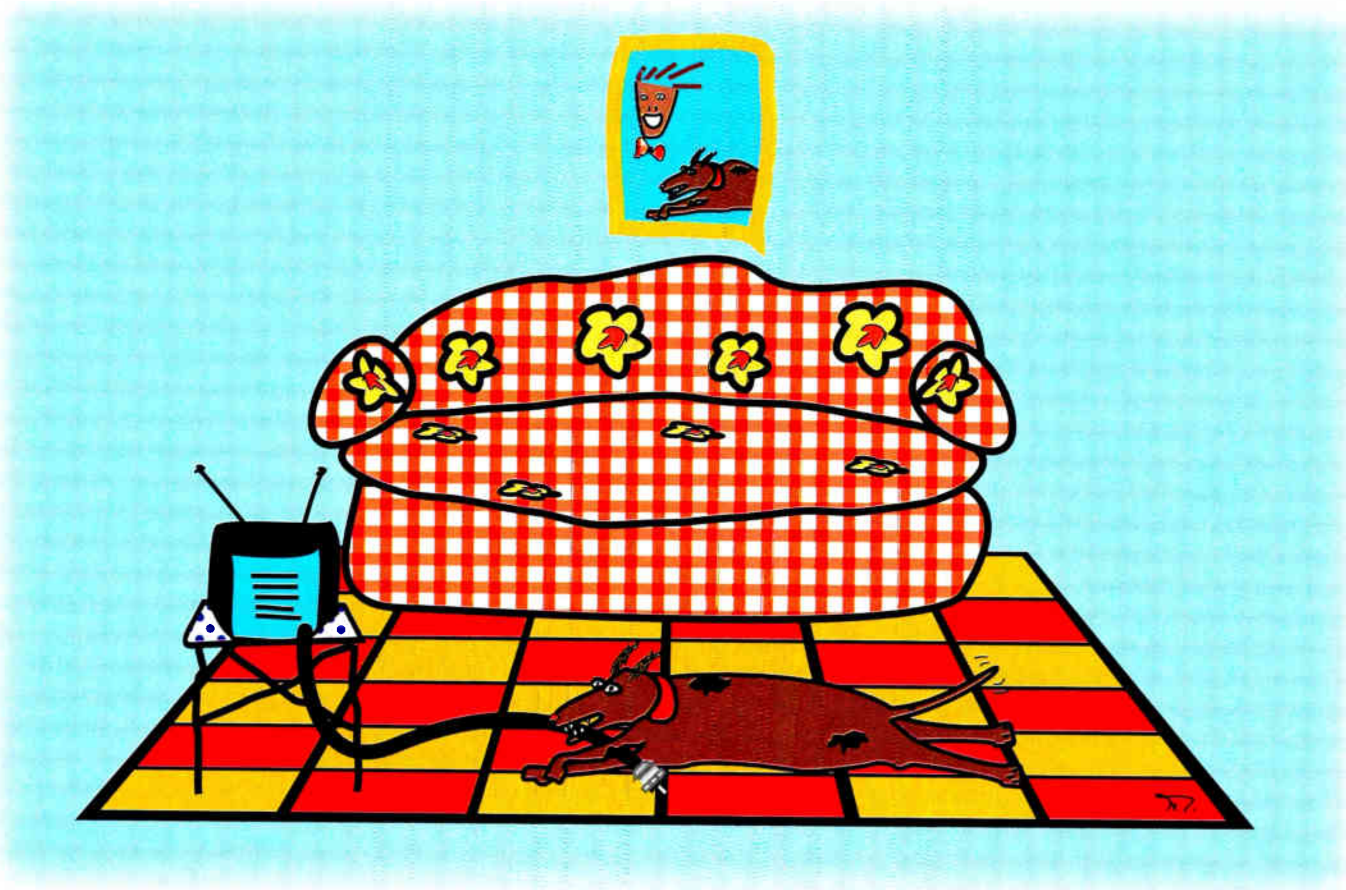
- Use only messengered cable on aerial drops.
- Use corrosion inhibitor type cable for all aerial drops and flooded cable for all underground drops.
- Use tri-shield or greater shielding on all drops.
- Install good quality connectors, hardware and drop passives.
- Practice good installation.
- Fix drop-related leakage and ingress problems.
- Use proper common-point grounding/bonding to minimize ground loops and sheath currents.
- Use high-pass filters and common mode chokes for problem drops.

To filter or not to filter

Let's take up Hranac's last point on the previous list—that is, high-pass filters. Even though most in the industry give them the nod as a necessity for reducing ingress problems in the return, there seem to be two general schools of thought on how extensively they need to be utilized. The two arguments, while not far apart, go something like this:

1) Filters are a temporary fix and should only be relied on for extremely problematic drops.
2) Filters are something of a "necessary evil" and may need to be installed a little more often than just at "extremely problematic drops."

We spoke to Dan Engelhardt, an engineer at Time Warner's Road Runner service in Portland, ME. (In case you've been living in a proverbial cave, Road Runner is TW's high-speed Internet access service.) Engelhardt said filters are "a big Band-Aid." ➤



"This system usually only uses them at houses that aren't subscribing to Road Runner or when we can't get hold of the homeowners, " Engelhardt said.

He's pretty confident in his drops especially because his system was rebuilt recently. Drops were cleaned up and installer training was "extensive, " he reported.

Customer training also was a part of the solution. Engelhardt noted, "We let them know we are using the sub-band. We try not to get too technical, but when you see a ham radio antenna on top of their house..."

Ham radio antennas, indeed. There are so many factors as to how subscribers can contribute to a messy upstream, that some are taking up the filter option with a bit more vigor.

"The MSOs have some really good crews observing due diligence, but you still don't know what the subscriber will do," pointed out Norm Reinhardt, vice president of technology and product development at Pico Macom. "The sub is the continual wild card.

With so many potential wild cards in your system, an open-minded look at installing more high-pass filters could be in order.

It seems that it comes down to a matter of preference. If your system was recently rebuilt and all the drops tightened, you'll probably vote for fewer filters. If you're not so lucky, you may need to use those filters more extensively as you go back and clean up your drops.

> "There are no short cuts."
>
> —*Dan Engelhardt, Road Runner of Portland, ME*

Regardless of your situation—and since you'll probably never be able to guarantee perfect drops throughout your system—the high-pass filter is a necessary tool in your engineering bag of tricks.

Tom Staniec of TW's Excalibur Group had this to say about the subject: "You have the options of total filtering, problem/partial filtering, spot problem correction or hope for a modulation scheme so robust you never have to worry about the return at all."

"If you chose that last one, I'd like to talk to you about a bridge I have for sale," Staniec added.

Culture changes

Staniec's stock answer to whether cumulative leakage index (CLI) measurements are relevant to the return is: "No, there is not a lot of correlation."

But he did make the curious observation that some of TW's Road Runner locations have *zero* ingress in the return portion of the band *without* high-pass filters, equalizers or other devices. Yes, you read that right. Zero ingress. No high-pass filters.

He noted that this is a recent observation, but sees a common thread occurring for systems that are clean vs. systems requiring work in the return.

"Every one of the clean systems has on their flyover 99% of all leakage in the range of -6 to -20 dB at the flight altitude," Staniec said.

What does that mean exactly? Staniec said it fleshes out to ground-based CLI ride readings between 5 to 10 μV/m everywhere in the system, *including all drops.* ➤

"The procedures used in these systems require that all installation, service and supervisory personnel carry leakage detectors and check all drops at each visit," Staniec noted.

He also explained, "This is a lifestyle change. You do not just slap on a detector and hope in the course of a month you 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."

Van Macatee, director of advanced network management at TCI Communications also took up the cry for a change of culture.

"The standing culture in a cable system is typically individual technician-centric. In other words, individuals make their own decisions on what and when they work," Macatee said.

For Macatee, this is counterproductive and will undermine the reliability of the overall service in an advanced network that carries Internet services. "Strict compliance with a change control and scheduled maintenance policy is vital to success. Every effort should be made to install this new culture, " Macatee explained.

> **"This is a lifestyle change. You do not just slap on a detector and hope in the course of a month you have all your problems resolved."**
>
> *—Tom Staniec, Time Warner's Excalibur Group*

In conclusion, perhaps it's best to end with the sentiments of an engineer who works with an up-and-running data service—namely, Road Runner's Dan Engelhardt:

- Clean up your drops.
- Train your installers extensively.
- Educate your subscribers so they know how they affect your network and how that will affect their service.
- Use high-pass filters when you have to in order to control those certain few "uncontrollable" subscribers.

In other words, as Engelhardt puts it, "There are no short cuts." CT

Reference

Ron Hranac and Tom Staniec, "Making Two-Way Work (Part II)," Cable-Tec Expo '97 Proceedings Manual, Society of Cable Telecommunications Engineers, 1997.

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Reader Service Number 44

How the Digital Revolution Drives the Internet

I'm often asked about the convergence of telecommunications, computing, and entertainment-oriented consumer electronics. While the convergence of these industries defines a rather large context for potential questions, the most frequently asked questions relate either directly or indirectly to the digital revolution and the Internet.

There are numerous dynamics that will govern the evolution of the Internet and the benefits it provides to its users. The diverse nature of a few of the more substantial "digital revolution" issues that will shape the Internet, and its related user benefits, can be seen by considering such topics as:

- Future (federal, state and local) regulatory developments and existing legislation definition and refinement;
- Compression, content encoding and encryption technologies and their evolution;
- Wide-area content distribution mechanisms and transport economics;
- Microprocessor and peripheral bus performance and storage system performance/capacities;
- On-line programming language developments;
- HDTV technology and directions;
- Display technology developments and related standards;
- Electronic commerce developments;
- Developments in switching fabrics and silicon fabrication processes/technologies;
- Telecommunications technology developments in transport (including broadband/fiber HFC, wireless, satellite, and local loop), and network access devices such as high-speed cable modem solutions, high-speed telephony solutions ("in" DSL technologies);
- Telecommunications infrastructure deployment (including two-way HFC networks, PCS and other terrestrial wireless deployment and global-linked satellite networks); and even
- Economic postures (such as stock value, debt, cash flows) of primary infrastructure deployment companies.

The evolution and interaction of these primary dynamics, and numerous other related developments, will ultimately define the scope and extent of benefits the digital revolution brings to Internet users.

Some evidence exists as to the likely course several of these dynamics will follow, as well as their impact on—and significance to—future Internet users. It would be pure speculation, however, to postulate details of the potential Internet user benefits they might define. (Perhaps in another 18 months or so it would be possible to accurately forecast many more definitive aspects of the future Internet services user-environment as they relate to these issues.)

Many benefits of the digital revolution have already taken root in the Internet infrastructure, as well as in the minds of those who use it. Some of these benefits are literally quite visible to Internet users, while others are largely buried in the infrastructure and less noticeable to end users with respect to being identified as a unique individual benefit.

For example, the capability to easily consume increasingly sophisticated multimedia content (such as video, graphics, sound and images), or interact with other users or applications through network applets and plug-ins, are already commonplace capabilities enabled by digitization that are largely taken for granted by typical Internet users. On the other hand, infrastructure-oriented developments such as class-of-service related Internet and transport transmission protocols (RSVP, ATM), switch and router performance improvements, advances in computing and bus technologies, are not readily visible as individual benefits, yet contribute substantially to the quality of the overall Internet experience.

How the underlying service delivery infrastructure contributes to the Internet experience should be of special interest to most readers of this publication. Cable TV's entry into Internet services delivery strikes an interesting chord with respect to the digital revolution's impact on Internet users. The visible aspects of Internet services mentioned previously are primary drivers of the Internet's evolution, since without continuing user appeal, the Internet would be short-lived.

The emergence of cable TV infrastructures (such as Internet services delivery networks, especially from the ergonomic perspective), virtually ensures a continued momentum in the evolution of Internet services value. Multiple classes and diversity of

Internet services, as well as entirely new forms of services ("push"-type services enabled through most types of cable modem access), all bode well for a significant and promising role for broadband/HFC networks in Internet service delivery. In addition, the role of broadband/HFC networks in Internet services delivery will play a substantial role in the evolution of those services.

Other Internet user benefits of the digital revolution have to do largely with how the Internet evolves, and the nature of what it ultimately becomes. The concept of "info-tainment"—the merger of information and entertainment—encourages a robust view of future Internet services.

With the emergence of HDTV, in combination with many of the related technical dynamics already mentioned, suggests a very interesting set of alternative developments in "info-tainment." Already listed as the primary reason for using the Internet by the majority of current users, the continuing fusion of information and entertainment is another primary driver of digitization, and will likely continue to drive developments in this area.

Perhaps a better topic of debate would be in response to the question of "Will the Internet ever replace TV as an entertainment choice?, or better yet, "Will the Internet become TV?" A quick review of the fundamental dynamics mentioned earlier, issues that are shaping the Internet's evolution today and for the foreseeable future, suggest that regardless of what the Internet becomes in the future, the road to the future will be interesting indeed. CT

BOTTOM LINE

Telecom in the Digital Age

The future of the Internet is entwined with the digital revolution. Increasing use of digital technology will drive developments in regulation and legislation, electronic commerce, and the economic well-being of the companies that provide the infrastructure for the Internet.

What to watch for: Evolving compression and encryption technologies; better, more reliable transmission of data and other signals; and improvements in transport, switching, display and online programming.

The snowball effect: Buildout of cable TV infrastructures virtually ensures continued evolution in the value of Internet services. New services, including "push"-type technology, hold promise for enhancements to broadband/HFC networks, and vice versa.

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Three Media Access Control Protocols

Let's take a look at media access control (MAC) protocols implemented for use with cable modems. As the name indicates, a MAC protocol controls access to a medium, which in this case is the return path of a cable TV network where multiple cable modems transmit on a single frequency channel.

A MAC protocol is not needed on the forward path of a cable modemsystem because a shared carrier is not used. Only a single cable modem termination system (CMTS), generally located in a distribution hub for hybrid fiber/coax (HFC) systems, will transmit on a forward carrier to the cable modems. The CMTS uses its forward channel to send data, as well as control and administrative messages, to modems.

The intent of the MAC protocol is to arbitrate transmission on the shared medium. A good protocol will make efficient use of the bandwidth on the medium. In the case of the return path, clean bandwidth is a scarce resource and must be conserved. As

more and different return path services are deployed (impulse pay-per-view, telephony, data, personal communications services, video conferencing, etc.), the return path bandwidth will continue to be used up. An MSO should deploy products that use this bandwidth efficiently. As a result, modem manufacturers have evolved their MAC protocols to be more efficient as the service have matured.

The return path is shared among all the devices that communicate on it. For the case discussed here, a group of cable modems share a specific carrier frequency on the return path. All modems that transmit on this return path carrier must follow the rules of the MAC protocol, as directed by the CMTS. As an example,

BOTTOM LINE

Which MAC Protocol Flavor Is Best?

What is MAC protocol? A media access control (MAC) protocol is responsible for controlling access to a shared medium (say, a return path carrier used for transmitting data).

What does it mean to Joe Internet (your customer)? The performance of the MAC protocol will determine how successful a modem is at transmitting on that carrier and this directly relates to the throughput a user will experience.

In this article, three examples of cable modem MAC protocols are discussed: random access, polling, and reservation. The latter is current "state-of-the-art."

MCNS vs. IEEE: There are two groups working on reservation-based MAC protocols, and they are philosophically taking different paths.

- Multimedia Cable Network System (MCNS) consortium has specified a MAC protocol that is optimized for variable length data packets as used with Internet protocol (IP) networking.
- The Institute of Electrical and Electronics Engineers (IEEE) 802.14 committee has optimized its MAC protocol for asynchronous transfer mode (ATM) traffic.

consider a common 2 MHz wide quadrature phase shift keying (QPSK) carrier. With current technology, this carrier can deliver more than 2 Mbps of data. It is the MAC protocol that controls how this bandwidth is allocated among the modems that share the carrier, determining which cable modems can transmit when, and how long. The performance of the MAC protocol will determine how successful a modem is at transmitting on that carrier and this directly relates to the throughput a user will experience.

In the most simple of MAC protocols, any modem can transmit whenever it has data. If two or more modems transmit at once, the messages will collide and the data will be lost. When a collision occurs, each modem will first have to detect that collision and then retransmit, possibly colliding even again.

The MAC protocol is critical to the efficient use of return path bandwidth. If the MAC protocol allows too many collisions, bandwidth is wasted. If the MAC protocol constrains modems to transmit one at a time, data will get through on the first attempt and the return path bandwidth will be used efficiently.

While efficient use of return path bandwidth is critical, there is another important reason to have a good MAC protocol. This is the user. When there are a lot of collisions and retransmissions, the user will perceive a "slow" system. On the other hand, having data get through the first time helps the user perceive a "fast" system. Hence, the MAC protocol directly impacts the experience of the end user. Since the cable industry is advertising cable modems as providing faster Internet access than telephony modems, an MSO should deploy product with a MAC protocol that provides the best service for the consumer.

Let's discuss three examples of cable modem MAC protocols: 1) Random access, 2) Polling, 3) Reservation

Variations of the first two of these protocols are available in cable modems today. Reservation is the most recent advancement in cable modem MAC protocol and a version defined by the Multimedia Cable Network Systems (MCNS) consortium is being implemented now.

As a consequence of allocating return path bandwidth, the MAC protocol relates directly to how an MSO can provide quality of service (QOS) for modem users. QOS is a concept whereby certain users are guaranteed more data throughput than other users and is a service that marketing can use to sell cable modems. If certain customers want to pay more for guaranteed bandwidth, they can be accommodated based on the implementation of the MAC protocol. When there are many users on the system, those guaranteed a higher QOS will receive preferential treatment with respect to data transmission and hence will receive greater data throughput as compared to users with a lower QOS.

Random access

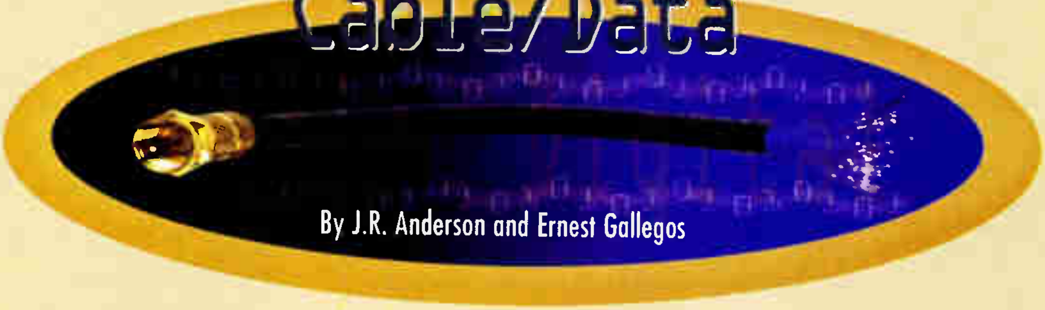
This protocol is accurately described by its name. In a random access based system, any modem can transmit whenever it has data. If more than one modem transmits at a given time, the data will collide and have to be retransmitted, which slows the response to the user. When a collision occurs, the modems must recognize data has been lost, generally by not getting an acknowledgment over the forward path, and only then will they retransmit. This sounds inefficient and is. Additionally, as more modems are added to the network, there will potentially be more collisions. With more collisions, there are more retries and even less data gets through. On a busy system, it is possible to get as low as 30% throughput. That is, 70% of the throughput is used for collisions and retries, an inefficient usage of the return path.

With a random access protocol, there is no way to guarantee QOS. Since any modem can transmit whenever it wants to, no modem is guaranteed throughput.

There is a place for a random access MAC however, and that is as an Ethernet local area network (LAN) interconnection. For example, a business with several locations might have individual Ethernet LANs at each location to interconnect. An MSO could offer an interconnect service that would be on par with a "leased line" Ethernet connection between the sites. If the cable operator can offer this service at a lower price using an HFC network, rather than another interconnect company, there is a potential business opportunity.

A polling-based MAC protocol has advantages over a random access based

Continued on page 104



By J.R. Anderson and Ernest Gallegos

Know Your Inside Wiring Options

In today's cable telecommunications arena, it has become less and less of an option for engineers and technicians to define themselves as purely "cable" or "telephony" or "computer." And that's especially true when you start getting into data delivery. With many cable operators taking up the telephony return path option—at least as a start toward learning the high-speed data delivery business—it is becoming imperative that the cable technical community improve its understanding of telephony wiring.

BOTTOM LINE

The Twisted-Pair Twist

Gone are the days that the cable technical community could basically ignore the down-and-dirty details of twisted-pair wiring. That was the competition's deal...

But in today's data arena, many cable ops are taking up the telephony return path option, and it's prudent to understand twisted-pair—especially at the customer premises—in part because it essentially becomes an element in *your* system.

Strategies for engineering supervisors and their technicians:

- It is imperative that cable's technical people become able to quickly recognize the existing wiring scheme in the home and the type(s) of connectors used in the wire system. The wire routing, connector type and housekeeping of connections places practical limits on the services available within the dwelling.
- Administering data services through existing loop wired systems is time-consuming, both for new services and re-locations to other outlets. This makes it much harder for supervisors to schedule installer workloads. Specific strategies need development to maximize efficiencies for the work force.

This article explains the basics of twisted-pair evolution, its installation history and practical guidelines for maintaining wire systems. Topics include the definition of unshielded twisted-pair (UTP), a history of tip and ring, color coding for telephone cabling, loop vs. home run wiring, physical connection schemes and testing of structured wiring systems.

Any distribution scheme routing video, voice and/or data throughout a residence or business environment is classified as a wiring system. These internal networks have evolved from simple voice-grade telephone distribution systems into sophisticated, high-speed digital transport avenues. Customer needs have forced the business environment to rapidly evolve over the last decade and residential development is now gaining a wider audience due to work-at-home developments and outsourcing by employers. It has become unacceptable to force new customers to continually upgrade internal wiring as new network speeds and services are marketed by providers. The concept of backwards compatibility is more important in dealing with the residential segment, particularly since homes and apartments were not originally wired to support the newer networking access speeds. Modem vendors have been forced to deal with the ever-growing number of multiple providers of networking connections. This battle refocuses on practical limitations of existing wiring and recommendations for new wiring deployment.

The existing, or wired universe, domain continues to work fairly well for analog voice provisioning. Older wiring systems can be forced to allow multiple vendors of voice services to provide dial-tone within the premise (building or residence). It is the desire to network computers that has forced connection providers to upgrade and change business strategies to meet market demands.

Structured wiring?

The existing universe tends to consist of copper wires running from a building's

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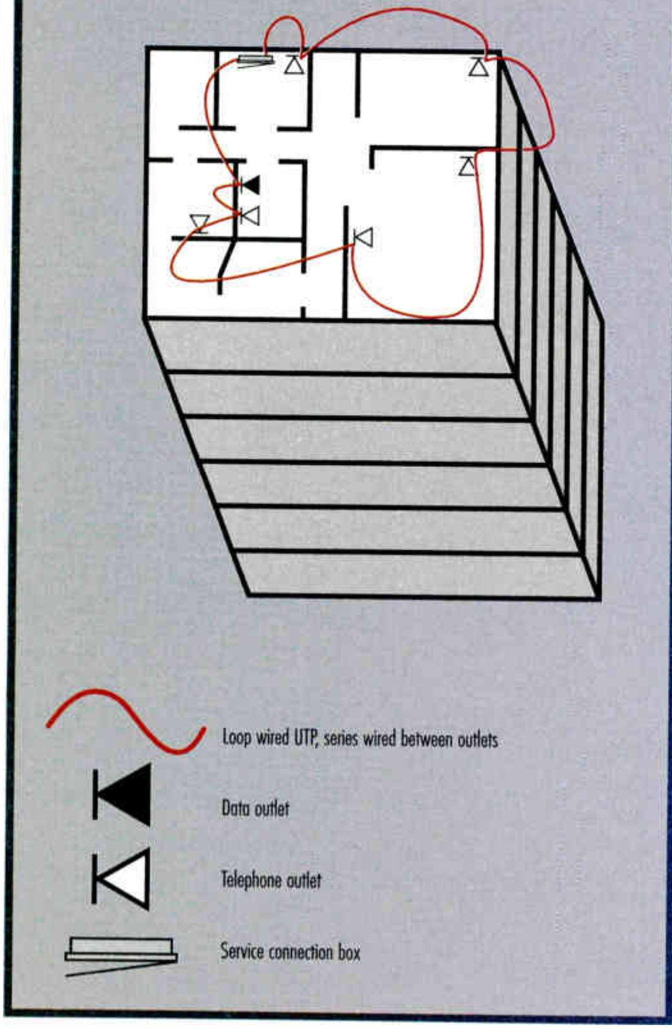


Figure 1: Loop wired structured wiring

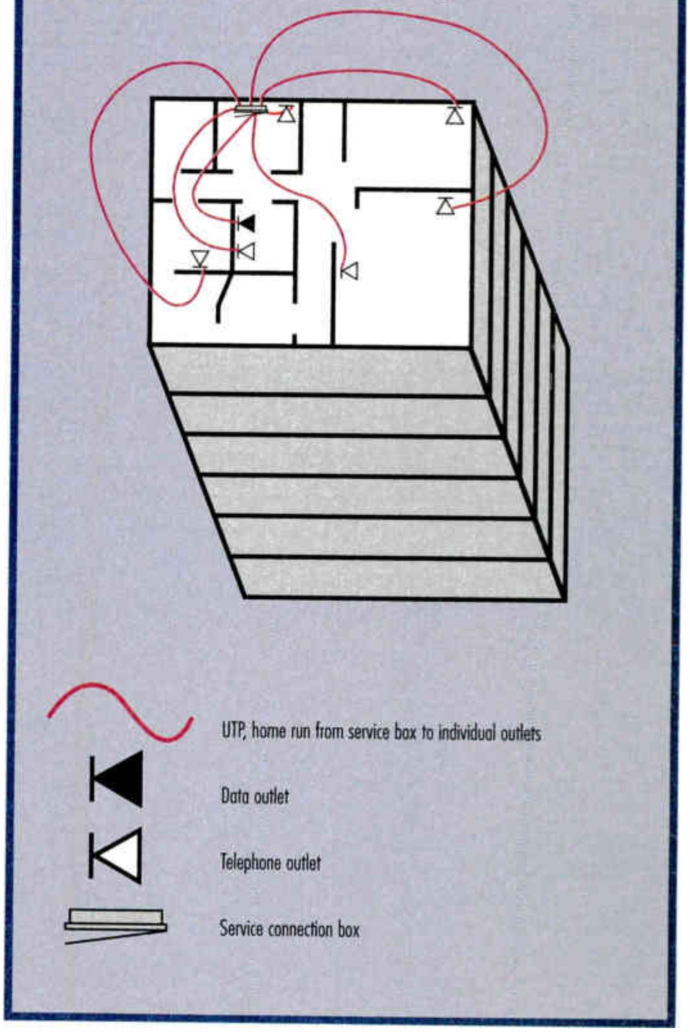


Figure 2: Home run structured wiring

entry to individual outlets—predominantly of a loop-wired nature. Most cable telecommunications personnel are familiar with the limitations of loop wiring for video: signal degradation, outlet wiring problems and administration of set-top box controlled access. The same issues occur when customers want to add different telephone and data services within an existing residence or office. Existing wires were typically run in a looped fashion (series wired) by the original electrician from outlet to outlet. Wire was acquired from wherever the contractor purchased and installed the product to provide 30-4,000 Hz of voice bandwidth.

The advent of data modems and the need for new outlets where a computer or satellite receiver resides has forced businesses and homeowners to install additional outlets to existing distribution systems. Twisted-pair conductors are typically not offered with any external electrical shielding. UTP is the standard media used today to interconnect voice and data services within a premise—be it business or residence.

The data market has forced better connection schemes and revised architectures to increase the local bandwidth of wiring systems. Home run or dedicated conductors from the individual wall plate are installed back to a hub or star-point. This technique for UTP conductor placement allows changes of service to be provisioned to each individual user location, and ensures high capacity connections up to 100 Mb/s. Different classifications of UTP cabling and connectors may be purchased that specify delivery of varying amounts of bandwidth to users. Loop wiring and home run systems are reviewed in Figures 1 and 2. Several modular wall plate and connector variations are shown in Figure 3 on page 58. Beware—multiple standards for connectors and pair terminations exist!

Tip and ring

Tip and ring are derived from the old patch cord days when live operators were used to connect the telephone world together. The 310 cord that went to the calling party would be plugged into that party's line. The 310 cord had a tip (the point of the plug). The middle of the 310 plug was called the ring and the outer part of the 310 plug was called the sleeve. When the 310 plug was inserted into the slot, the current was placed to the line from the switch office equipment. The line would have -48 VDC (talk battery).

POTS (plain old telephone service) is a relatively simple circuit. It takes a tip and ring, commonly called a pair, to establish a telephone connection. Current (-48 VDC) or voice outbound is sent on the tip wire. Return path, or receive, is on the

Continued on page 58

Cable Modem Facts At-a-Glance

By Andrew Morris

Company	Address	Modem Model	Modem Type	Upstream Frequencies	Upstream Modulation	Upstream Data Rate	Upstream Channel BW
New Media Communications	Tel Aviv, Israel	Cyber City010 ASK	Internal PC: ISA Bus	Telephone Return	Telephone Return	Telephone Return	Telephone Return
		Cyber City020 QAM 64	Internal PC: PCI Bus	Telephone Return	Telephone Return	Telephone Return	Telephone Return
		Cyber City 020 QAM 256	Internal PC: PCI Bus	Telephone Return	Telephone Return	Telephone Return	Telephone Return
Motorola	Schaumberg, IL	CyberSURFR	External	5 -42 MHz	pi/4-DQPSK	768 kbps	600 kHz
NetGame Cable	Givatayim, Israel	NeMo	External	5 - 42 MHz	QPSK	up to 5.5 Mbps	up to 2.75 MHz
		Phazer	Extenal	5 - 42 MHz	QPSK	6 Mbps	2 MHz
		Juno	Internal PC: PCI Bus	5 - 42 MHz	QPSK	6 Mbps	2 MHz
LANCity	Andover, MA	LCP Personal Cable Modem	External	5-42 MHz	QPSK	10 Mbps	6 MHz
		LCw Four User Workgroup Cable Modem	External	5-42 MHz	QPSK	10 Mbps	6 MHz
		LCb Multi User Cable Modem	External	5-42 MHz	QPSK	10 Mbps	6 MHz
Terayon	Santa Clara, CA	TeraPro	External	5-42 MHz	16 QAM	14.3 MHz	6 MHz
Zenith	Glenview. IL	HomeWorks Unviersal LANHWU-5K	External	12 - 108 MHz	BPSK	500 kbps	1 MHz
		HomeWorks Unviersal LANHWU-4M		12 - 108 MHz	BPSK	4 Mbps	6 MHz
Toshiba	Irvine, CA	PCX Cable Modem	External	88 MHz-750 MHz	QPSK	8.192 Mbps	6 MHz or less
Hayes	Norcross, GA	ULTRA	Internal PC: ISA Bus	Telephone Return	Telephone Return	Telephone Return	Telephone Return
IBM	Research Triangle Park, North Carolina	IBM Cable Modem	External	5.1 - 40.1 MHz	QPSK	2.56 Mbps	1.8 MHz
Com21	Milpitas, CA	ComPORT	External	5 - 40 MHz	QPSK	2.56 Mbps	1.8 MHz
Intel	Santa Clara, CA	CablePort CBL6MDM9701	Internal PC: PCI Bus	Telephone/ISDN	Telephone/ISDN	Telephone/ISDN	Telephone/ISDN
General Instrument	San Diego, CA	SURFboard SB1000	Internal: PC ISA Bus	Telephone Return	Telephone Return	Telephone Return	Telephone Return
Scientific-Atlanta	Norcross, GA	dataXcellerator CM-1000	External	Telephone Return	Telephone Return	Telephone Return	Telephone Return
		dataXcellerator 2	External	5 - 40 MHz	QPSK	1.5 Mbps	1 MHz
Hybrid Networks	Cupertino, CA	Client Cable Modem CCM-201	External	Telephone Return	Telephone Return	Telephone Return	Telephone Return
		Client Cable Modem CCM-221	External	8 - 15 MHz	FSK	19.2 kbps	300 kHz
Toshiba	Irvine, CA	PCX Cable Modem	External	10-40 MHz	QPSK	2.048 Mbps	1.5 MHz or less
US Robotics	Skokie, IL	U.S. Robotics Cable Modem	Internal	Telephone Return	v.34	33.6 kbps	Telephone Return
Phasecom	Cupertino, CA	Speed-Demon	External	5-42 MHz	QPSK	2.56 Mbps	2 MHz

GADLine—information not available at press time

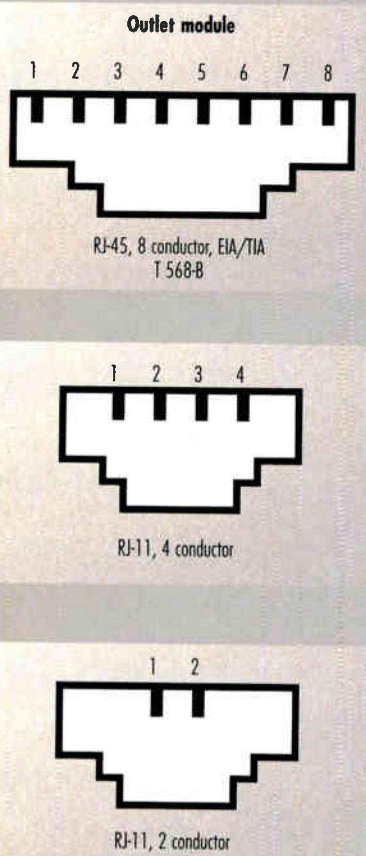
Editor's note: They say you can't tell the players without a scorecard. That's particularly true in the fast-growing technology segment of cable modems. Startups compete with established names and networking companies make technology acquisitions to better service the end-to-end needs of their customers. Things are moving pretty fast.

What follows is our best effort to keep track of the actual hardware now on the market. We at "Communications Technology" understand that new companies may have entered the race after this chart was compiled. If we have inadvertently omitted any companies, for whatever reason, feel free to contact us at 1201 Seven Locks Rd., Suite 300, Potomac, MD 20854. We will happily publish information on companies missing from this list.

Andy Morris is a freelance writer out of New York.

Downstream	**Downstream Frequencies**	**Downstream Modulation**	**Downstream Data Rate**	**Notes Frequencies**
48 -855 MHz	ASK	550 kbps per modem	5 MHz	total throughput is 5.5 Mbps per channel
46 -862 MHz	QAM 64	9.62 - 38.43 Mbps	6 - 8 MHz	
46 -862 MHz	QAM 256	12.83-51.24 Mbps	6 - 8 MHz	
65 - 750 MHz	64 QAM	30 Mbps	6 MHz	
50 - 820 MHz	QPSK	12 Mbps	6 MHz	
50 - 820 MHz	256 QAM	38 Mbps	6 MHz	Phazer & Juno are same modem - Phazer is an internal PC Card and Juno is an External modem
50 - 820 MHz	256 QAM	38 Mbps	6 MHz	
54 - 750 MHz	QPSK	10 Mbps	6 MHz	owned by Bay Networks
54 - 750 MHz	QPSK	10 Mbps	6 MHz	
54 - 750 MHz	QPSK	10 Mbps	6 MHz	
400 - 750 MHz	16 QAM	14 Mbps	6 MHz	Access scheme is S-CDMA; Cisco Systems has equity interest in Terayon
50 - 750 MHz	BPSK	500 kbps	1 MHz	2-way or telephone return
50 - 750 MHz	BPSK	4 Mbps	6 MHz	2-way or telephone return
10-40 MHz	QPSK	2.048 Mbps	1.5 MHz or less	
55 - 850 MHz	BPSK	4 Mbps	6 MHz	
54 - 800 MHz	64 QAM	30.72 Mbps	6 MHz	
300 - 800 MHz or 88 - 450 MHz	64 QAM	30.336 Mbps	6 MHz	3Com offers same modem under name 3Com Home Modem - 3Com has equity interest in Cam21
300 - 750 MHz	64 QAM	5.056 Mbps	6 MHz	also available for European 8 MHz channel configuration
54 - 806 MHz	64 QAM	26.9707 Mbps	6 MHz	
300 - 600 MHz	9 QPR	6 Mbps	3 MHz	
54 - 800 MHz	QAM	27 Mbps	6 MHz	tentatively scheduled to ship in 1st Quarter 1998
54 - 806 MHz	64 QAM	10 Mbps	2 MHz	supports up to 20 PCs; single user version is N-201
54 - 806 MHz	64 QAM	10 Mbps	2 MHz	supports up to 20 PCs; single user version is N-221
88 MHz-750 MHz	QPSK	8.192 Mbps	6 MHz or less	
50-860 MHz	256/64/16 QAM	27 Mbps (in 64-QAM mode)	6 MHz	
50-860 MHz	64 QAM	30 Mbps	6 MHz	

Figure 3: Telecommunications terminations, modular jack fields



Plug end of connector

Pin#	Color	Tip/ring
1	W O	Tip 2
2	O W	Ring 2
3	W G	Tip 3
4	B W	Ring 1
5	W B	Tip 1
6	G W	Ring 3
7	W BR	Tip 4
8	BR W	Ring 4

Pin#	Color	Tip/ring
4	Y	Ring 2
3	G	Tip 1
2	R	Ring 1
1	BK	Tip 2

Pin#	Color	Tip/ring
2	G	Tip
1	R	Ring

Warning: Multiple pin assignments exist on plugs and wall plate modules! Use caution when specifying install components.

Continued from page 54

ring. This is known as a positive ground system, where power flows from negative to positive. When the station set (customer receiver) is raised, current flows from the switch office, over the ring side of the cable pair, through the set and back to the central office on the tip side of the pair. The circuit is completed by the battery or voltage source since the tip is grounded at the switch office. Today, tip and ring designations are still used and two wires are required to establish most telephone connections.

These two wires are known as a twisted-pair, which means that the two wires are twisted around each other a given number of times per foot. The number of wraps of each pair also has to do as to where the pair lies in the bundle of wires that make up a cable. Twist helps on power induction and noise influence.

Today, as in the early days, telephone cables are placed on the same poles as power lines (typically 48 inches below power). Telephone cables also are placed in the same trench as power (12 inches minimum earth separation from power is recommended.)

Color coding

Color coding of the conductors for inside wiring and outside copper cables is best explained using examples. Inside UTP is typically installed in two-, three- and four-pair increments of bandwidth capacity and are rated by category. For example, Category 3 and 5 cabling systems are the most common in today's telecommunications arena. Category 3 cables are specified for 16 Mb/s rates, while Category 5 cabling has a 100 Mb/s capacity. The color code for two (2) through eight (8) conductor inside cable is detailed in Figure 4 on page 60.

Outside plant cabling and typical telephone service cables are color coded differently. Strict housekeeping is necessary when dealing with copper pair administration since 25-pair binders are grouped inside of one cable sheath. Table 1 on page 68 depicts the pair assignment and colors within a typical 25-pair binder group. Also, the binder group color schemes for up to 600 pair is shown in Table 2 on page 68.

To distinguish the different pairs from each other, a color code was developed for the telephone cable. (Note: This color code scheme is different than the one used for resistors.) The color code is used on 25 pairs of wires and repeats on multiples of 25 pairs. At first, there were problems with many different color codes. The current code in use has 10 colors: white, red, black, yellow and violet (known as tips), and blue, orange, green, brown and slate (known as rings). There are five of each color. So, for example, Pair 1 would be white-blue, Pair 2 would be white-orange and so on to Pair 25—violet-slate.

Binder groups also use the same color code to determine one 25-pair group from additional 25 pair groups in the same cable. Group 1 has a white-blue color just as it has in Pair 1. Binder Group white-blue is Pair 1 to 25 and Binder Group White-Orange is Pair 26 to 50. Binder Group White-Slate is Pair 101 to 125 and so on to Binder Group Violet-Brown, which is Pair 576 to 600.

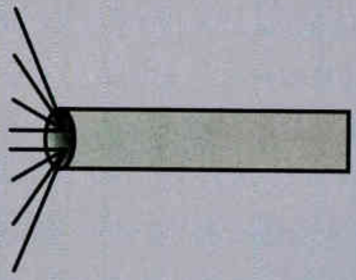
Wiring and connection

The internal wiring at the customer location, referred to as the premise, is of prime concern for the purpose of this discussion. It is imperative that the installer/technician be able to quickly recognize the existing wiring scheme in the home and the type(s) of connectors used in the wire system. The wire routing, connector type and housekeeping of connections places practical limits on the services available within the dwelling.

Older types of cables and its connections force the installer to determine the best means of adding service through the entry facility (service box), after the protection system is installed on the drop. This protector—carbon block, gas tube or solid state—is routinely mounted on the outside wall and functions much as a cable TV ground block. Transient voltages or


RiserBond
MODEL 1205C
PULSE WIDTH
VOP
CONTRAST
CURSORS
WAVEFORM

Figure 4: UTP, four-pair/eight conductor cabling



Pair#	Tip (+)	Ring (-)
1	White/blue	Blue/white
2	White/orange	Orange/white
3	White/green	Green/white
4	White/brown	Brown/white

Category 3 = 16 Mb/s rate, two twists per foot, minimum.
Category 5 = 100 Mb/s rate, varying short pair lay technique.

undesired current is shunted away from the premise wires by these telephone protectors. In multiple dwelling units (MDUs) the surge protection systems will vary in physical appearance; however, its function is to isolate the outside plant and any transient energy from the building's structured wiring system.

One of the largest challenges to the new installer is efficiently determining the wiring scheme within the unit or home. Tracing the drop wires from the entry point through the dwelling requires the knowledge of where the outlets are located and the level of service currently provided. If a single set of telephone wires leave the entry, it is obvious that loop wiring was used, especially if multiple phone outlets are currently in service. New service may be provided to new outlets in parallel to an existing loop. This is a common means of adding a datacom outlet for a home office application. Routing the new wires through a crawl space or attic is a common installation practice; twisted-pair cables tend to be easier to place than their coaxial counterparts.

The UTP wiring is smaller in diameter and minimum bend radius is far less critical than video cabling,. However, care in maintaining clean connections and placement skills is important for higher speed data services. Should the existing loop wiring be utilized for new outlet activation, a careful review of all intermediate wall plates may be required to activate pairs not previously in service. In these instances, it may actually be easier to place new cabling from the service box to the new outlet location. This new cable with new connectors could easily offer higher transmission speeds than could ever be forced through the existing wire system.

Home run drop systems are the norm in today's business world. Newer homes and apartments are moving to star-wired architectures to allow for multiple service providers and ease of service administration within the dwelling. Strategies must be developed that enable the technician to rapidly determine which scheme is most effective for the customer's application. As usual, the most lasting impression left with the new customer is the quality of the installation!

The actual connection utilized on the twisted-pair is the practical limitation on network throughput within the dwelling. The use of Category 5 wiring without proper connection techniques would effectively waste the added price premium

Figure 5: Network interface unit

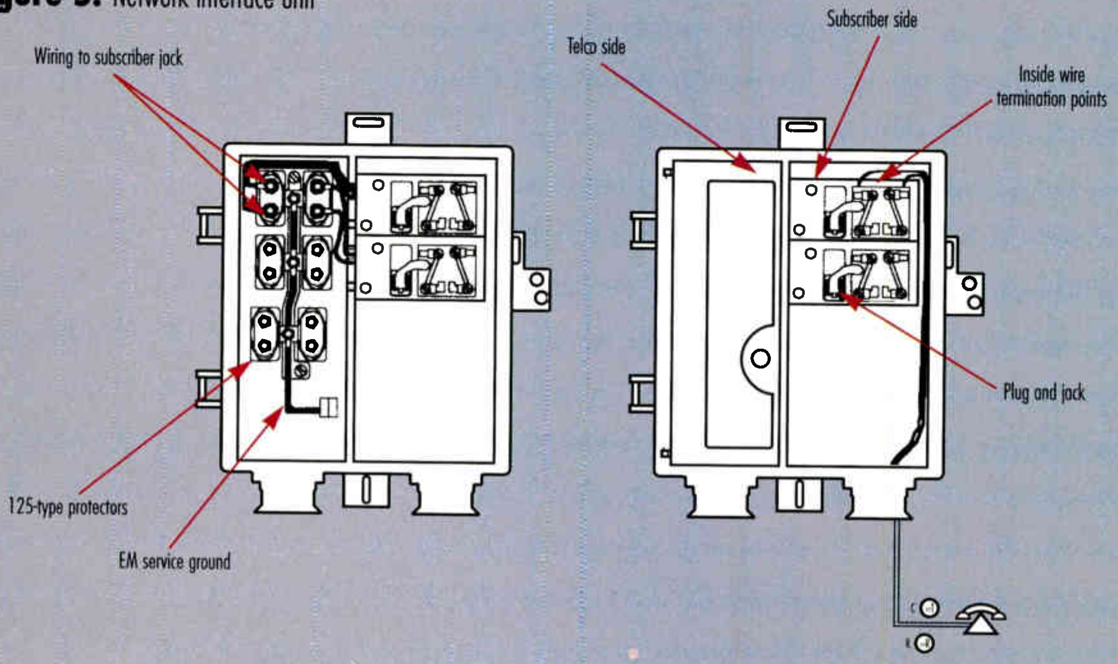
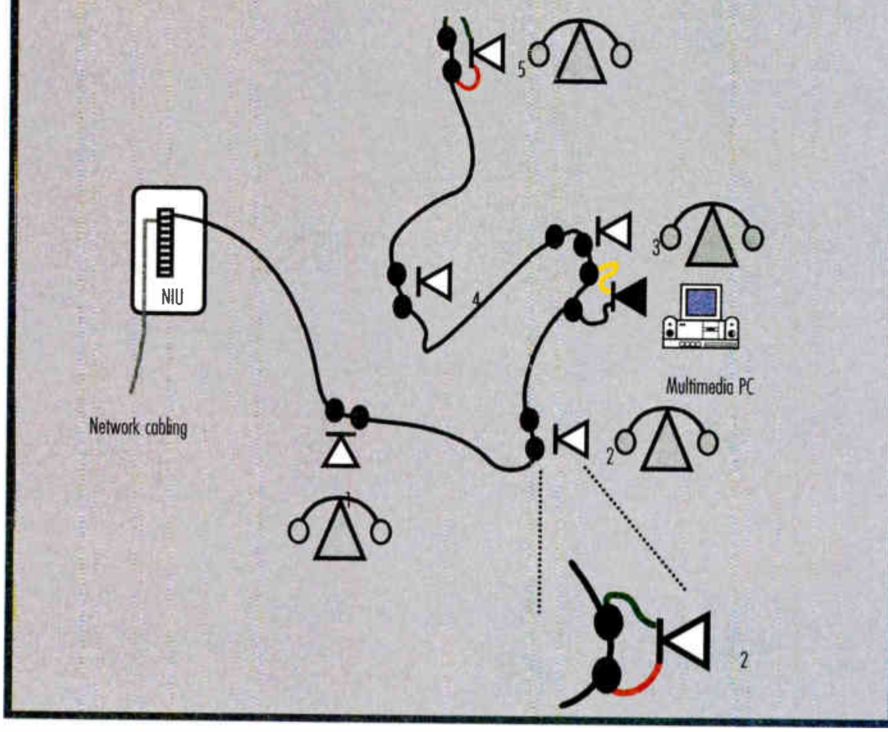


Figure 6: Cabling schematics, loop wired



versus Category 3 cabling, which is approximately a 60% premium!

The most prevalent connection block encountered in older wire systems is the venerable 66 block. Twisted-pair cabling is cut to the specific length desired by the installer and forced into the connection block with a punch-down tool. This particular tool allows the wires to be quickly terminated without stripping the electrical insulators from the conductive pairs. Some punch-down tools terminate and cut the conductors to the desired length, thereby eliminating the potential shorting of pairs across the 66 block.

On a common 66M1-50 block, 50 pairs can be terminated onto each side of the connector block. Cross-connecting station wires (outlet wires) into the service cabling is accomplished with bridging clips that span the center of the block, or with short spans of patch wiring. Most 66 connection systems cannot enable the bandwidth of Category 5 cabling systems to be realized. Newer 66 systems are Category 5 capable, but carry an additional price premium.

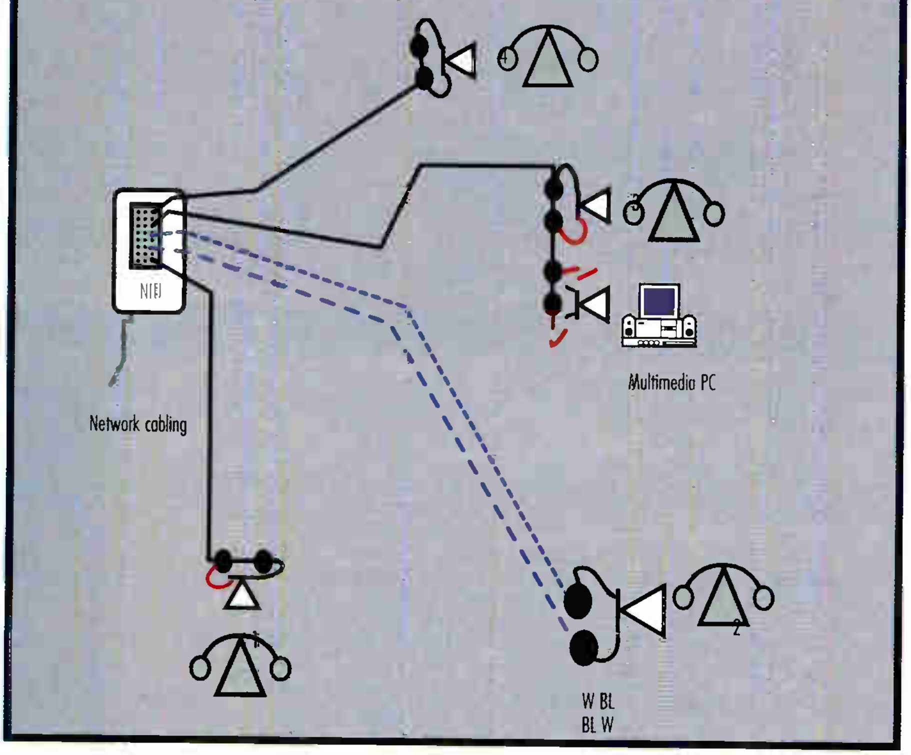
Older, screw terminal type hardware works well for voice and low-speed data and carries the lowest cost.

The datacom applications launched during the last decade have forced the business market to move to newer, more modular connection schemes. Bend radii, conductor termination and pair management were critical criteria, which led to the deployment of the 110-type system. The gripping of the actual copper conductors must securely fasten the termination but allow for drop service changes, additions and moves. Insulation displacement contact (IDC) connections allow for repeatable and lasting terminations. The 110 system's physical routing and termination of pairs is accomplished with proper attention to environmental requirements needed for 100 Mb/s data rates.

Twisted-pair conductors are fanned-out (unwound) and placed into the connector block with a special punch-down tool. Special cutting heads allow the network pairs to be accessed at multiple points along the rails down the center of the backplane. Station wiring to the individual outlets is terminated onto the outer rails of the system. The pair count of the cabling determines the size of the connector block it is terminated into and its location on the backplane.

Housekeeping of the input network cabling is commonly accomplished into the bottoms of the connector block units. Cross-connecting to station wiring is accomplished on the top of the three-, four-, or five-pair blocks. Changes and outlet

Figure 7: Cabling schematics, home run



moves are easily completed because of the physical appearance of the wiring at a single outlet in the home run or star wired distribution associated with today's 110 system deployment. Rapid testing of services at each outlet is achieved since the outlet is easily identified at the service box location with inexpensive test equipment.

Once each outlet is properly spliced and tagged at the service box, the wall plates never require removal since all pairs are pre-terminated and tested during activation. All service and outlet administration is controlled from a central point, which offers security and convenience.

Additions and tests

Determining the best means of providing additional services via an existing wire system requires rapid recognition of the routing and service outlet layout within the dwelling. Single family and MDU distribution systems behave as electrical equivalents. However, the materials used in the original construction can vary immensely. Care must be taken to recognize levels of service currently active at the subscriber's network interface unit (NIU) and pairs exiting the NIU should be carefully documented.

A schematic of the wiring system is generally unavailable, therefore it is imperative that the technician recognize the system's electrical nature. It may be advantageous to place new wiring from the subscriber interface directly to the new outlet in a residential application. Apartment domains tend to force the use of vacant pairs within the existing walls. This requires several tests of the wiring prior to outlet activation.

Structured wiring should be inspected at the interface location (NIU)—see Figure 5 on page 60—and vacant pairs identified. If appropriate, can expansion modules be placed in customer-owned termination units, or will new service providers place their own entry facility? General installation practices recommend starting with the pair farthest in count from the existing service wires. For example, if the primary pair of a three-pair cable (WB = white-blue) is the existing phone line, new service should be routed via the third pair (WG = white-green). This minimizes the chances of crossed pairs and other potential wiring problems within the unit.

> "Much of the technical knowledge cable TV service personnel currently have can be applied to the twisted-pair domain."

Figure 6 on page 62 is an example of adding service to a loop wired residence. Four existing phones and one spare outlet are currently active off the first pairs of a two-pair loop, and an additional data outlet is requested for the study (Outlet 3). The installer first determines a model of the routing and verifies the "in-service" pair.

The first test performed is to check for potential short circuits on the desired pairs, whether due to drywall attachments or bad installation/splicing problems. A time domain reflectometer (TDR) can be used at the NIU in conjunction with a drop toner to verify the existence of shorts in the wiring.

A continuity test is then performed between the NIU and the outlet to verify the pair integrity and proper tip and ring splicing. Crossed pairs may exist due to installation errors. This will identify any potential problems within the dwelling requiring correction. Notice that the second pair (BK&Y = Black and Yellow) is used from the original wiring to offer data service to Outlet 3.

Figure 7 on page 64 shows the addition of data service over a home run, or star wired, dwelling. The actual tests of premise wiring performed by the installer are the same, but there are no intermediate splices/outlets to offer problems between the NIU and the desired outlet. If modular outlets were used, there is a good possibility that the wall plate need not be removed. The data service is spliced onto the fourth pair (W/BR = White Brown) at the NIU via a 110 block and cross-connected to the network via patch wiring or bridge attachments. A 66 block would accommodate this function, but the 110 system was chosen for administrative convenience by the service provider.

It is obvious that administering phone and data services through existing loop wired systems is more time-consuming, both for new services and re-locations to other outlets. This makes it much harder for the supervisors to schedule installer workloads. Specific strategies need development to maximize efficiencies for the work force.

A competitive advantage is available to progressive companies that eliminates service barriers common with the incumbent local phone provider! Multiple standards exist for modular, customer premise wiring systems. However, the data world has attempted to reduce the possible quantity of physical connection schemes. Careful attention to the installation manuals for customer premise equipment (CPE) and the ability to crimp modular jack cords in the field are necessary skill sets for new service providers.

Strategies for success

The emergence of second or third service providers within the community will lead to market confusion. New providers must have a well-documented plan for deployment to avoid adding to the turmoil! The underlying theme of this article is that twisted-pair networking is a robust and easy-to-learn media for administration and maintenance purposes. It should be patently obvious that housekeeping and proper documentation of structured wiring systems is critical to the success of new service providers. The original installation of twisted-pair within a building or home will have the greatest probable impact on the technician's ability to provision new services.

Training of the installation staff needs to emphasize rapid determination of the existing wiring scheme and its potential for transport of new services. The connector practices utilized during the activation of existing POTS circuits and housekeeping at the wall plates should be quickly verified as usable within the unit or new conductors will have

Table 1: Copper cabling color coding

Tip and ring	Pair	Pair	Pair	Pair	Abbreviation
White Blue	1	26	51	76	W BL
White Orange	2	27	52	77	W O
White Green	3	28	53	78	W G
White Brown	4	29	54	79	W BR
White Slate	5	30	55	8.0	W S
Red Blue	6	31	56	81	R BL
Red Orange	7	32	57	82	R O
Red Green	8	33	58	83	R G
Red Brown	9	34	59	84	R BR
Red Slate	10	35	60	85	R S
Black Blue	11	36	61	86	BK BL
Black Orange	12	37	62	87	BK O
Black Green	13	38	63	88	BK G
Black Brown	14	39	64	89	BK BR
Black Slate	15	40	65	90	BK S
Yellow Blue	16	41	66	91	Y BL
Yellow Orange	17	42	67	92	Y O
Yellow Green	18	43	68	93	Y G
Yellow Brown	19	44	69	94	Y BR
Yellow Slate	20	45	70	95	Y S
Violet Blue	21	46	71	96	V BL
Violet Orange	22	47	72	97	VO
Violet Green	23	48	73	98	V G
Violet Brown	24	49	74	99	V BR
Violet Slate	25	50	75	100	V S

Table 2: Cabling binders color coding

Pairs	Group binder	Color	Abbreviation
1-25	1	White Blue	W BL
26-50	2	White Orange	W O
51-75	3	White Green	W G
76-100	4	White Brown	W BR
101-125	5	White Slate	W S
126-150	6	Red Blue	R BL
151 175	7	Red Orange	R O
176-200	8	Red Green	R G
201-225	9	Red Brown	R BR
226-250	10	Red Slate	R S
261-275	11	Black Blue	BK BL
276-300	12	Black Orange	BK O
301-325	13	Black Green	BK G
326-350	14	Black Brown	BK BR
351-375	15	Black Slate	BK S
376-400	16	Yellow Blue	Y BL
401-425	17	Yellow Orange	Y O
426-450	18	Yellow Green	Y G
451-475	19	Yellow Brown	Y BR
476-500	20	Yellow Slate	Y S
501-525	21	Violet Blue	V BL
526-550	22	Violet Orange	V O
551-575	23	Violet Green	V G
576-600	24	Violet Brown	V BR

to be placed. Care must be taken to recognize existing features at the dwelling, no compromise of service is acceptable for any provider within the unit wiring.

A quick review of the steps for the technician at the premise are shown in the accompanying sidebar.

Structured wiring systems are the best means of providing reliable services throughout the dwelling. More time should be spent inspecting the connector mating of customer equipment and testing of the circuit, rather than becoming lost in the dwelling's wire network.

Much of the technical knowledge cable TV service personnel currently have can be applied to the twisted-pair domain. Remember, the phone industry has been using the copper media within the dwelling reliably for approximately 100 years—they may actually be on to something! CT

J.R. Anderson is vice president of facilities engineering and Ernest Gallegos is MTS supervisor, facilities engineering, for Integration Technologies in Englewood, CO.

At the Customer Premises Checklist

- Inspect NIU for existing service termination and network test access. If the POTS provider has offered RJ-11 test access at the NIU, will new providers install like equipment?
- Determine if existing wiring system is accessible at the new outlet location. Are there available conductors to support the service(s) requested by the customer?
- How does the new service enter the structured wire system? In the multi-unit domain, is the demarc for network and access to the building wire from one location or distributed throughout the building?
- If existing wiring is to be used (vacant pairs only): Test with drop toner for shorts and opens of each conductor pair.
- Locate problems on conductors, with TDR if necessary.
- Test continuity of pair and for splicing problems (crossed tip and ring).
- Modify dwelling entry point for service entrance to wiring system.
- Activate outlet and thoroughly test service on CPE.
- Carefully label any new wiring additions at each end. Document the installation for administrative purposes.
- Place new wiring in accordance with local electrical codes. Particular attention is necessary in the MDU market. Terminate and provision service at entry point. Test and document service.
- Above all, take the time to impress the customer with a thorough understanding of the new service(s), its impact on dwelling wiring and demonstrate a willingness to complete the activation in a professional manner. Time spent educating the new customer with the service(s) and its particular installation needs will leave the most favorable impression, long after the service(s) activation takes place.

By Michael Burtz

Explore "Computerless Browsing"

Analog Set-Tops: Alive and Kicking

Advanced analog set-tops can provide an excellent vehicle for subscribers to gain Internet access on their TV sets. Quickly and with minimal investment, broadband operators can add value to their current installed base of advanced analog set-tops by introducing the World Wide Web, e-mail, and newsgroups to a significant number of cable subscribers.

Internet access using existing, widely deployed technology offers obvious time-to-market advantages. Operators can simultaneously tap a potentially significant source of incremental revenue and satisfy subscribers who have an interest in gaining Internet access, but don't own a PC.

There are Internet services available to cable operators today that leverage existing advanced analog system technology. Some companies are working to establish low-cost Internet access for consumers without the need for a PC, modem or additional in-home equipment. This article will describe the advantages and requirements of launching this service, from both the consumers' and operators' perspectives.

Also highlighted is an alternative approach to gathering and delivering Internet data to home TV sets: distributing Internet content to advanced analog set-tops via virtual channels.

Advanced analog's pros

There are several performance advantages inherent in using advanced analog systems and a TV Internet approach.

Some analog set-tops can access the Web via a cable return path and avoid the use of a phone line. Data performance is approximately three times faster than today's 28.8 kbps telephone modems. Bypassing the phone system also eliminates the inconvenience of using one phone line for both voice and data or the expense of adding a second phone line for Internet access.

Faster connection time is another speed-related advantage of using cable for both downstream and upstream access. The cable operator is connected to the Internet—and the subscriber is connected to the operator—24 hours a day. Hence, the subscriber can initially access an Internet service within a few seconds as compared to the several minutes normally required by a telephone modem.

Advanced analog systems also allow operators to marry the power of the Internet with video. For example, one solution features the concept of "channel hyperlinking," which gives content providers and broadcasters the ability to join video broadcasts to related information on the Web. A subscriber watching a CNN story could click on a hyperlink to view related background information, or a subscriber watching an advertisement could hyperlink to that advertiser's Web site to get more detailed information.

> **BOTTOM LINE**
>
> **Don't Pitch Your Analog Set-Top Yet!**
>
> Buying a bunch of cable modems or digital set-tops is not necessarily the absolute first step before a cable op can consider offering Internet access over its network. Advanced analog set-tops offer creative options to bring the Internet to cable subscribers over their TV sets.
>
> **The evolution has already started:** For many operators, the first two steps to Internet access have already been undertaken—building a two-way system and deploying advanced analog set-tops. Your system might well be fired up and your time-to-market for Internet services is perhaps much less than you'd thought.
>
> **More pros:** By positioning yourself as viable Internet service provider now, you can truly learn the trade and then eventually proceed to offer advanced Internet services with cable modems and digital set-top terminals with experience under your belt. Also, this could be a proactive move to combat the loss of current subscribers to direct broadcast satellite services and a compelling new feature to attract new subscribers.

These features can be provided to cable subscribers using existing set-top terminals. A subscriber does not have to

Figure 1: Addition of a server for Internet access

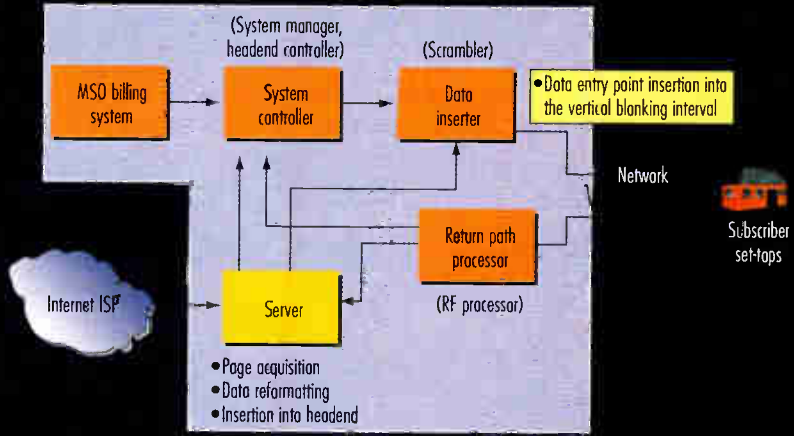
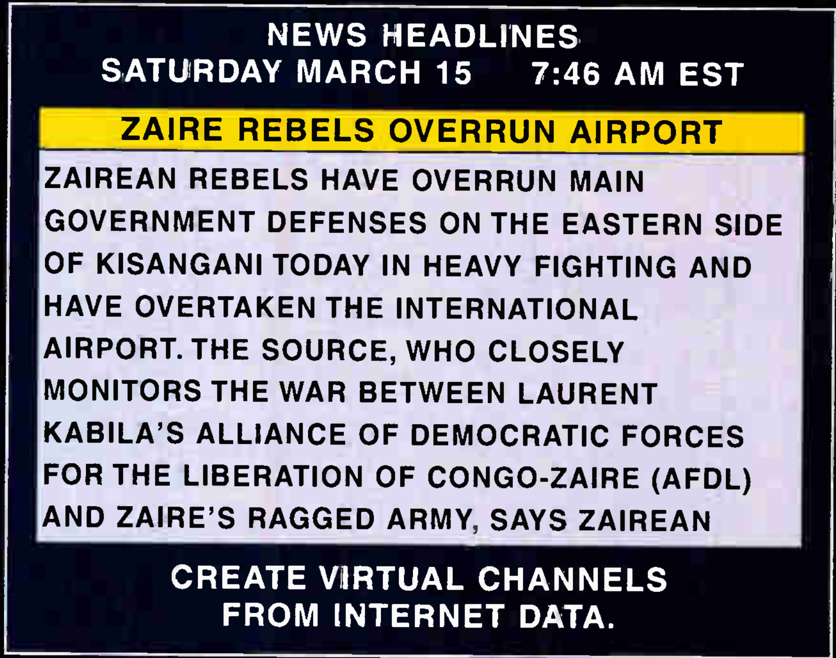


Figure 2: Sample screens from virtual channels



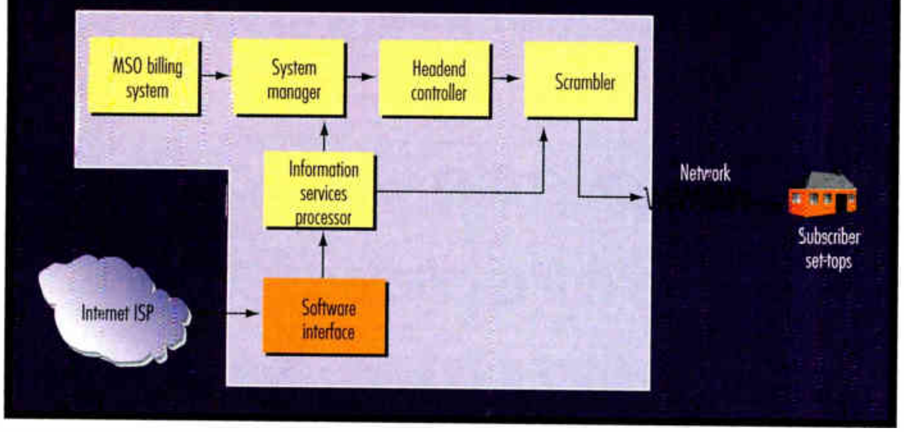
purchase an expensive add-on device to get Internet access.

Some other devices cannot do hyperlinking from a video broadcast because this feature can only be provided by devices in the video path.

Collectively, the performance and feature advantages of advanced analog set-tops provide an easy-to-use, low-cost means for novice Web surfers to experience the Internet without having to purchase or learn to use a computer. Furthermore, because there is no requirement to buy hardware or software, the consumer does not have to worry about equipment becoming obsolete. And even for the experienced PC user, Internet access via an advanced analog set-top terminal provides performance and availability advantages that complement Internet access via a PC.

Advanced analog technology for Internet access has business advantages too—in particular, as a means of increasing revenue and building customer loyalty. First, remember that existing advanced analog set-tops are already producing revenue in the form of base equipment charges (usually about $3 a month) for interactive viewing guides and other features, not to mention the greater pay-per-view (PPV) and premium channel

Figure 3: Using a software interface



penetration that usually results from their deployment. With about four million advanced analog set-tops installed, Internet access opens several new ways for operators to leverage this large and rapidly growing base of advanced analog set-tops.

In addition to base fees operators will gain from offering Internet access, revenue can be generated from e-mail services and advertising. Hyperlinking, for example, offers tremendous potential as a new source of advertising revenue.

Except for optional peripherals, such as a wireless keyboard, no special equipment is required in the home for the subscriber to begin using some of these advanced services.

Headend, set-top requirements

A key factor in the success of advanced analog set-tops is their ability to transmit information, such as impulse PPV orders upstream in systems with a two-way plant.

That same reverse path capability can now support Internet access. Again, this opens new doors for leveraging investments many operators have already made in their two-way networks.

Figure 1 on page 72 shows how Internet services might be layered into an operator's existing headend. A typical cable headend that supports advanced analog set-top terminals usually contains a number of standard elements. The MSO's billing system normally interfaces to a system controller device that manages the transactions and data necessary to operate the installed set-top terminals. The system controller normally interfaces to a scrambler, which also serves the function of inserting data into a cable network for communicating with the set-top terminals. A return path processor device is used to retrieve data transmitted from a set-top terminal within the cable network.

To add the Internet access function, the Internet provider would typically add one or more servers to the headend. The server would be connected to an Internet service provider (ISP) and interface to the cable headend at the following points:

- System controller: Exchange set-top terminal control information,
- Scrambler: Insert Internet data (Web pages, e-mail, etc.) into the cable network, and
- Return path processor: Receive data/keystrokes from set-top terminals.

The set-top terminals providing the Internet service should have the following minimum capabilities:

- Memory sufficient to hold the Internet service software application,
- Ability to download the set-top terminal application electronically from the headend to minimize or eliminate hardware changes and truck rolls to the subscriber's home,
- Support for true bitmapped graphics,

Leading the World in Broadband Communication Networks

Partnership

In the race to build broadband networks for future video, voice and data services, you need more than just a supplier. You need a reliable partner you can trust.

ANTEC is a partner in the process. Our process is to help our customers upgrade and build today's networks into lucrative new businesses. Our approach is simple: we determine what you need, and get it. We do this by inventing, developing and integrating research, manufacturing and engineering know-how into seamless network solutions for our customer partners.

For over 25 years, ANTEC has pioneered many of cable television's firsts. With the introduction of the industry's first AM LaserLink™ fibre optic system, ANTEC transformed the industry's one-way, video only systems into interactive video, voice and data delivery networks. Other industry firsts followed. ANTEC's line of Regal taps and passive devices were the first to deliver quality signals at one gigahertz. And, ANTEC's Gateway™ Optical Receiver was the first fully redundant optical receiver to help deliver interactive services to residential cable television customers by integrating multimedia, telephony and entertainment video.

ANTEC is constantly searching for new ways to expand our product offering to find solutions for our customer partners throughout the world. We are defining the way broadband network providers engineer, purchase and install their drop systems. ANTEC's Integrated Drop System (IDS®) has established exacting drop specifications, fully compatible components and proven installation practices to help radically improve the quality, reliability and performance of signals delivered through broadband network subscriber drops.

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ANTEC

Reader Service Number 10

- At least 16 colors, and
- A transmitter to send data from the set-top terminal to the headend over the cable network.

Virtual channels

Virtual channels, which can be either advertiser- or subscriber-supported, offer operators another avenue for delivery of broadcast informational services. Transmitted over the vertical blanking interval (VBI), virtual channels require no additional video bandwidth to deliver a wide variety of text-oriented services through advanced analog set-tops. These services are available as commercial packages of electronic TV listings, headline national news, sports and business stories, regional news and weather, entertainment news, daily horoscopes, soap opera summaries, and so on.

In addition, there are myriad sources of text information within the World Wide Web that can provide on-demand, valuable information to your subscribers. In this manner, the Internet becomes a significant content source for value-added broadcast information services. The fact that the content is sourced from the Internet is transparent to the subscriber.

The following are examples of text-based Internet content that can serve as virtual channels:

- News headlines,
- Sports scores,
- Local community events (many communities have their own Web sites for this purpose), and
- Weather.

> "Internet access using existing, widely deployed technology offers obvious time-to-market advantages."

Figure 2 on page 72 illustrates how virtual channels can be presented to an operator's subscribers.

There are several advantages to using virtual channels to provide Internet-based content, including:

- Ease of implementation,
- Access to valuable information, and available when the subscriber wants it, and
- Low-cost means to introduce subscribers to the value of Internet access. Subs can upgrade to more robust Internet applications as the value of the service is established.

To supply Internet content via virtual channels only requires a software application to retrieve data from the operator-selected Web site (and of course, approval from the content's owner).

Figure 3 on page 74 illustrates how the software interface unit (SIU) interfaces to the cable headend. The information services processor (ISP) is a standard element in this advanced analog system. This device normally retrieves data from third-party data suppliers, such as program guide providers, and formats and sends it to the scrambler for transmission over the cable network. The SIU software interfaces to the operator's normal ISP, retrieves data from the Internet and sends the formatted data to the ISP to be processed as a normal third-party data input.

A competitive advantage

Fast, inexpensive Internet access is a trend likely to continue in the foreseeable future. Advanced analog set-tops offer creative ways to bring the Internet to cable subscribers—and more revenue to cable operators. By leveraging the large installed base of this popular device, operators can start a new steam of revenue to finance further expansion of services, both analog and digital.

For many operators, the first two steps to Internet access have already been undertaken: building a two-way system and deploying advanced analog set-tops. For these operators, few network changes are needed to support Internet access services. The only remaining second step is marketing the new service to subscribers as a low-cost, simple way to access the Internet.

Internet TV over advanced analog provides another advantage for operators. By positioning themselves as viable ISPs, operators can proceed to offer advanced Internet services over cable modems and digital set-top terminals. Finally, it is a proactive move to combat the loss of current subscribers to direct broadcast satellite (DBS) services and a compelling new feature to attract new subscribers. CT

Michael Burtz is director of software and applications, analog video systems at Scientific-Atlanta.

EAS Compliance Made Easier

with the TFT EAS 911 Encoder/Decoder For Cable

User Survey Shows TFT EAS 911 Preferred 7 to 1

CABLEfile
600 South Cherry Street, Suite 400
Denver, CO 80222
303/393-7449 • Fax 303/329-3453

May 21, 1997

Mr. Joe Wu, President
TFT, Inc.
3090 Oakmead Village Drive
Santa Clara, California 95051

Dear Mr. Wu:

In a recent survey of actual users of EAS encoder/decoders, the TFT EAS 911's sequentially lighted keyboard was preferred 7 to 1 for purchase over the competition. The survey was conducted by telephone between April 29 and May 16, 1997, to determine customer reaction and preferences from a sample of over 1,000 users in broadcast and emergency management.

During the two weeks of calling, CableFile was able to speak to 9.2% of the sample group who were identified as having used both the four-key and the 50 sequentially-lighted-key EAS units. Among the qualified respondents, the TFT 50-key products was overwhelmingly reported to be easier to use on a day-to-day basis by 54.2% who favored it.

Most respondents found both units easy for initial setup, but 95% said that the TFT was easy to setup, a full 20% more than the other type. 89% of the users told researchers that the TFT was easier to setup. For day-to-day operations, 83% of the qualified respondents preferred the TFT front panel design. When asked "If you had to add more EAS encoders/decoders to your system, which would you buy?" the TFT was once again the clear favorite. 68.5% said they would purchase the TFT. Only 8.5% said they would purchase the competition's product to the exclusion of TFT.

TFT provided CableFile with 1,000 names derived from its product registration cards to sample. Later in the surveying, TFT provided an additional 75 names of association presidents to broaden the sample. Out of the 75 names on the EAS association presidents list, 32% were unqualified, 40% were unavailable, and 28% were contacted; 14.2% of these contacts had used both systems.

Based on the above results you will find that of those we called who purchased emergency alert systems, TFT was the definitive choice.

(more)

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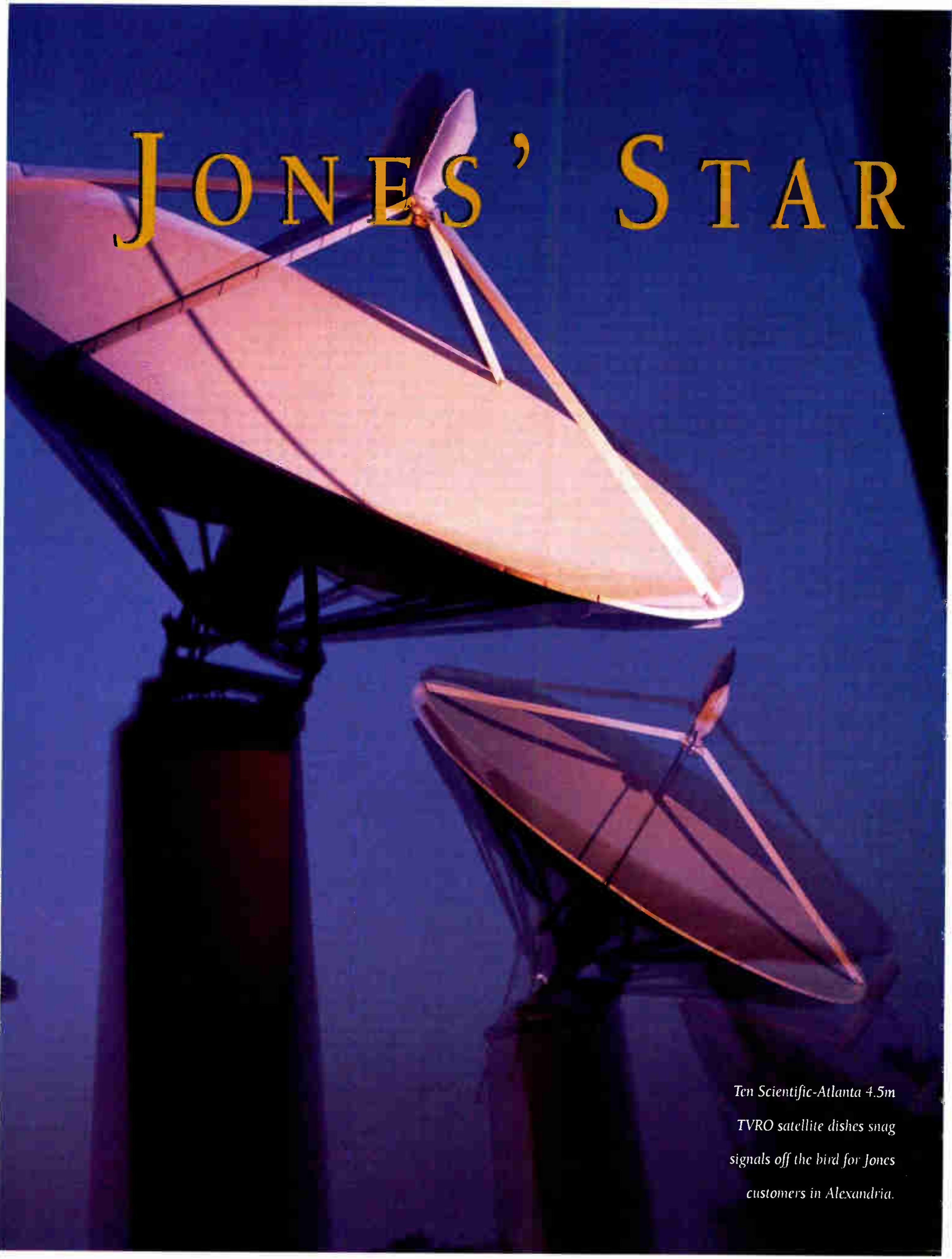
Reader Service Number 194

9500-0453

JONES' STAR



Ten Scientific-Atlanta 4.5m TVRO satellite dishes snag signals off the bird for Jones customers in Alexandria.

SYSTEM SHINES

Virginia Headend Offers Galaxy of Services

By Alex Zavistovich with E. Brooke Gilbert

A scant handful of miles from the city that revamped the Telecommunications Act, cable subscribers in the affluent Virgina town of Alexandria are already reaping the broadband benefits of cable telecommunications.

The Jones Communications headend across the Potomac River from Washington, DC, is offering not only high-speed Internet access via the Jones Internet Channel, but business and residential MDUs (multiple dwelling units) telephone service as well. Only two and a half years earlier, this was a basic 400 MHz system, primarily run off of Jerrold equipment. Then Jones Communications CEO and Chairman Glenn Jones decided that its proximity to Washington would be the ideal place for a "star" system, employing a nearly passive fiber network—a substantial rebuild. Jones Communications of Alexandria currently serves some 40,000 customers. The fiber network was expected to pass 27,544 residential units, 29,847 MDUs and 15,709 commercial businesses.

By the end of construction, the plan is to have deployed ten redundant fiber-optic rings around the town of Alexandria. Each ring contains between 120 and 180 fibers, and more than 2,800 fibers will terminate in the headend. A total of 461 fiber-optic nodes will be activated, with planned expansion beyond 525 nodes. Each node will have its own standby power supply.

According to Craig Chase, system engineering director for the facility, main and sub-splice enclosures feed optic nodes, that on average probably pass 125 residences. Said Chase, "We might not have true fiber to everybody's front door, but we're about as close as you can get: literally every neighborhood, every apartment complex, every subdivision, is linked."

The system is virtually passive, Chase said, acknowledging that, "in some cases, it just made sense to put in an active device at the last couple of taps." The forward bandpath is 750 MHz; the reverse is 5 to 200 MHz, although presently Jones is only utilizing 5-42 MHz of spectrum.

One of the unique characteristics of this system is switching in the event of fiber damage. The network is set up on a quad system, explained Chase. If one piece of glass is cut, field optical receivers and all their paths are switched to an alternate route. Virtually everything in the plant portion is redundant with the exception of the optical transmitter. Chase said the inherent reliability of optical transmitters made that level of redundancy unnecessary.

Chief Engineer Tim DeVinney noted that switching in the quad setup poses something of a maintenance challenge. "If someone's working on the plant, they have to be constantly thinking about it. The switching doesn't necessarily occur in one part of town: It might be an optical receiver here and one over there, and techs have to make sure that the forward or reverse paths have certain path loss when they switch to protect the loss integrity of the paths."

Approximately 80% of Jones' customers are carried on the new system, according to DeVinney. At press time, Jones was slated to have the new network completed by mid-June.

Originally, the glass fiber came from Siecor and the jacketing was provided by Pirelli. Now the company purchases directly from Siecor. The network contains some 16,072 fiber miles, and 283 actual strands miles. The company has run fiber for its 10 optical rings to roughly the last 3,000 feet for full continuity between all the rings; they are now focusing on the network spurs.

The tour

Outside the headend are ten 4.5 meter TVRO satellite dishes from Scientific-Atlanta. At press time, analog integrated receiver-descramblers (IRDs) were being used with three different General Instrument decoders: the DSR 1500 (the first GI decoder) as well as the 4400 and the

The Alexandria, VA headend is the brightest star in the Jones system.

4500. Headend amplifiers come from Quality RF Services, according to Tom Freeman, Jones' senior headend engineer.

For the IRDs and actual network monitoring, Freeman said, Jones' choice was Barco. "Barco had a lot of influence on the way we built or mixed all of our analog channels together, mainly because they had guaranteed us an incredibly high combined carrier-to-noise (C/N) number. I'm looking to achieve a C/N of 64 or above at the combined point here in the headend," he said. Jones' network monitoring solution was Barco's ROSA software, powered by the Copernicus server.

Barco's FSM860 headend status monitoring is also used. According to Freeman, "The FSM860 can give me an alarm if I lose video on a particular channel; it can tell me if I have an audio problem for an extended length of time, or if an RF level drops on video, or on any one of the channels." The combined RF signal runs over to a five-way splitter, where it's distributed to several headend DAs.

Routing and management

At the main monitor console in the headend is a 128 x 128 router from Iris Technologies that is run by the AV Video/L-R Commander software. The router is tied in with Barco's ROSA (RCDS Open System Architecture—a software package operating on MS Windows-based PCs), said Freeman. Should the headend incur failure on the downlink (the loss of a satellite dish or receiver, for example), the ROSA software will take appropriate action.

Freeman has the Iris switcher set up for "sources" and "destinations," with two display panels looking at 128 sources and two looking at 128 destinations. Only one side of the switcher's power supply is actually on line. The other side is wired into a redundant switch, so if Freeman loses any of the busses on any of the units, it automatically switches over to the other side.

> "All status and monitoring adjustments can be made at the console, and fine tuning can be done at the modulators."
>
> *fine tuning*

"I'm very happy with the IRIS router," said Freeman. "It saves me a lot of work. Operations can create a completely different channel line-up and I could do it in a matter of minutes."

As for network monitoring, Freeman said the headend was initially using Barco's RCDS, or Remote Control and Diagnostic System, basically a DOS-based system to control Barco hardware. The ROSA software was then installed, controlling both Barco and non-Barco equipment in a Windows-type environment. The next evolution from that was to Copernicus, a client-server architecture with ROSA as fixed software.

Ultimately, although there are no plans to do so, the Jones system will be operable nearly unmanned, said Freeman.

Barco's Copernicus server is the next step in Jones' implementation of Barco network management. "It treats the system truly as a client-server architecture," said Barco Product Group Manager George Walter. "When Copernicus is completely up and running, any PC anywhere in this building—because it will have dial-up lines to Copernicus—will be a client." At press time, estimates were that 85 to 90% of the implementation of Copernicus would be completed within 30 days.

Receivers and transport

Satellite receivers and the transport of satellite signals also presented challenges for Jones. At press time, Freeman said the facility was only two to three weeks from converting to Barco-developed IRDs carrying NTSC signals.

Barco's Walter reiterated that Jones chose his firm's equipment because it promised the highest carrier-to-noise specs at the combined output—essential to the optimal performance of a passive system, where the fewer active devices are used, the cleaner the return path and the fewer failures.

When Barco first began working on the Jones project, his company did not have an IRD satellite receiver, acknowledged Walter. However, to fully implement some of the aspects of ROSA, he said, the company had to control the satellite receiver. The solution? Barco built its own satellite receivers with external IRD. As expected in a new product, the installed Barco SAT 200IRD units have required some minor modifications. Making those modifications in a working network, however, was another matter.

"The system has to run. There are 50 receivers operational and we can't change all 50 at once," said Walter. "We have to modify the remaining 50 units while the system's running, and the only time we can do that is midnight to 4 a.m.." The company has been making the modifications in groups of 10 at a time, which keeps the system operational.

The over-the-air signals, said Freeman, are transported either by a digital link (for

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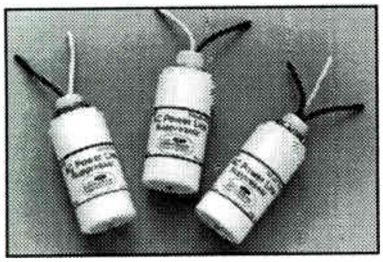

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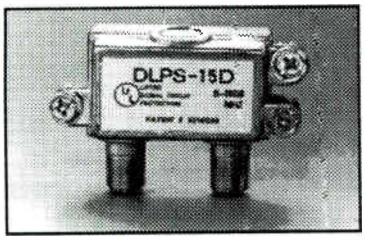
Reader Service Number 301



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Reader Service Number 210

See the Cable Innovations Showcase Products on this page!

some of the higher frequency harder-to-carry channels) or over an ADC Broadband Communications AM Laser Link.

According to ADC Video Systems Manager of Technical Services Roy Harbert, the Laser Link "is basically a digital video transport system that allows us to transport up to 16 channels per wavelength—and currently two wavelengths per fiber—with up to studio or D-1 quality video." Currently, Jones is using 8-bit systems, which Harbert said are more than adequate to transport any broadcast or satellite signals.

The transport sends pulse modulated video with a proprietary encoding scheme. With standard mux or standard V-mux cards, Roy said, the digital video system "is capable of passing through several sites; you can add and drop channels at various locations, or reinsert other channels in time slots. It's a nearly transparent video transport."

Command center

When Jones designed its headend facility, the goal was to control almost everything from the master console, including system test and measurement. For the most part, said Freeman, almost all status and monitoring adjustments can be made at the console, and fine tuning can be done at the modulators.

Tektronix's DM 700s, and precision demod downconverters run off a platform at one end of the console and work in conjunction with a Tektronix spectrum analyzer. Freeman has set up predefined programs to ensure that his four headend distribution amps are balanced equally to feed all the fiber transmitters.

CSS 500 software from Tektronix works in conjunction with the DM 700 , the precision demod and spectrum analyzers, said Freeman. The software displays performance parameters, including visual carrier level, visual carrier frequency, aural carrier level, aural frequency offset, carrier-to-noise, composite second order and composite triple beat.

SiteScan software from Liebert monitors environmental variables: the temperature in the headend control room, the air handlers as well as amperage and voltage draw. "If we lose power," said Freeman, "we switch over immediately to battery power."

UPS is again from Liebert: "They are the medium between our generators and our batteries as well as the voltage system," Freeman noted. From the SiteScan system, technicians can monitor and control generator status. "I have two 500 kVA generators outside and each one of them can run for approximately 41 hours," said Freeman. "Last summer we had an outage. We went to battery power for probably about 15 seconds and our generators went up. We were up for three days, and the headend and everything in it, nothing missed a beat. It was amazing."

Another monitor on the headend master console updates the status of Jones' digital ad insertion system, provided by SkyConnect, with video storage from Digital Equipment Corp. Bar graph software displays percentages of spots, local avails, percentages and similar information.

"We're doing 16 networks in one rack, which to me is awesome," said Freeman. "I've been involved with several ad insertion systems over my career and this one is without a doubt the one I'm most impressed with as far as functional ability."

Internet access

The Jones Internet Channel uses Bay Networks' LANcity LCP cable modems at the customer premises and LANcity reference nodes or translators at the headend. MCI provides Jones' gateway to the Net; data throughput from the headend to the customer is approximately 10 Mbps.

BARCO's SAT 200IRD satellite decoders were designed with the Jones headend in mind.

The headend LANcity reference node uses channel space on channel 71 as a forward carrier. The company originally had installed the Livingston Enterprises Port Master 2E communications server for dial-up Internet access; the system is now used for contingencies. "If we run into ingress problems, we can set the customer up with dial-up service until we can fix their problem," explained Chase.

Jones uses ADC's NMCS (network monitoring control shelf) for network monitoring of the system for telephony and related applications. Said ADC's Harbert, the ADC platform "takes our proprietary status monitoring code and pours it out to TL-1—a higher standard interface for telephony." This system monitors virtually all of the characteristics and parameters of the transmitters, the nodes, and the status of the A/B switches for redundancy. "In the event of failure, these switches will reverse quickly, so that no telephone calls should be dropped; customers should barely notice if anything happened. With our status monitoring, they could be running on their redundant system and not even realize it."

The network RF modems transmit a forward signal of 52.5 MHz up to the ADC optical nodes, do the polling and request their status, said Harbert. Nodes will respond on a 10.1 MHz tone and the data is then fed into the NMCS, which translates that into TL-1.

At eight nodes per modem, each shelf can accommodate 64 nodes. Optivideo

The main and secondary consoles in the headend allow nearly unmanned operation.

switches for primary and secondary signal paths work in conjunction with the NMCS. The switches receive communication of a signal from the return receivers. If the return path goes dark, that's a signal to these units of a failure, which triggers the switches to go to the secondary paths.

On the upstream side, said Harbert, ADC Homeworx quad receivers receive an optical signal coming from the node back to the headend. At the node, an optical splitter provides light via two reverse paths to the headend. If this primary fiber gets cut, the quad A/B switch will look to the secondary receiver for its optical input and the RF output. When this switch fires, it communicates with the Optivideo forward switches for redundant operation.

Telephony

Upstairs from the video headend is the telephony central office. Employing a DMS 500 switch from Northern Telecom fed at the DS-1 level, the facility is fully SS-7 compliant, a status it gained last October.

According to Telecommunications Facilities Manager Gerald Boeke, once the switch is fully configured, it can offer 128,000 subscriber lines. The company has an interconnect agreement with Bell Atlantic. A Jones OC-3 feeds the Bell Atlantic central office; that is the way most of Jones' traffic is routed through their tandems, Boeke said.

Boeke is proud of the DMS 500 digital switch, noting that fewer than 20 are actually up and in service in the U.S. The switch provides service to the MDUs served by Jones. At each MDU, an access node is installed, each capable of 672 subscriber lines once it's fully configured. The switch is fed directly by fiber with four fibers per node.

Fiber enters the transport side of the central office from the outside plant. On the transport side, everything is fed either by an FMT-6 (four DS-1s), OC-1 (14 DS-1s) or an OC-3 (84 DS-1s). The entire network offers redundancy with a primary and a secondary path through the ring. In the event of signal loss, the path is switched without any detection or loss of signal.

Altogether, the Jones central office and headend facility in Alexandria is truly a "star" system, offering a galaxy of two-way services to its Washington, DC-area subscribers. CT

Alex Zavistovich is executive editor of CT. Brooke Gilbert is assistant managing editor.

By Alex B. Best

How to Please Your Subs

Cox Takes Home the J.D. Power Customer Service Award

Having earned the 1996 J.D. Power and Associates award for achieving the highest customer satisfaction rate in the cable industry, Cox Communications is committed to exceeding customer expectations again in 1997 and beyond. Introducing new products, such as high-speed Internet access service, residential telephone services and digital video challenge the MSO to continue delivering the highest quality customer care with even greater reliability.

While Cox has steadfastly concentrated on improving its customer care operations for over a decade, the company is pursuing several new approaches to its customer care strategies and infrastructure maintenance. To uniformly provide high-quality telecommunications services with superior reliability, the MSO is combining the attributes of its unique network architecture, network surveillance equipment, call centers, Web technology and award-winning army of customer service representatives.

Network architecture

Using a long-standing business philosophy that has always emphasized the impact of customer relationships on Cox's ultimate success, the company's engineers designed and constructed a unique fiber-optic ring architecture that can reliably deliver video, voice and data to its more than 3.2 million customers. As the 1996 J.D. Power award reflected largely on Cox's abilities to provide quality cable TV service, a greater dedication to network reliability and customer service is essential to Cox as it launches new products over its hybrid fiber/coax (HFC) network.

According to the Federal Communications Commission's Network Reliability Council, the industry average for repair of a fiber cut is 4.7 hours. This average will not be acceptable for telephony applications, particularly when applied to the BellCore standard, which establishes the average customer outage time at less than 53 minutes per year, or 99.99% availability.

Using an example taken from actual experience, a cut on a fiber cable coming out of the headend with 144 active fibers took nearly one day to repair, averaging about 10 minutes per fiber to prepare and make the splice. Clearly, a new standard for reliability is critical in order to provide future applications that impact consumers' health, safety and livelihoods. Examples include plain old telephone services (POTS) with emergency 911 capability; work-at-home data transfer and home banking services; and home security monitoring. The highest level of reliability is difficult, if not impossible, to provide using home-run fibers due to accidents, such as fiber damage due to gardening cuts, torn down utility poles or even house fires.

Cox's solution: a unique fiber-optic network design called ring-in-ring architecture, a radically different application of the ring concept for an HFC broadband platform. The ring-in-ring architecture provides nearly 100% reliability because two diverse paths are provided. In the event of a fiber cut, service is maintained via the second diverse path. The concept is truly a ring in a ring. For each node there is more than one fiber pathway in the event of a cut fiber line. Electronic circuitry senses the loss of signal and automatically switches to the backup route without any interruption to the customers' services.

One ring is a dedicated ring in which fibers originate at the headend and run to each individual node over diverse routes. The second ring is a continuous "loop-through" configuration that rides piggyback on the dedicated ring. The loop-through ring begins at the headend

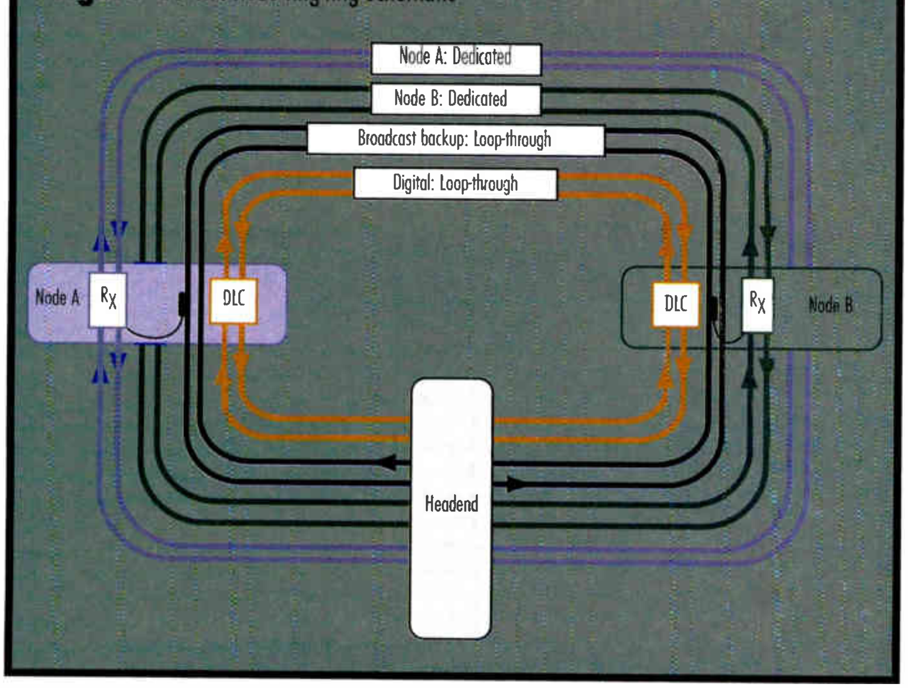
BOTTOM LINE

Cox's Customer Service Tactics

One way to get the much sought-after 99.99% availability in your own system is to do it Cox's way. And Cox recognizes that the challenge included in receiving the J.D. Powers Award is continuing to provide excellent customer service in a competitive environment.

Several of Cox's successful customer service tactics include building state-of-the-art call centers that use Intranet technology to support inbound service calls; building unique fiber-optic ring architecture for delivering video, voice; and data and constructing a network operations center or NOC.

Figure 1: Two-node ring-ring schematic



but does not terminate at the node. The fibers in the loop-through ring pass through each node around the dedicated ring and continue from one node to the next around the ring, ending back at the headend. (See Figure 1.)

The dedicated ring provides the broadcast and targeted services directly from the headend to the selected node and, if needed, transports reverse signals from the node back to the headend. The loop-through ring consists of two sets of fibers. One set can provide telephony and data services by multiplexing many subscriber communications paths onto a single high-speed digital signal. The other set provides primary and backup two-way digital traffic in the event of a fiber cut. Cox's route diversity token is unique to most MSOs and will be rolled out with the company's current plans to upgrade all of its large cluster systems by 1998.

Centralized surveillance

To further ensure network reliability, Cox engineers constructed a network operations center (NOC) in their Atlanta headquarters. The NOC helps Cox monitor its cable infrastructure to guarantee network reliability nationwide. (See Figure 2.) "As the cable industry in general has been plagued by customers' perceptions of poor quality service, we realized that we must provide exceptional service of our new services from day one. Customer loyalty will depend on a network that is not only reliable, but easy to use and quickly repaired," said David Fears, director of Cox's network operations center.

Enhancing the ring-in-ring's reliability factor, Cox's proactive, 24-hour NOC will help the company deliver first-class service that meets and exceeds service level requirements as well as end-user expectations. As telephony and data services are launched in various Cox markets. the NOC will be responsible for operating, administering, managing and maintaining Cox's switched, packet-switched, data and cable TV network. It can also detect real-time network faults and provide the means to respond both automatically and manually to equipment failures.

> "A new standard for reliability is critical in order to provide future applications that impact consumers' health, safety and livelihoods."

Already in use to monitor the MSOs' Fibernet operations, network specialists at the NOC can remotely take control of any equipment in the company's network designed to receive commands. They can perform the same functions from their NOC workstations that can be performed from the field terminal. The NOC can also perform remote queries, initiate diagnostics and restore equipment to an operational state, often without the customer even knowing a problem existed in the network.

Cox selected Harris Corporation's Harris Network Management (HNM) system as the network management platform. HNM is a leading enterprise-wide network manager capable of meeting all of Cox's objectives for comprehensive network management today and well into the future. HNM was designed by Harris to manage complex multi-protocol, multi-vendor networks through easy-to-use, customized graphical displays. The HNM open-architecture design enables the NOC to interface with other enterprise operational support systems and element managers used by Cox such as Superior Electronics' cable TV status monitoring platform and Nortel's Network Manager, used to manage the HFC telephony service. With this platform, the NOC can also interface Cox's service management and business management platforms.

In effect, Cox customers everywhere can rely on professionals at the NOC watching their network seven days a week, 24 hours a day. With the NOC's advanced detection and dispatch of outage situations, the customer will enjoy a much faster speed of repair, or in some instances, never realize a cut has occurred in the fiber lines of their neighborhood. In addition, the company has a single point of contact for solutions to networking problems, avoids repetition of effort, and pools resources of highly-trained, effective personnel to support field technicians. Universal application of "fixes" to field software and hardware upgrades or modifications also creates uniform operations management strategies company-wide. Improved productivity in

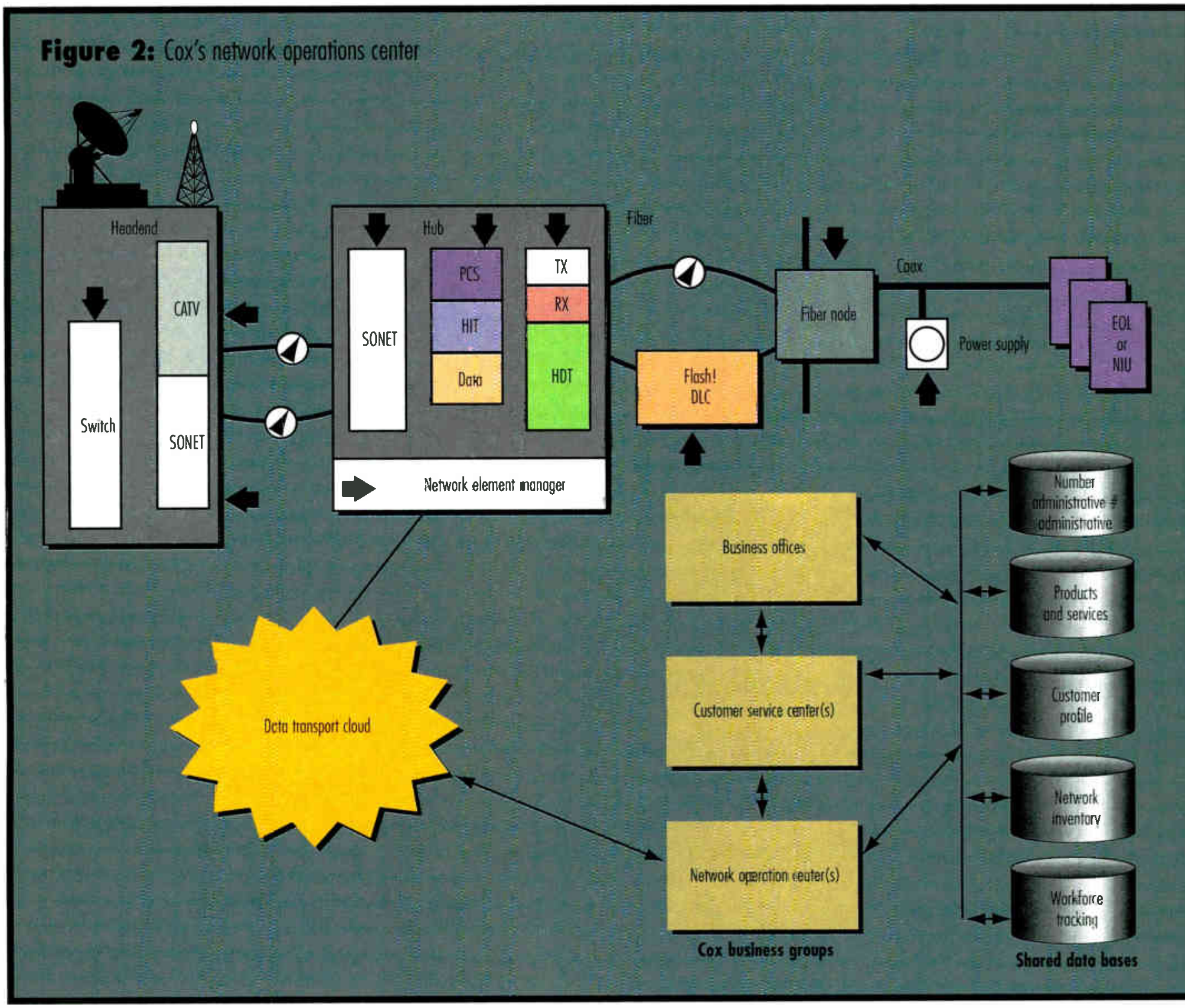


Figure 2: Cox's network operations center

the field, fewer service call outs, and reduced costs for vendor technical support spell a more efficient company and increased customer satisfaction.

Recognizing that a sophisticated network architecture and surveillance system cannot alone meet all of its customers' expectations and needs, Cox is also building state-of-the-art call centers to support inbound service calls. These call centers will migrate the company's customer contact employees (CCE) from a paper environment to a new PC-computing environment. CCEs will utilize Web-based applications such as on-line reference guides and information-rich databases of customers' service records and individual communications and entertainment needs. Graphical user interfaces will replace desk manuals and provide CCEs with real-time information as well as access to the Internet's powerful resources in a format conducive to serving customers.

"Using intranet technology, we can provide customer contact that is timely, consistent and organized. The CCEs and supervisors can share current programming information, local and national marketing strategies, competitive analysis, display schematics of Cox products, local weather forecasts, as well as real-time performance monitoring of the call center, all at the click of a button," said Kimberly Edmunds, Cox's director of customer care.

Customers also have the option of sending their questions and concerns to Cox via the Internet. In the near future, the company's Web site will offer online customer account information through use of personal identification numbers (PIN). The customer's PIN will also route them automatically to an electronic programming schedule and channel lineup specific to their system. An e-mail form will offer to send their concerns or comments directly to the company's CCEs for immediate reply.

While honors such as the J.D. Power award can delight companies, the challenge to continue providing superior service in a steadily growing competitive environment is staggering. Cox recognizes the value of a fiber-based infrastructure and Web-based service applications as only half of its formula for success in the customer satisfaction business. As part of its commitment to its "legendary customer care" training program, Cox's trainer to employee ratio is 1:144. CT

Alex Best is senior vice president of engineering for Cox Communications. Best can be contacted at (404) 843-5514.

New Tier Traps

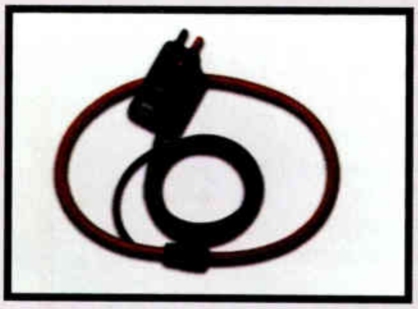
Eagle Comtronics Inc. recently unveiled standard and ultra sharp negative, positive and tier traps to 1 GHz. Other products from Eagle include: tier traps in six-, eight-, 10-, 12-, 14- and 16-pole combinations; sideband interdiction (decoding filters) and encoders; installation tools; security sleeves and diplex filters.

Reader Service #312

Telephony & Data System

The new Crystal Line broadband telephony and data system from Philips Broadband Networks is a breakthrough access platform that allows HFC network operators to reliably and affordably deliver two-way voice and data services. Crystal Line enables voice and data services to be delivered simultaneously with video services, supporting on-line services, high-speed Internet access and other interactive multimedia services. Philips also introduced its new state-of-the-art Diamond Series multi-taps, a complete line of 16 models, featuring standard bypass taps, as well as telephony and extended-length units in both F-port and twisted-pair configurations.

Reader Service #311



Flexible Current Probes

The AmpFlex, a new product from AEMC Instruments, is a flexible current probe designed to take measurements in tight breaker panels, around large bus bars, around cable bundles, and wrapped around irregular shapes. The sensor has an output for readings on DMMs, loggers, oscilloscopes and power quality instruments.

Reader Service #310

LNBs, Remote Controls

The new 9000 series Ka-band LNB is now available from Norsat International Inc. The unit is available in four models, each with a different frequency range, for global communications networks. A noise temperature rating of 1.8 dB enhances the 9000 series' reliability.

Also new from Norsat are two RS232 remote control options for the company's multistandard private cable headend system. Both options, the RC60 and the RC62 offer Windows-based graphical user interfaces that provide automated control over all cable headend functions including: operating frequencies ranging from 5 MHz to 800 MHz, A/B input source switching, audio and video modulation levels, and carrier and subcarrier power levels.

Reader Service #309

Broadband Multi-Service Platform

West End has just launched a new generation of its cable communications technology, offering product maturity and widescale deployment experience. The following products comprise the new WestBound 9600 Multi-Service Platform: Westbound Horizon network interface unit—West End's Horizon cable TV network interface unit delivers high performance access to cable TV broadband networks.

Adaptable to traditional as well as HFC networks, the Horizon answers the typical predicament of return path ingress noise impairments; Westbound 9600 Host Digital Terminal—The WestBound 9600 broadband Host Digital Terminal (HDT) is the intelligent switching core of the WestBound 9600 broadband Multi-Service Platform, located at the operator's headend or major node sites; and the Astrolabe Network Node Manager—The latest release of West End's network management package, the Astrolabe enables full element, network and service management of the traditional or HFC access network. It allows the WestBound 9600 HDT and the Horizon NIU (as well as non-West End broadband access technologies) to be configured for service and maintained directly from the operations and maintenance center.

Reader Service #308

New Line of Fiber Products

Telonix International Corp., recently debuted its new line of products at the 1997 Cable-Tec Expo. The company provides the cable industry with subscriber security boxes as well as fiber-optic cable management systems and attenuators.

Among Telonix's introductions are the FOVA-1310 fiber-optic variable attenuator, which uses precise microbending to attenuate the signal on a standard 3mm fiber cable from 0.5 to 5.5 dB. The FOJO series of fiber-optic jumper organizers, available in two configurations, stack to allow multiple layering and interlock end-to-end to create any required path.

Reader Service #307

Total Telecom Solution

An integrated access transport and management solution is available from Tellabs. Cablespan is a universal telephony distribution system for competitive local exchange carriers (CLECs), which can be used as a next-generation loop carrier for business customers.

The Titan 5500 wideband digital cross-connect and Titan 5200 broadband node provide SONET transport connecting the HFC distribution network to a central office, headend or point of presence. The Cablespan element management system and the Telenium network management system for the Titan interoperates to provide operators with a single control interface for managing the entire Tellabs solution.

Reader Service #306

Multipurpose Mini OTDR

Wavetek has developed the MTS 5100, a multipurpose mini OTDR designed to maximize fiber test productivity. The MTS handles single and multimode installations, in-service testing and out-of-band monitoring. The MTS is suitable for switched public networks, long haul transport systems, analog or digital broadband systems, or local area networks.

The MTS features optical testings from 635 to 1,625 nm, dead zones as low as 1 meter, and dynamic ranges normally expected only from a mainframe OTDR. The unit has two available bays featuring field interchangeable modules with varying dynamic ranges and wavelengths.

Durable construction and 16-hour batteries make the MTS available and capable for extended field use. With a streamlined user interface, help functions and drop-down menus, the unit allows simple single button automated testing. Generous internal memory size (200 traces) and fast power PC processing, coupled with simple memory and file management menus, provide complete measurements in Bellcore GR196 format. Wintrace, Wavetek's Windows-based trace analysis software, is available for detailed expert analysis.

Reader Service #305

BOOKSHELF

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

- *Sweep: The Complete Story*—Cofunded by CaLan, Hewlett-Packard and Tektronix, this program provides a thorough treatment of sweep technology and applications. Detailed operating instructions are provided for the CaLan 1776/1777, HP 8591C and Tektronix 2722A/ 2721A systems. This program covers passband, frequency response theory, definition of sweep, resolution/ scan loss, potential interference, TV scan theory, high level/low level/ no level sweeps, CATV transmission techniques, amplifier signatures and standing wave analysis. (105 min.) Order #T-1149, $22.

- *Compression: Expanding Channel Capacity While Enhancing Video and Audio Quality*—This presentation features Thomas Elliot (moderator), H. Allen Ecker Ph.D., Richard Prodan, Ph.D. and Geoff Roman. Cost-effective digital video compression is closer than ever and will provide new opportunities for services and revenue. This program deals with the realistic goals and benefits to be derived from digital video compression. It covers trade-offs such as pix quality vs. data rate vs. cost, data rate vs. ruggedness vs. cost and features vs. value vs. cost. Digital video compression architectures, performance of various digital techniques and DigiCipher and DigiCable products also are discussed. (80 min.) Order #T-1111, $45.

- *Technical Compliance: How FCC Reregulation Will Impact Your System Operations and Maintenance Practices*—This video features Steve Ross (moderator), Wendell Bailey, Jonathan Kramer and John Wong. With FCC reregulation a reality, this presentation seeks to provide an overview of the new regulations, as well as define key parameters including classes of signals covered, channel boundaries, aural standards, visual signal levels, signal-to-noise, signal-to-coherent disturbances ratio, hum modulations, color signals, testing requirements (including the number of test points required) and when tests are to be conducted. The federal/local relationship, as well as many other topics also are discussed. (85 min.) Order #T-1112, $45.

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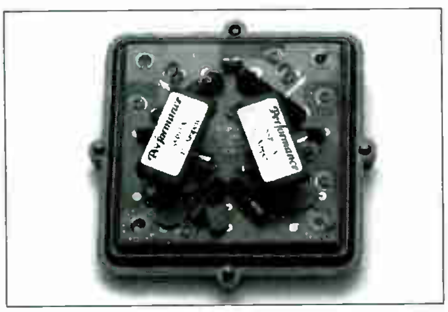

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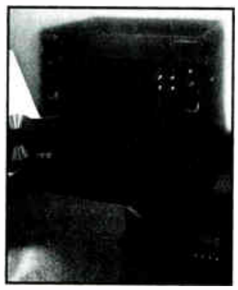

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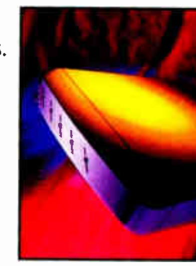

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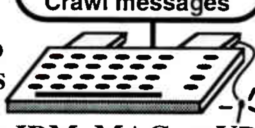

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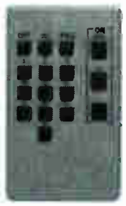

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Continued from page 51

protocol. Using this scheme, the CMTS can either poll individual modems, or, more likely, groups of modems, when it wants them to transmit. Until a modem is polled, it is not allowed to transmit. In either event, the number of modems allowed to transmit at any time is smaller than in a strictly random access system; hence, the number of collisions is reduced.

The CMTS will poll each group of modems in turn. When a group of modems is polled, any modem within that group can send data. The modems transmitting during this interval are essentially running in random access mode and there can be collisions. However, if the sizes of the groups are kept small, there will potentially be fewer collisions and hence less impact on data throughput. On the other hand, as the number of groups grows, the time between polling individual groups increases. Tiered polling, as this is sometimes called, is still more efficient that polling individual modems and clearly more efficient than a solely random access based MAC protocol.

A polling protocol has several weaknesses. The first is that every group has to be polled, even if no modem in that group has data to send. If no modem has data to send, then the return path may not be utilized, even as modems in other groups might have data to send and are just waiting to be polled. Secondly, if a modem does not get all its data sent during its polling period, it must wait to be polled again before sending any more data. These two aspects of a polling protocol combine to reduce the perceived throughput a user may experience with the system. The important issue is to engineer the sizes of the groups such that the return path is always utilized, but collisions are kept to a minimum.

QOS can be implemented keeping certain groups of modems smaller (hence reducing collisions within that group) and by polling those groups more often (hence offering more opportunities to transmit). Even if the high QOS groups have no data to send, they must still be polled more often. While these specific users are offered more chances to transmit, the other users of the system then have longer to wait before being polled. It is a better solution than random access, but not the best possible.

Reservation

This is the current "state-of-the-art" with respect to MAC protocols and is just beginning to be implemented in prototype modems. Using this type of protocol, a modem requests from the CMTS an opportunity to transmit a certain amount of data. As the CMTS receives requests from all the modems wanting to transmit, it reserves time on the return path accordingly and sends a message back indicating specific intervals of time that are reserved for each modem to individually transmit. In this manner, the CMTS only spends processing time on modems that have data to transmit. Additionally, modems are guaranteed a collision-free interval in which to transmit.

An astute reader will wonder how a modem could even request bandwidth without first being reserved a time to send messages. To allow this, the CMTS periodically allocates a portion of the return bandwidth for any modem to send a reservation request. These requests are sent in contention mode and may experience collisions; however, the CMTS can vary both the length and frequency of the contention request interval to keep the number of collisions to a minimum. Once a reservation request gets through, the modem is guaranteed time to transmit and may even "piggy-back" additional transmission requests along with the data.

With reservation, QOS can be implemented in several ways. In one example, the CMTS has a database indicating the QOS associated with each modem. As the CMTS receives reservation requests, it can guarantee that modems with high QOS get preferential treatment when bandwidth is reserved. Even if many modems with low QOS are requesting bandwidth, a modem with a higher QOS can be guaranteed the opportunities it needs to transmit. An important part of this protocol is that modems with no data to transmit will not request data slots, even high QOS modems. Therefore, the CMTS neither has to allocate transmission opportunities to nor poll high QOS modems that have no data to transmit. Only modems with data to send make data requests, but when granted, they are guaranteed to be collision free.

There are two groups working on reservation-based MAC protocols:

- The Multimedia Cable Network System (MCNS) partners, which is an MSO consortium
- Institute of Electrical and Electronics Engineers (IEEE) 802.14 committee.

While both groups are working on MAC protocols that use reservation to guarantee bandwidth to individual modems, they are philosophically taking different paths. MCNS has specified a MAC protocol that is optimized for variable length data packets as used with Internet protocol (IP) networking. IEEE 802.14 has optimized its MAC protocol for asynchronous transfer mode (ATM) traffic.

Both MAC protocols offer advantages depending on the implementation. However, the MCNS specifications are complete now and prototypes are being deployed. MCNS chose a MAC protocol optimized for IP based on both time-to-market and perceived market need over the next three to five years. Additionally, equipment using IP is more prevalent in the marketplace at this time as the favorite applications sought by Internet users run over IP. MCNS believes the choices made for its MAC protocol will better meet the needs of the North American cable market over the next three to five years.

IEEE 802.14 chose an ATM-based protocol because it potentially offers a more robust means to implement QOS. This may be important in the future as new and varied applications are developed. At this time however, ATM technology is both more expensive than IP and it has not made its way into the home networking market. Additionally, the IEEE 802.14 specifications are not yet complete, therefore, no implementations are available at this time.

Conclusion

An efficient MAC protocol ensures that the return path carrier is utilized to the fullest extent possible while at the same time providing good user performance. The most recent MAC protocol to be implemented, the MCNS MAC protocol, provides both more efficient use of return bandwidth and offers guaranteed quality of service for individual cable modems users. These modems are planned to be trialed in late 1997 for service in early 1998. CT

Doug Jones is a network architect at US West Advanced Technologies in Boulder, CO. He may be contacted via e-mail at jonesy@advtech.uswest.com.

Reader Service Number 45

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9: SCTE Great Plains Chapter seminar, HSD/wireline telephony, Bellevue, NE. Contact Randy Parker, (402) 292-4049.
9: SCTE Mid-South Chapter meeting, BCT/E and Installer Certification exams to be administered, Memphis, TN. Contact Kathy Andrews, (901) 365-1770, ext. 4110.
10: Society of Cable Telecommunications Engineers Satellite Tele-Seminar program, "In-premises wiring issues," Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact Janene Martin, (610) 363-6888.
14: Career Fair Coordinators' high tech career fair, Denver. Contact Ceilia Smith, (972) 462-8807.
14-16: Institute for International Research conference, "Optimizing the Functionality and Cost of Set-Top Boxes," San Francisco. Contact (800) 999-3123.

August

6: SCTE Ark-La-Tex Chapter annual golf tournament. Contact Terry Temple, (318) 631-3322.
9: SCTE Llano Estacado Chapter seminar, system powering, Lubbock, TX. Contact David Fielder, (806) 793-7475.
13: SCTE Appalachian Mid-Atlantic golf outing/picnic, Lebanon, PA. Contact Doug Hair, (717) 243-4918.
14: Society of Cable Telecommunications Engineers Satellite Tele-Seminar program, "Video transport (part one)," Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact Janene Martin, (610) 363-6888, ext. 220.
18-20: 1997 Great Lakes Cable Expo, Indianapolis. Contact show management, (317) 845-8100.
21: SCTE Gateway Chapter meeting, BCT/E and Installer Certification exams to be administered. Contact Chris Kramer, (314) 579-4627.

Planning Ahead

Sept. 15-17: ICSPAT/DSP World 1997, International Conference on Signal Processing Applications and Technology, San Diego. Contact Jennifer Call, (415) 278-5239.
Sept. 21-26: ISS '97: World Telecommunications Congress, "Global Network Evolution: Convergence or Collision?" Toronto, Canada. Contact Victoria Lord, (416) 588-2420.
Oct. 14-16: Mid-America Cable Show, Kansas City. Contact (913) 841-9241.
Oct. 20-22: Eastern Cable Show, Atlanta. Contact Southern Cable Television Association, (404) 255-1608.
Dec. 2-4: Converging Technologies Expo & Conference, Los Angeles. Contact John Golicz, (203) 256-4700, ext. 121.
Dec. 10-12: The Western Show, Anaheim, CA. Contact the California Cable Television Association, (510) 428-2225.

TRAINING

By the National Cable Television Institute

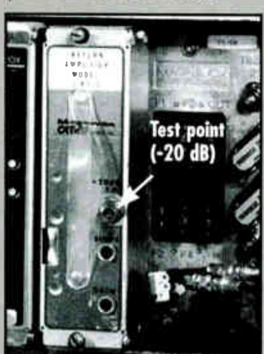
Return Signals in Bridger Amps: Part 3

This month concludes the series on the return amplifier module in 450-550 MHz trunk/bridger amps. The top portion is excerpted from a lesson in NCTI's System Technician Course. The hands-on training suggestions are modeled after NCTI's facilitator training courses for administering hands-on labs.

The return amplifier test points are typically 20 dB less than the actual operating level and may either be located on the front (Figure 1) or the side (Figure 2) of the return amplifier module.

These test points are on the output of the return amplifier, but before the final attenuator pad and equalizer. Two technicians are typically required to set the return amplifier's output levels using reverse RF signal input test points. One technician adjusts the gain and slope controls at one amplifier station, while the other technician monitors the input levels at the next station's return amplifier input test points.

Figure 1: Location of Magnavox return amp test point on front of module



Return amplifier module specs

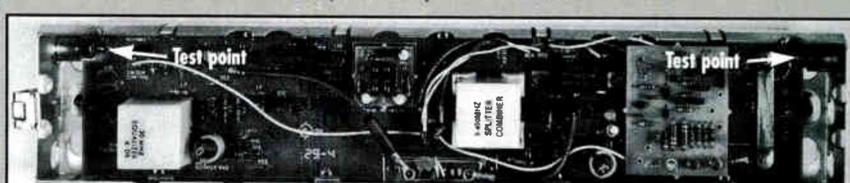
The return amplifier specifications are similar between each of the different manufacturer modules and are better than the trunk and bridger modules. This improvement in distortion characteristics is due to the lower levels of cable loss, the need for fewer amplifiers in cascade and sending fewer channels upstream than downstream. The typical sub-split return has no more than four TV channels in the 5 MHz to 33 MHz bandwidth. The specifications in the accompanying table list the similarities in four different return trunk amplifiers.

Return trunk amplifier specifications

	C-COR 142026-01	Jerrold XRM-30	Magnavox 5-RT 30	Scientific-Atlanta 372741
Reverse passband	5-33 MHz	5-31.5 MHz	5-30 MHz	5-50 MHz
Gain control range	0-8 dB	0-9 dB	15 dB	
Full gain	18.5 dB	15 dB	15 dB	14 dB
Slope control range			1-6 dB	
Output	32/32 dBmV		36 dBmV	31 dBmV
Distortions				
2nd order beat	90 dB	68 dB	86 dB	84 dB
X-mod	100 dB	70 dB	100 dB	102 dB
3rd order beat	108 dB	76 dB	103 dB	
Noise figure	8.5 dB	12 dB	13 dB	9 dB
Current	115 mA @ 60 VAC	260-300 mA @ 24 VDC	280 mA @ 24 VDC	200 mA @ 24 VDC

Next month's installment will be a quiz covering a variety of return path concerns in RF amplifiers. © NCTI.

Figure 2: Location of S-A return amplifier test points on side of module



Hands-on Performance Training

Proficiency objectives: *Locate the test point(s) on and identify the specifications for the return amplifier module in your system's trunk/bridger amplifier(s).*

Provide each student with a copy of the specs and block diagram of your trunk/bridger(s) return amplifier module.

Use the block diagram to show the location of the return amplifier test points. Then, with the actual equipment, have students locate the test points.

While discussing the specifications, explain what each value means with regard to the upstream signals.

Verify that each student can locate the test points on the return amplifier module in your system's trunk/bridger amplifier(s) and describe what the return amp's specifications mean for the upstream signals. CT

By William W. Riker

What's New At the SCTE Bookstore?

This year, the Society of Cable Telecommunications Engineers is offering even more comprehensive training materials and technical publications than ever before—and the list is still growing. We have added several new publications to our already extensive offerings in a continuing effort to keep our members on the cutting edge of broadband technology.

New Additions

One of the newest additions to our vast variety of reference and training resources is the *Recommended Practices for Coaxial Cable Construction and Testing* manual, which provides information necessary to manage, construct, document and test a coaxial cable telecommunications system. This is an excellent guidebook that contains facts on project management, cable handling equipment, aerial and underground cable placement, underground enclosures, bonding and grounding, cable preparation and connectorization, as well as activation and testing. A detailed glossary is also included. The price of the manual is $125 for SCTE members, $150 for nonmembers.

SCTE Region 7 Director Jim Kuhns has been a longtime hands-on participant in the Society, calling upon his many years of experience in the industry. Now, you can benefit from his knowledge, as he has compiled information and data that is essential to every person in the telecommunications industry to create the *Satellite Calculations Handbook*, published by the National Cable Television Institute. Topics include coordinating geographic coordinates and decimal degrees, determining map scale, locating North, plotting geographic position, antenna azimuth, antenna elevation and declination angles, decibels, watts and dBW, minimum antenna distance to obstruction, slant range distance, free space path loss and more. This new publication is available to SCTE members for $30 or $36 for nonmembers.

The *1997 Cable-Tec Expo Proceedings Manual* is now also available from the SCTE Bookstore. This two-volume set includes every Pre-conference Session, Engineering Conference paper, and Expo Workshop summary presented at Cable-Tec Expo '97 held last month in Orlando, FL. From digital deployment to cable modems to inside wiring, each information-packed paper in this manual will not only guide you through equipment problems and solutions, but will present the most current information on the latest in broadband telecommunications technology. The cost of this exclusive compendium is only $40.

Must-have resource

The Society's *Emerging Technologies 1997 Proceedings Manual* is another fine collection of materials introduced at our annual conference held on January 8-10 in Nashville this year. Sponsored by *Communications Technology* magazine and CommScope, this 426-page manual includes 27 papers from industry experts on such vital topics as new polymer technology, security issues, HFC network management and fiber optics. Priced at just $30, the "ET '97" manual is your source for information on the most crucial issues facing the cable telecommunications industry today.

Industry favorites

One of the Society's most popular offerings is the *Consumer's Guide to In-Home Wiring*. With more than 120,000 copies in print, this handy booklet is the result of many years of research and development. The *Consumer's Guide* will educate your subscribers and local building contractors about the "do's and don'ts" of in-home wiring, including installation, choosing the proper materials, and the potential risks of using the wrong equipment. As a direct mail piece, it can help systems build a better rapport with their customers by letting them know that their cable providers are concerned with providing them with the best possible service. The *Consumer's Guide* can be customized with company logos, and its text encourages subscribers to call their local cable company for additional information.

Another favorite among industry personnel, SCTE's comprehensive *Broadband Communications Course* consists of 24 videotaped programs that complement William Grant's *Cable Television*. Areas covered include noise, intermodulation distortion, fiber optics and light, among others. The complete course, with a member price of $795, can be customized to fit any local operation. Hands-on seminars are conducted by industry experts and coordinated with SCTE's local chapters and meeting groups. Nonmembers can purchase this invaluable program for $954.

For additional information on any of the comprehensive books, videotapes, training packages or publications that the Society has to offer, please contact us at (610) 363-6888, or FAX to (610) 363-5898. Our Website is also a great source for SCTE reference materials, current activities and information. You can visit the site at http://www.scte.org. CT

Bill Riker is president of the Society of Cable Telecommunications Engineers

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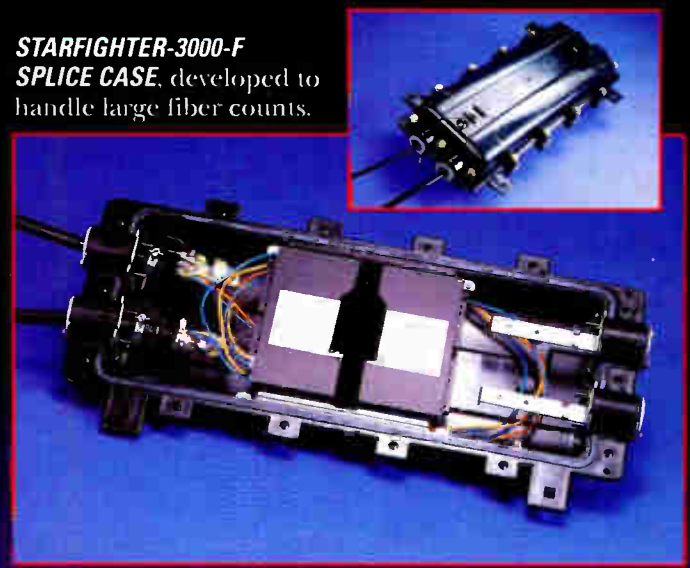

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