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SEPTEMBER 1997

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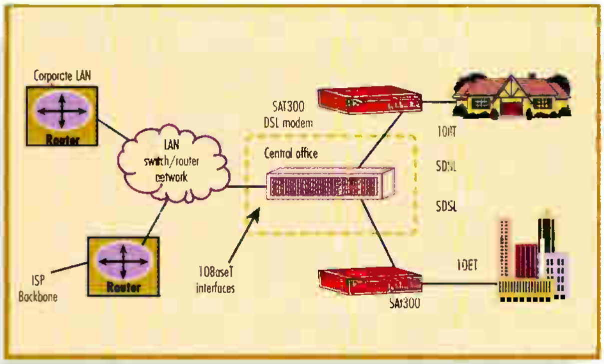

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"It's important to build the foundation of technical knowledge in digital communications

—Steve Johnson

DEPARTMENTS

NEWS & OPINION

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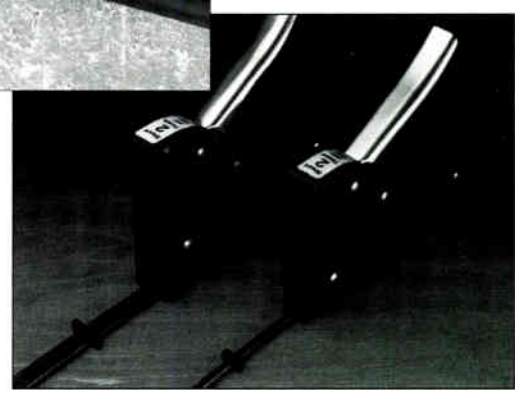

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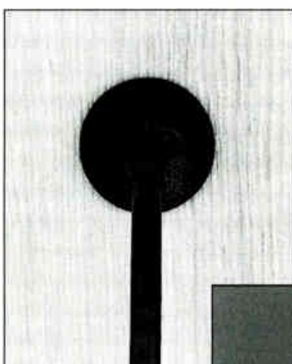

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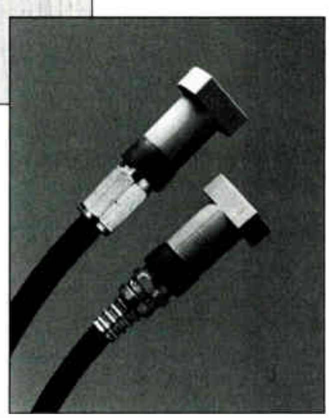

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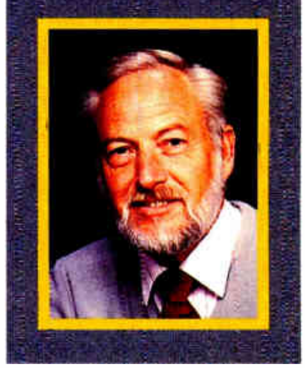
By Rex Porter

Work Together, Play Together



One of the big things I have always loved about this industry is how we enjoy each others' company, almost like a family.

I don't mean from the sense of families owning the businesses, although that is how some of us got started. What I'm referring to is how we like to associate with each other, even when we don't have to. Steve Johnson, our SCTE board chairman couldn't be reached when I wrote this because the Time Warner team of Steve, Dave Myers, Cheryl Williams, Bob Shank and June Speaect, were out "riding the Rockies." This bicycling event , for charity, takes its 2,000 riders from Grand Junction, through Delta, Montrose, Gunnison, Salida, Leadville, Frisco, and finally into Golden—almost 284 miles.

When we get a little "time off," it seems to center around activities between the industry vendors, technicians and engineers. The "Polebender" fishing tournament is a classic example. When you plan your relaxation, next year, be sure you wrangle an invite to this fishing tourney. This year's eighth annual, held at Lake Pueblo, was again headed by Dave Willis and Frank Eichenlaub. Thursday afternoon, everyone met at the Pueblo West Inn for an afternoon of golf. It was then "early to bed" because we had to be up by 6:30 a.m. on Friday and on to the marina in time to get an early 8:30 a.m. start. It was a beautiful sunny morning but the wind would keep the casts away from the intended targets all day. Boats loaded with cable people moved out from both the North and South marinas.

The Matt Endsley team was top candidate to win again (seems like they win every time). The top five winning teams in 1996 were given point handicaps but, even with the handicap, everyone felt they had to be gunning for the Endsley team. The father and son team of Dave and Randy Willis seem to be the perennial second place team. And it is rumored that Dave was overheard to say, "Maybe a 100 point handicap for the 1996 winners would be sufficient." We returned to a picnic area to tally up the final scores, have some lunch, and describe how big that one was—you know, the one that got away!

Sponsors of the tournament were Alcatel, Alpha Technologies, ANTEC, Comm/Scope, Digital Video, Gilbert, Integrated Cable Services, Panduit, Reltec, Regal, Scientific-Atlanta and Telewire. Just about everyone received a gift when names were pulled during the raffle. My teammate, Dave Lang, of Scientific-Atlanta, won top prize—a four-head, stereo VCR.

Once again, the Matt Endsley team took first place. And, once again, the father-son team of Dave and Randy Willis hung in with a second place finish. If you've never competed in the Polebender Classic, get invited in 1998. It's a great opportunity to enjoy the company of cable vendors and fellow-technocrats away from the pressures of the job!

Rex Porter,
Editor

Don't miss *CT* Senior Editor, Laura K. Hamilton's new column, *Solutions*, premiering this month. She'll be exploring the SCTE-List and gives pointers on how to subscribe.

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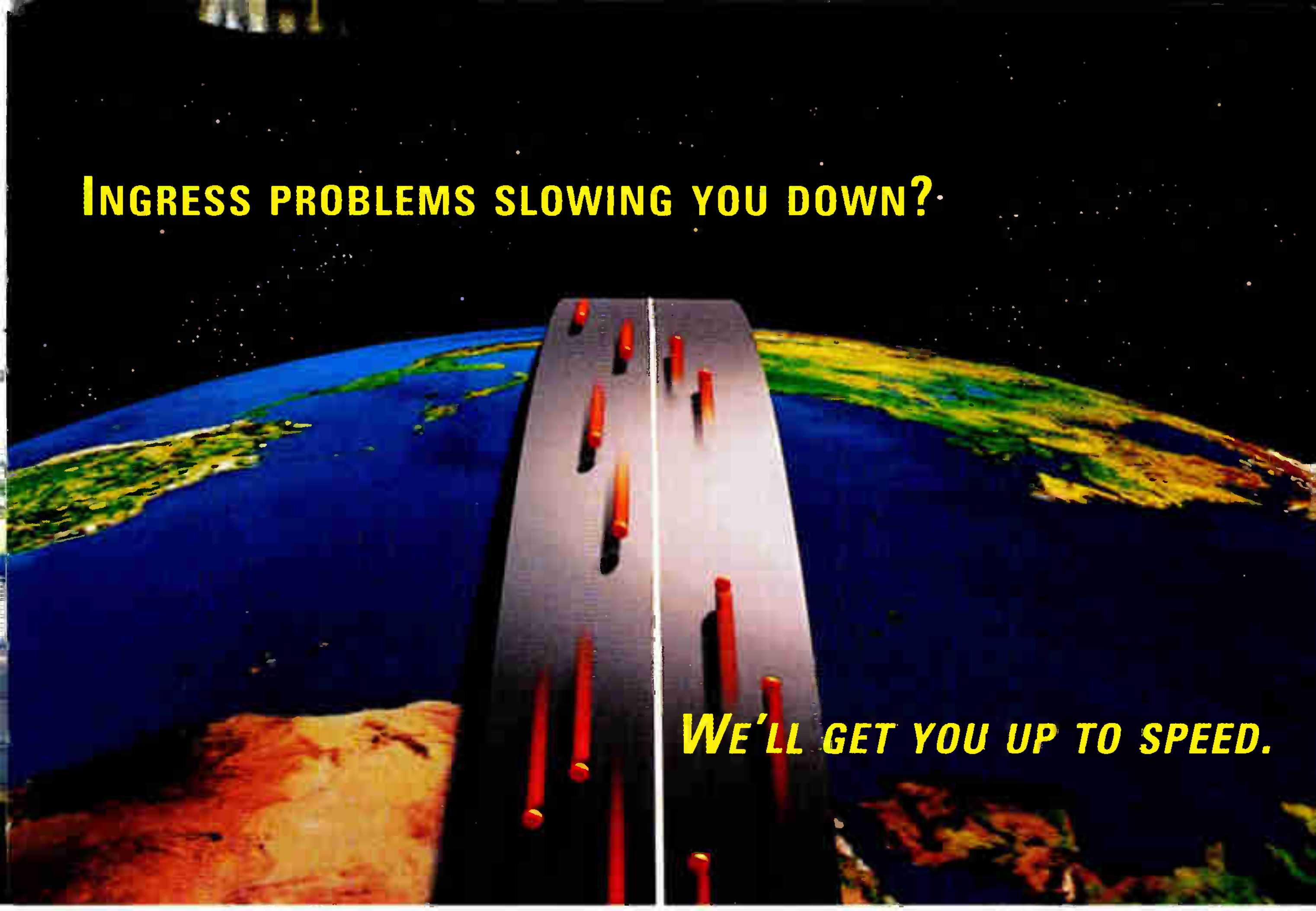

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HEWLETT PACKARD

Twin Peaks Gets HDTV

The McClier Corp., was awarded a contract by Sutro Tower, the 900-foot TV tower located at the top of Twin Peaks in San Francisco. This expansion project will bring high definition TV (HDTV) to Bay Area viewers.

The project will involve expanding the 31,000 square foot facility to accommodate the transmission of HDTV signals and the standard analog (NTSC) signal used by conventional TV. The tower will house additional transmitters, channel filters, cooling equipment and electrical service.

Boosting Cable Modem Applications

The recent alliance made between Analog Devices, a manufacturer of integrated circuits (ICs) used in analog and digital signal processing applications, and Libit Signal Processing, a designer, developer and maker of modem solutions and products for advanced digital communication applications will result in the production of SCTE/ MCNS-compliant ICs for cable modem applications.

The first IC will be a highly programmable chip for high-speed, two-way data transfer at the subscriber end of hybrid fiber/coax (HFC) cable networks. This device will combine Libit's core modem technology with Analog's mixed-signal technology and integrate a downstream quadrature amplitude modulation (QAM) demodulator, an upstream quadrature phase shift keying

Set-Top Seminar: Digital, HDTV and More

Set-top vendors, a Federal Communications Commission rep and system operators took advantage of the "Optimizing the Functionality & Cost of Set-Top Boxes" conference presented recently by the Institute for International Research in San Francisco. Vendors from both the set-top and high definition TV (HDTV) universe—General Instrument, Scientific-Atlanta, TV/COM, and Zenith—spoke alongside FCC rep Robert Pepper (who gave an update on the Commission's recent over-the-air digital ruling and how it could affect cable—including considerations for the short-term market for the set-top box).

S-A's Rob Van Orden detailed set-top enhancements over the last year. These included improved Internet access, increased near-video-on-demand applications and better channel selection and menu options.

Ron Martin of system operator Buford Television gave a real-life spin to his presentation by showing attendees how costs of hardware and software can be determined and how a system could decide to what extent hardware costs could be passed on to customers.

The vendor/MSO relationship was discussed by TV/COM's Bob Luff. Realistic timetables for rolling out high volume orders were discussed as well as the ways Digital Audio-Visual Council (DAVIC) and Society of Cable Telecommunications Engineers standards impact functionality requirements.

Zenith took up the HDTV question by way of Henry Walton's presentation. How does the market for HDTV influence the demand for set-tops? In part, Walton considered shelf-life for digital boxes and the roll-out for fully functional digital TV sets.

Complete details, including audio cassettes and copies of papers presented, are available from the IIR in New York at (800) 345-8016, ext. 3108, or fax (212) 599-2192.—*Laura Hamilton*

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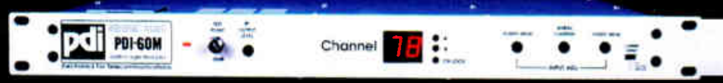

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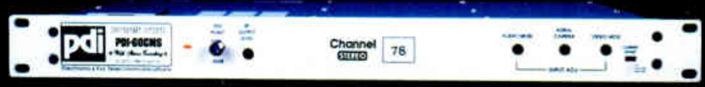

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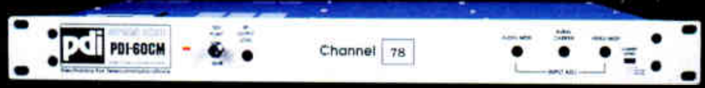

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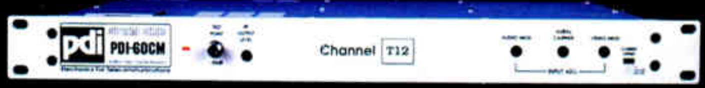

PDI-60CMT 60 dBmV "T" Channel Modulator

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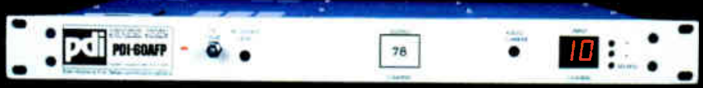

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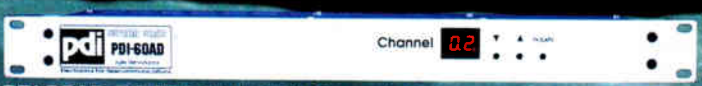

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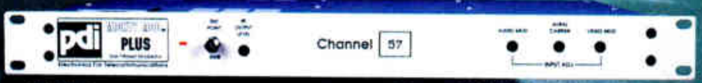

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ANTEC, TCI Agree to Terms

After completing a letter of intent May 15, 1997 to form an engineering design and construction management company, ANTEC and Tele-Communications Inc. have reached an agreement regarding the terms of this new company. The joint venture will provide turnkey services for a minimum of 50% of all of the projects in TCI's three-year infrastructure upgrade program.

The company created by both parties will purchase the required broadband transport products from ANTEC—these include lasers, amplifiers, optical receivers, powering systems and other equipment.

NEWS BITES

- FrontLine Communications was selected by DiviCom, a provider of digital video networking solutions, to supply equipment to create a digital emergency alert system (EAS). The FrontLine EAS system will interface to DiviCom's digital broadcast systems, allowing digital cable and wireless services to meet the current EAS requirements.
- The Fiber Optic Association is undertaking a study to examine the status of fiber optics and to determine why it has had success in some markets while failing in others. To participate contact the FAO at (617) 469-2FOA.
- Aegis Integration has completed the purchased of the SIGMA and ProGuard product lines of San Diego-based TV/COM International.
- Stanford Telecommunications has finished the first in a series of tests to confirm the interoperability of various hybrid fiber/coax (HFC) system components based on Multimedia Cable Network System (MCNS) specifications at CableLabs. Stanford's evaluation assembly, the subscriber modulator chip and the headend demodulator assembly supporting the upstream link were tested. CT

New SCTE Data Standard Approved; Prepares for International Recognition

The Society recently approved technical standard regarding compatibility for the design and manufacturing of cable modems will be reviewed by the International Telecommunications Union—Telecommunications (ITU-T) in August in Geneva for consideration as a globally recognized standard.

SCTE Standard DSS-97-2, "Data-Over-Cable Radio Frequency Interface Specifications," was submitted to the U.S. State Department on Aug. 1 for review. The 174-page document was slated to be brought on Aug. 13 to ITU-T's Geneva meeting as a U.S. contribution for recognized as an international standard.

This standard specifies radio frequency (RF) interface data transmission going from cable headends into subscribers' homes and businesses. The standard will enable the interoperability of cable modems purchased by consumers from one cable system to another. The document defines both the characteristics of the radio frequency interface on the cable system and the signaling sequences between the headend and the subscriber's equipment as part of the overall data-over-cable specifications.

The SCTE Data Standards Subcommittee (DSS) evaluated and voted on three key standards soon after the Multimedia Cable Network System (MCNS) released its cable modem specifications in late Spring. An overwhelming majority of DSS members voted to adopt DSS-97-2 on July 23. It was then unanimously approved by the SCTE Engineering Committee.

By establishing the standard for data transmission equipment, SCTE may bring the incompatibility issues that cable modem manufacturers have been facing closer to resolution.

Interactive Training Programs Available

Taking steps to stay abreast of advances in training techniques, SCTE recently expanded its educational offerings to include computer-based training (CBT) for industry technical personnel.

"As our industry deploys telecommunications services, it becomes imperative that the Society's members understand the telephony and wide-area data services history of development," said SCTE Vice President of Technical Programs Marv Nelson. "This is one of the reasons behind the introduction of the Society's Telephony Certification Program."

The two software packages, Telecom Technologies and T-1 Transmission Basics, which are currently available only to SCTE members, together provide a solid introduction to the fundamentals of telephone and T-1 transmission, as well as switching technologies. Graphics, navigation tools, glossary features and online help bring the practical information on these emerging technologies to life. Each program takes about 4-6 hours to complete.

The information provided in these interactive training programs is designed to support the Society's Telephony Certification Program in a way that is both convenient and cost-effective for telecommunications employers. The CBT courses are licensed to allow each cable system to purchase one copy of the program and install it on a computer for up to one year—allowing for not only an unlimited number of trainees, but tremendous flexibility in opportunities to learn and review the material.

"One of the big advantages of CBT is that is self-paced," said Nelson. "Each student can go through the program at his or her own speed rather than trying to keep up or be slowed down by an entire classroom of students."

These software packages are currently available through Dec. 31 at the introductory price of $345 each. Beginning Jan. 1, 1998, the cost of one of these exclusive courses will be $395 for Society members. At that time, both programs will be available for purchase at $695 for the set. CT

Call for Nominations for '98-'99 SCTE Board

The Society of Cable Telecommunications Engineers currently is seeking nominations for candidates to run for eight positions on its National Board of Directors:

- Region 3—Serving Alaska, Idaho, Montana, Oregon and Washington
- Region 4—Serving Oklahoma and Texas
- Region 5—Serving Illinois, Iowa, Kansas, Missouri and Nebraska
- Region 7—Serving Indiana, Michigan and Ohio
- Region 8—Serving Alabama, Arkansas, Louisiana, Mississippi and Tennessee
- Region 10—Serving Kentucky, North Carolina, Virginia, West Virginia and District of Columbia
- Region 12—Serving Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont
- At-Large Director—One position open. Can be from any region, elected by all members.

Interested parties should contact Bill Riker or Roberta Dainton at (610) 363-6888 no later than Oct. 15, 1997.

By Rex Porter

In Step With Time Warner's Steve Johnson

Steve Johnson

Steve Johnson is a graduate of Oklahoma State University with a bachelor of science degree in electronics engineering technology. He got his start in cable TV when he joined LVO Cable (later becoming United Cable) in 1974 in Tulsa, OK.

Between 1975 and 1977, he worked in the oil field and, deciding cable TV was still in his blood, he rejoined United Cable in 1977. There, he served as project engineer and eastern regional engineer. He has also worked as a consulting engineer both with Cotten and Associates and independently before joining ATC (which later became Time Warner Cable) in 1984.

Johnson oversees Time Warner Cable's Signal Leakage Program including annual flyovers of all cable systems (over 170,000 miles of plant) and is in charge of Federal Communications Commission technical compliance for the company. He is TWC's representative on the National Cable Television Association Engineering Committee, the NCTA Signal Leakage Subcommittee, and the NCTA Technical Standards Subcommittee. He also is the NCTA's liaison with the National Electrical Code, has served on the Article 830 Task Group, and serves on NEC Panel 16.

Johnson is chairman of the board of the Society of Cable Telecommunications Engineers, has been a member of the society since 1977, and is currently a senior member. He has been active in the BCT/E program from the beginning and was the fourth society member to be certified at the Engineer level. His national SCTE committee work includes SCTE Engineering Committee (chairman), Broadband Communications Technician/Engineer (BCT/E) administration subcommittee, and the subcommittee (chairman). He is presently the Region 2 director on the society's board.

Johnson is also a member of the Society of Broadcast Engineers where he is certified as a broadcast engineer with a television endorsement through the SBE's program. He is a member of Institute of Electrical and Electronic Engineers and holder of FCC General Radiotelephone License and Advanced Class Amateur Radio License (N0AYE).

Johnson recently spoke with *CT* Editor Rex Porter about his goals for the SCTE and the state of new technologies.

Communications Technology: *Congratulations on your election as chairman of the SCTE board of directors. Over the last few years, you have either chaired or served as a member on the engineering committee, the emergency alert system (EAS) subcommittee, and the BCT/E administration subcommittee. Will this affect your involvement with the committees and subcommittees that you have served?*

Johnson: I feel very honored to have been selected by the board to be the chairman of SCTE for the coming term. I'm very excited about it and look forward to serving. I've been a member of the SCTE since 1977 and have seen it come a long way during that time, from a membership of around 1,000 to over 15,000 today. I'm very appreciative of the fact that I work for a company that sees the benefits of the SCTE and supports me in my work with the Society.

During my term as chairman, I plan to stay active in the committee work, in which I have participated in the past, with some modification. As chairman of the SCTE board, the bylaws require me to be a member of the operations committee. I also plan to sit in on finance committee meetings to offer input before that committee brings items to the full board. I will continue as chairman of the EAS subcommittee because I think it is very important to maintain continuity on that subcommittee as we conclude our work in the task group. The task group was established to deal with the participation of small systems in EAS and ensuring that our deaf subscribers' needs are accommodated in these systems.

The engineering committee oversees the work of seven subcommittees: data standards, design and construction, digital video, EAS, interface practices, maintenance, and material management. With my new responsibilities as chairman of the board and the time required for those, I plan on stepping down as chairman of the engineering committee. Andy Scott has agreed to take over as chairman, beginning in October. This is a very important committee as it oversees the society's standards setting activities.

CT: *You've become chairman when the SCTE has begun to achieve many of its goals of adopting industry standards with American National Standards Institute, getting settled into its new headquarters environment, record membership growth, and recognition as "The Engineering Voice" of the cable telecommunications industry. What new programs or plans you would like to see this new board introduce?*

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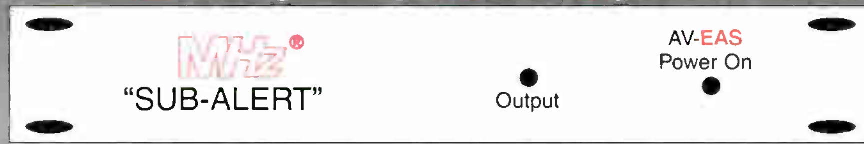

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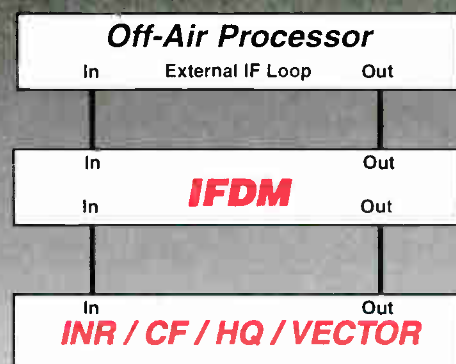

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Johnson: I would like to see us beef up the support to our chapters and meeting groups. Over the past few years, the national membership has shown a tremendous growth. We've also seen substantial increases each year in registrations at the Emerging Technologies Conference and at Cable-Tec Expo. At the same time, many of our chapters and meeting groups are struggling. Local system operations are in a state of flux with changes in ownership, personnel and management. We're starting to see some turn around but one of the most important things the Society can do is to support the chapters during this change.

Hiring Steve Townsend to fill the chapter development manager opening is a good start. Steve will be working with the chapters to find where our weaknesses lie and to offer help to shore up those weaknesses. Regional directors need to be involved in this process too. One of the easiest things we can do to help is to share good ideas among the chapters. No sense in reinventing the wheel 75 times.

CT: *Digital TV has begun to have the lion's share of attention in the "new technology" arena. I know the SCTE has the "DigiPoints" handbook published each month and the digital video subcommittee, chaired by Paul Hearty, is working closely with CableLabs, ANSI, and IEEE to keep our engineers and technicians abreast of this new and promising technology. Are there more programs or training you would like to see come forth?*

Johnson: Right now, it's important to build the foundation of technical knowledge in digital communications. DigiPoints is an excellent publication for doing that; sort of a Digital Communications 101 course. The work done in the digital video and data standards subcommittee is of a higher level for the engineering members. With the amount of deployment of digital services to date, I don't think we have a firm grasp yet on what other training requirements we might have.

A lot of work has been done on return path issues. These issues seem to be largely plant setup and maintenance items. The return spectrum has been only lightly utilized until now. As we add services to this spectrum, we're finding that the proper setup of the return plant is more critical. Ingress is a similar but different problem in the sub-band than the forward bands.

One opportunity we have is in the test and measurement of digital signals. We don't presently have low-cost signal level measuring equipment for field personnel. With a variety of modulations schemes, I don't see an easy answer, however. This remains a challenge that we will have to face.

CT: *We were all pleased to see the addition of the two new SCTE staff members, Alan Babcock and Steve Townsend. Alan is just the person we need to search out new training programs for the SCTE. Steve will, I'm sure, have a positive effect on chapter growth. But I believe a campaign to bring in new members, both from the operations side and the manufacturing* *side, would be something we should emphasize. I believe we could quickly attain membership of more than 20,000 with a concentrated effort within our own industry. How do you feel about this?*

Johnson: The rate that membership has been increasing is very satisfying. During 1995, we changed our name from the Society of Cable Television Engineers to the Society of Cable Telecommunications Engineers to reflect a change in our scope. As we change our scope to encompass telecommunications rather than limiting it to television, we increase the universe of potential members too. Based upon recent growth, 20,000 members is conceivable by the year 2000.

CT: *Each year, we try to encourage the membership to cast their votes during the campaign for regional directors. And, each year, about 20% of the members vote. Any comments on this sad situation?*

Johnson: After seeing a downward trend in voting percentages during the last few years, this year's voting was up slightly, compared to last year. This year, the Society instituted a program to provide the chapters with information on the candidates and to encourage the members locally to vote. This appears to have been successful with voting up 4%, overall. I don't know if the low voter participation indicates apathy or contentment with present operations. Still, I would like to see voting percentages up considerably more than the current 21%.

> "It's important to build the foundation of technical knowledge in digital communications."

CT: *With new digital and data technology, attendance at the local meeting groups and chapters should swell and managers at the MSO headquarters should demand that attendance. Any recommendations concerning how we get the eneral/system/technical managers to better understand the importance of this training and the certification testing?*

Johnson: Selling the operators on the benefits of the SCTE technical training is a two-step approach. First, it is necessary to sell the MSO's upper management and I think we've done a good job here. Second, we need to sell the local managers. Due to the shear number of local managers, this is the difficult part and involves the local chapter people meeting with these local managers.

As we move into new technologies, technical training becomes even more important. SCTE chapter meetings provide an excellent training value. Where else


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I really don't think that economics is keeping technicians from attending local meetings, however. As our industry is restructuring and getting leaner, we have fewer people doing more work. It is difficult to let a large part of your work force off to go to an all-day meeting. Chapters need to be more innovative in scheduling meetings to accommodate the operator's needs (not that they are not innovative already). Find which days might work better for your local operators; try Saturday meetings, try evening meetings, try half-day meetings—or half-day meetings that are repeated, covering the same material , morning and afternoon, to allow more of the local work force to attend with minimal impact on the operators' schedules.

CT: *The SCTE has grown from day one back in 1969 and you have moved from the technician's ranks at LVO back in Tulsa, OK, to a prominent engineering position with Time Warner. Any advice to those starting out as technicians and installers in the cable industry?*

Johnson: One interest I developed that has made a great contribution to my career was my interest in ham radio. The principals learned through building and experimenting in amateur radio activity taught me a great deal. The RF theory I learned, easily transferred into cable television. Knowing how signals propagate, knowledge of antenna theory, and participation in hidden transmitter hunts provided a head start in signal leakage detection and measurement.

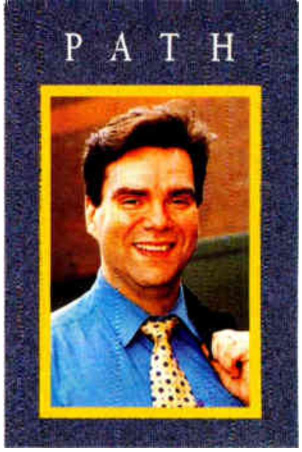
For installers and technicians starting out in the industry, I would recommend two things: training and certification.

First of all, take advantage of every training opportunity you can. Attend vendor seminars, your own company's training sessions, SCTE chapter meetings, Cable-Tec Expo, the Conference on Emerging Technologies, college classes, etc. Take advantage of as many of these resources as possible.

Secondly, certify in the SCTE's BCT/E program. This program is an excellent measure of your knowledge and shows your employer (or future employer) that you have attained a level of competence in your field. The FCC had a First Class Commercial Radiotelephony License that, although it wasn't totally appropriate to cable TV, showed you had reached a certain level of competence and had a certain knowledge base. The SCTE's BCT/E certification program is tailored to our industry and provides a much more specific bench mark for cable TV. It takes work to accomplish this benchmark but it is definitely worth the effort. 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.

By Alex Zavistovich



The Duke of URL

In the Bell Curve of Internet Savvy, I am neither at the pointy-headed bleeding edge of technology nor the receding tail of semi-literacy.

Not me. I'm the test marketing poster boy: squarely in the big, bulging middle of post-Baby Boom, pre-Gen X adult males. We use the Internet mostly for e-mail and research, occasionally for games or entertainment, and rarely for chat rooms or other phenomena of the wired generation.

Most of the electronic baggage that comes with the Internet tells me that some webheads have way too much time on their hands. Take expressions, for example. If you get an aggressive reaction from someone on e-mail or in a chat room, it's called being "flamed." Junk e-mail is called "spam." (I, not being "in the know" with this lingo, have been calling junk e-mail by a term apparently much more confusing to Internet denizens than spam. I've been calling it "junk e-mail.")

I don't always offer my e-mail address. Getting immediate feedback on all my valuable opinions is intriguing, of course. Still, that's counterbalanced by the threat of flaming spam à la computer—now there's a serving suggestion Hormel never considered.

So I'm not the most connected person on the block...but I know what Joe Six-Pack wants from his Internet access. He wants speed, reliability and immediate access. Everything else is window dressing.

People, the competition we knew was destined to come after the Telecom Act is mustering on the near horizon, especially when it comes to the Internet. If I were king, I'd get the cable industry to move faster on cable modem deployment, even if it means using telco return to get in the race. Some surprising competitors may beat you to it.

Who am I talking about? The power companies, for one. Here in the Washington, DC area, the Potomac Electric Power Company (PEPCO) is teaming with RCN, a New Jersey-based telecommunications service provider. The venture will offer bundled services—including Internet and cable TV—to consumers in the DC area.

RCN actually formed the joint venture with Potomac Capital Investment Corp., a non-regulated PEPCO subsidiary. RCN and Potomac Capital Investment each will invest up to $150 million over the next three years to offer phone, cable TV, and high-speed Internet service. This is already old news for consumers in Boston, MA. RCN has for some time been working with Boston Edison to provide similar offerings in the Boston metropolitan market. New York, too.

> "Cable's bandwidth advantage is being eroded as time slips away"

Local and long distance phone and Internet service is only six months away for DC, Maryland and Virginia under this plan. Cable TV and high-speed Internet will follow within 18 months. In three to five years, service will expand throughout Northern Virginia and Maryland. I'd expect RCN's next move to be somewhere between New York and DC, like Philadelphia, maybe. With that kind of coverage, the power utilities could work together and even have a good shot at offering competitive PCS services.

RCN is making use of a network that deploys fiber virtually to the home, important for digital delivery. Of course it's going to work. It's the power company, for crying out loud. One-stop shopping for electricity, cable, telephony and data? For some folks, it would be a no-brainer.

This could be especially damaging to District Cablevision, TCI's Washington, DC cable system. Jones Communications cable customers in neighboring Virginia now have high-speed data access, while DC residents (and lawmakers) are stuck in the information slow lane. And at an average of $62 per month for basic and two premium channels, plus a $45 installation charge, cable entertainment in DC is pricey. That's a market vulnerability someone is going to exploit before long.

Wireless companies are also getting involved. In Seattle and San Jose, a customer can buy a $400 wireless modem, pay a $125 installation fee, and get a 128 kbps feed for a flat $120 per month. He can buy dedicated service at 1.5 Mbps for $500 a month. Is there money to be made here?

Let's get our act together. Cable's bandwidth advantage is being eroded as time slips away. The remaining market advantage, price, won't last long if you let outside competition beat you to the punch. The middle of the bell curve is waiting. CT

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

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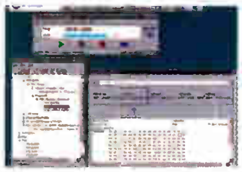

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By Ron Hranac

Subscriber Drop Wiring For Interactive Services—Part 3

The main reason for grounding and bonding is safety. This includes safety of people—subscribers, cable and utility companies personnel; and safety of equipment—subscribers' in-home equipment and your network's equipment. Contrary to some old tales that have floated around the industry for years, proper grounding and bonding does not reduce leakage and ingress. More on this later.

Effective grounding and bonding helps to reduce potentially harmful sheath currents. In most U.S. electrical distribution systems, the power company neutral conductor is intended to handle phase imbalances and fault currents. These phase imbalances and fault currents can create substantial sheath currents on grounding conductors, so good grounding and bonding practices are essential.

Common point grounding and bonding is best. That is, all grounds in a house should be connected to the same point. This eliminates differences of potential among the power, telephone and cable TV ground conductors. It also helps to avoid ground loops. In all cases, your subscriber drop grounding and bonding practices must comply with applicable local and national codes, which are usually based on the National Electrical Code.

In some situations it may not be possible to ground or bond the subscriber drop. The home's electrical wiring may not have a good ground connection, or it may be inaccessible. This can be a real problem in older homes and certain (MDUs). In these cases, you may want to consider the use of drop isolators. Isolators are common in some countries where local and national codes prohibit common point bonding and grounding, and require the cable TV drop's ground connection to be separate from other grounds. *A note of caution: Drop isolators may not be allowed by local or other electrical codes that pertain to your system. Check first before using them.*

Drop isolators are passive devices that break the coaxial cable's DC continuity in both the shield and center conductor, while still allowing RF to pass. Isolators allow the home's interior drop cabling to float at the same electrical potential as the TV set, VCR and other consumer devices (and most likely also the home's electrical wiring) to which it is connected, while the exterior cabling stays at the electrical potential of the cable TV distribution network. Some poorly designed isolators will cause signal leakage and ingress, so use only good quality ones. Also, the physical location of the isolator may affect an isolator's susceptibility to ingress.

Back to my earlier comment about signal leakage and ingress not being reduced by proper grounding and bonding. First of all, leakage and ingress occur when the cable's shielding is rendered ineffective for some reason. This might be due to a loose connector, a cracked or otherwise damaged cable shield, and poorly shielded cable TV system components or even consumer devices such as TV sets, FM tuners, and VCRs. All of these will still be there after you ground or bond the drop, and they will still allow signals in and out of the system.

Furthermore, unless the ground wire is very short, it will be a quarter wavelength or an odd multiple of a quarter wavelength long at some frequency carried on the cable network. A quarter wavelength wire acts as an impedance transforme from one end of the wire to the othe The grounded end will be a low imped ance, but the point where the ground wire connects to the cable will be a h impedance at the affected frequency. T means the ground wire will not groun an RF signal at that frequency no mat how good the ground at the other end the wire actually is, because the RF floating on the cable shield "sees" the ground wire's input impedance as what is roughly the equivalent of a path of extremely high resistance. For DC and 60 Hz AC this is not a problem. But RF is another story.

High pass filters

In two-way systems, high pass filters can be a useful tool to combat reverse path ingress caused by drop problems. Ideally, it would be nice if cable TV companies would replace or upgrade all bad drops when preparing for two-way operation, but this is usually cost-prohibitive (of course, had they been installed right the first time, this wouldn't be an issue). There are two schools of thought regarding the use of high pass filters.

One camp supports installing high pass filters on all non-two-way drops. This has been shown to be very effective at eliminating much of the ingress affecting the reverse signal path. If a non-two-way subscriber decides to use two-way services, then the high pass filter can be removed and the drop replaced or upgraded at that time. This allows problem drops to be dealt with on a case-by-case basis. The downside to this approach is the cost to install a large number of high pass filters throughout a system. Granted, the filters themselves are relatively low-cost (some of the mini high pass filters sell for less than $3 each), but the labor to install them is the killer. ➤


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The other camp supports the use of high pass filters only where absolutely necessary. If most of your drops were installed right and aren't causing reverse path problems, why arbitrarily install high pass filters where they may not be required? No matter which camp you're in, when high pass filters must be used, they should be installed at the tap port or as close to the tap port as possible.

In two-way homes with multiple outlets, high pass filters may have to be installed on splitter ports feeding regular TVs and VCRs. The splitter port(s) connected to the two-way device can be left unfiltered. High-pass filters are available with band stop attenuation up to 60 dB or so. In practice, 40 dB attenuation has been found to be adequate for most applications.

Common mode chokes

Most ingress is caused by signals that start out as common mode currents (this is not the same thing as common path distortion—only the name sounds similar) on the cable shield's outer surface. The common mode currents may be induced onto the shield in the home, or even some distance away from the home. When common mode currents reach a breach in the cable shield, they will enter the cable and become differential mode signals that can interfere with signals in the cable.

An effective way to reduce common mode currents is to place a common mode choke at the input to every device in the home that is connected to the cable TV system. A simple, low-cost common mode choke can be made by wrapping about 10 feet of the drop cable into a small 7-turn coil approximately 5 or 6 inches in diameter. This type of common mode choke is very effective at reducing common mode signals in the 5-40 MHz range. For more information on this, see my column in the July and August 1996 issues of *Communications Technology*.

Wrapping up

Subscriber drops play a critical role in a cable TV operator's ability to provide two-way and interactive services. The majority of problems in most two-way systems occur in the subscriber drop, but the problems are manageable. Trouble-free drops require good materials, good installation practices, comprehensive training, and an effective (QC) program.

Other tools to minimize drop problems include an effective signal leakage program (more on this in a future column), proper grounding and bonding, and when necessary, the use of high-pass filters and common mode chokes.

This concludes my mini-series on subscriber drops for interactive services. As I said before, all of what I've discussed involves relatively simple things that collectively can help to ensure your subscriber drops will provide trouble-free operation in an interactive environment. CT

Ron Hranac is senior vice president, engineering for Denver-based consulting firm Coaxial International. He also is senior technical editor for "Communications Technology." Hranac can be reached by e-mail at rhranac@aol.com.

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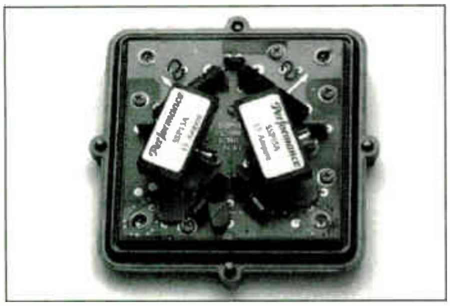

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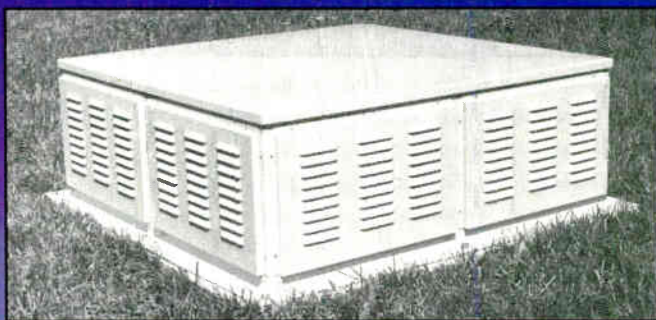

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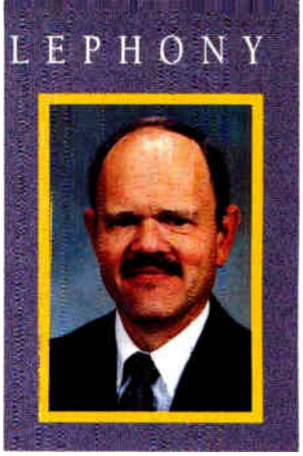

By Justin J. Junkus

Asynchronous Transfer Mode

Telephony's Version Of the Money Machine

In telephony, ATM is a different type of money machine than banking's automatic teller. Our ATM refers to asynchronous transfer mode, which is a digital communications technology built upon the concept of a fixed length data unit called a cell. The reason our ATM is also a money machine is that it permits communications companies to offer new multimedia services with flexible bandwidth allocation. After reading this column, you decide whether this particular money machine is for deposits or withdrawals.

Building blocks

First, let's look at the basic building block of ATM, the fixed length cell. This cell is a set of 53 bytes of digitized information that can represent a sample of speech on a telephony circuit, part of a data transmission on a local area network (LAN), or part of digitally coded video transmission. (Just for a refresher, one byte is eight bits, so the cell contains 424 ones or zeros.) Forty eight bytes of the cell are reserved for user information—the voice, data, or video mentioned earlier.

The first five bytes of the ATM cell are the header bytes, which contain information on paths through the network, the type of cell, its priority when the network becomes congested, and the type of information within the user part of the cell.

The technology is called asynchronous because cells can be placed on the physical medium (translation: fiber or coax) as needed for the particular application, rather than at fixed intervals of time. *Communications Technology's* August, 1996 "Focus on Telephony" column on multiplexing will help you see the important difference between ATM and time division multiplexing (TDM) that gives ATM its bandwidth on demand capability. While TDM dedicates specific segments of time (timeslots) to a user for the duration of the transmission, ATM uses the medium only when the medium is required.

> "Low bandwidth voice transmission is less tolerant of cell delays than higher bandwidth data."

In plain English, when no information is being transmitted, the medium can be used by another application. On the other hand, if the application needs more time on the channel (bandwidth), let the application have the time needed, within the capability of the medium, and the cell priority indicated in the cell header.

ATM priority

Priority is a key issue in ATM. For voice to be transmitted via cells, it is important that the individual samples arrive within a reasonable time of each other. Otherwise, the telephony subscriber will notice breaks in conversation or other audio degradation. Curiously enough, in this respect, low bandwidth voice transmission is less tolerant of cell delays than higher bandwidth data. That's because data can be buffered, or stored, while a machine waits to receive it, but voice needs real-time delivery.

One way to minimize delay might be to set a high priority on all cells containing voice information. In this manner, voice cells would be guaranteed their place on the line before data or video. Unfortunately, this might result in data cells being completely dropped during network congestion.

Which type?

Which type of degradation is more critical is another issue for debate among system designers. Just so you know, some trade-offs are that minimal lost voice cells will not be noticed, lost data cells can be retransmitted when the loss is detected, and there are thresholds of acceptable delay for both voice and data. In part, the dilemma

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was resolved by making the ATM cell relatively short when compared to other data units, such as an X.25 packet. Short cells mean more chance for small pieces to be placed on the medium, even during higher traffic periods.

Operations and maintenance

Another key issue for ATM is operations and maintenance. As I noted earlier, the ATM cell header contains bytes that indicate the type of cell. One type of cell is strictly for maintenance. No user data is carried on that cell, only system information. Herein lies a real value if the system uses ATM from end to end.

The maintenance cell can be used to indicate fault conditions and specific locations, and could be automatically generated by the equipment in question, to be sent to a central location. Since much of the ATM protocol is standardized, this maintenance data can be moved between equipment provided by multiple vendors. This allows multiple sourcing while getting the benefit of centralized monitoring.

SONET transport

Enter the major challenge, and perhaps the point that determines whether this money machine is for withdrawals or deposits. ATM was originally specified for high-speed optical circuits using SONET (synchronous optical network) as the transport mechanism. End to end means that the medium will no longer be purely optical. Also, it means the system will probably operate at multiple transmission rates, from SONET OC-x gigabyte per second ranges down to as low as T-1 at 1.544 megabits per second.

Physical layer interfaces need to be designed for each medium, rate, and transport mechanism, and each interface must meet the standard for multiple parts of the ATM protocol. This takes time and coordination among several vendors. Mix the applications and the coordination becomes more difficult.

> "Service providers must choose the boundaries of their ATM systems so that maximum benefit can be realized."

One example that comes to mind is the full service network trials in Orlando, FL, where ATM technology was delivered to the set-top. Given telephony, video servers, broadband switches, data and several flavors of video, coordination was a massive, and often costly, effort.

Does that mean the practical application of end-to-end ATM, particularly in telephony, is far off? Not necessarily. For example, Ericsson is currently running a trial of their ANx hybrid fiber/coax system with Cox in Oklahoma, and is projecting commercial delivery later this year. The trial provides participants with a set of consumer services including telephony, energy management, Internet access, broadcast video, switched video, and energy management. (Note the suite of new revenue opportunities for a potential service provider!) In the trial system, ATM terminates at the network interface on the customer premises. Notice that this vendor made a choice of where to terminate that avoids interfacing ATM with multiple consumer appliances, but still gives the benefit of monitoring at the ATM cell level to the customer premises.

This may well be the key to deposit or withdrawal (translation: cash infusion vs. profits) from the ATM "money machine." Service providers must choose the boundaries of their ATM systems so that maximum benefit can be realized and problems can be avoided, given the available technology.

When multiple vendors can agree on standards beyond the original boundary, or when the service provider is satisfied that its primary vendor will be sufficient to support additional applications, it is time to continue the technology to the next termination point, perhaps even down to the consumer appliance. CT

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

By Laura K. Hamilton

Why Aren't You On the SCTE-List?

You've got this great little white box in your office that's holding inside it (almost) all the answers—or at least some great suggestions—to any cable system dilemma.

It gives you virtually instantaneous access to hundreds of cable technologists' minds and innumerable years of telecommunications experience. You can ask it a question, wait a little while and out will pop suggestions from fellow engineers and technicians from all over the United States and the world.

It's your computer, of course, and if you'll use it and your e-mail address to subscribe to the "SCTE-List," you've just added a powerful tool to your repertoire of cable engineering bag of tricks. (See the sidebar for information on subscribing.)

What is it?

The SCTE-List is an unmoderated Internet forum for discussing issues in cable TV, telecommunications and the Society of Cable Telecommunications Engineers. Looking for return path optical transmitter advice? Do you have a grounding question? Wondering about cable sag? Frustrated with a particular piece of equipment? Do you need a speaker for your SCTE chapter or meeting group?

The list is a excellent place to go.

So how did this all start? Enter David Devereaux-Weber, a network technician with the network engineering technology group at the University of Wisconsin-Madison. (You might have seen him nabbing the Member of the Year Award at this year's SCTE Cable-Tec Expo in Orlando, FL.)

Back in August 1994, Devereaux-Weber started the list with a subscriber base of one, operating on a computer at UW-Madison. About a month later, it was up to 203. By mid-July 1997, it was up to 1,300.

How it works

Messages are not edited or screened in advance. As soon as the listserver gets a valid post, it is sent out to all subscribers. Like a lot of Internet mailing lists, it's the old good news/bad news predicament.

"This has some good sides, like fast response and no time necessary for editing or review," says Devereaux-Weber, "and some bad sides like unintended messages are difficult to stop once they are received."

"We have had several instances of private messages being unintentionally sent to the list, which has caused great consternation on the part of the unintentional posters," he adds.

Flames

However, one of the great things about the list is subscribers have been extremely good about avoiding "flame wars" and advertising posts. While on other lists you might risk being bombarded by ads or publicly humiliated in cyberspace with condescending responses to your messages ("flaming"), the SCTE-List doesn't have a lot of these difficulties.

"When the conversation has got heated, I have posted messages pointing out that the load on the server gets real high when flame wars erupt," says Devereaux-Weber. "Since the server is already so heavily loaded, a flame war could introduce long delays or even crash the system."

This has been enough to keep the flames under control.

Advertising

As for advertising creeping on to the list, Devereaux-Weber sends a direct message (not through the list) if someone sends a message that is too commercial. He simply points out that since the list operates on the equipment of a public institution, advertising isn't allowed. Vendors have done a good job honoring the policy.

Browse the list

Recently, a way to browse the SCTE-List popped up on the World Wide Web by way of the Cable Addicts Broadband Lounge (http://cable.com/scte/). Courtesy of Rick Goldeck of GoldCom Inc., the Lounge houses an archive of list messages.

"This was a difficult programming task," says Goldeck, "Not because it was technically hard to do, but because once I had the articles listed, I found myself reading messages instead of writing code. There is volumes of interesting information!"

So start sharing—and contributing—to those volumes of telecommunications know-how. Subscribe to the SCTE-List.

How to subscribe

To subscribe to the SCTE-List, send an e-mail to:
listserver@relay.doit.wisc.edu

In the body of the message, type:
subscribe scte-list Your Name

There is no official link between the list and the SCTE, but the Society does pay the university a fee for storing the list archive. Devereaux-Weber's time is volunteered. UW accepts financial contributions and they may be earmarked for the SCTE-List. Write to University of Wisconsin Foundation, P.O. Box 8860, Madison, WI 53708-8860; phone (608) 263-4545.

(Editor's note: Look for a new column "From the SCTE-List" to start in "Communications Technology" soon.) CT

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

By Alan Babcock

Training—An Introduction

This column will become a regular feature for *Communications Technology*. I will use this space to provide updates on training and certification programs offered by the Society of Cable Telecommunications Engineers, and I will highlight activities of the training committee.

I'd like to introduce you to how training activities and projects are handled at the national level. I hope you will get a better understanding about how you can become involved and have input into the types of training and certification programs offered by SCTE.

Origins

The board of directors some time ago created five standing committees that provide direction and oversight for the many programs and activities offered by SCTE. The standing committees include planning, operations, engineering, finance and training. Each committee is staffed by members of the board of directors and others from the general membership who can make specific contributions. The chair of each committee is normally a member of the board of directors. The committees engage numerous persons in subcommittees and working groups to complete work that needs to be done.

Who's who

The training committee membership includes: Jim Kuhns, Comcast, Region 7 director, eastern vice chair and chair of the training committee; Dennis Quinter, Time Warner Cable and Region 11 director; M.J. Jackson, Gilbert Engineering and Region 4 director; and Andy Scott, NCTA and at-large director. Additional members of the training committee who are not on the board of directors include Don Oden of NCTI, Pam Nobles of Jones Intercable, Keith Hayes of Bell South Entertainment and Kent Vermilion of Time Warner Cable. The training committee is responsible for directing all of the training and certification programs offered by the Society. The committee approves training materials to be sold in the bookstore, determines new certification programs for implementation, sets and reviews rules in support of certification programs, reviews and approves training materials in support of certification efforts and has a voice in the program committees for Emerging Technologies and Cable-Tec Expo.

Subcommittees

Subcommittees reporting to the training committee include Broadband Communications Technician/Engineer (BCT/E) curriculum, BCT/E administration, installer certification, service technician certification, telephony certification, National Cable Television Center and Museum liaison, and health and safety. Chairs for these subcommittees include the members of the training committee or other individuals who have a specific interest.

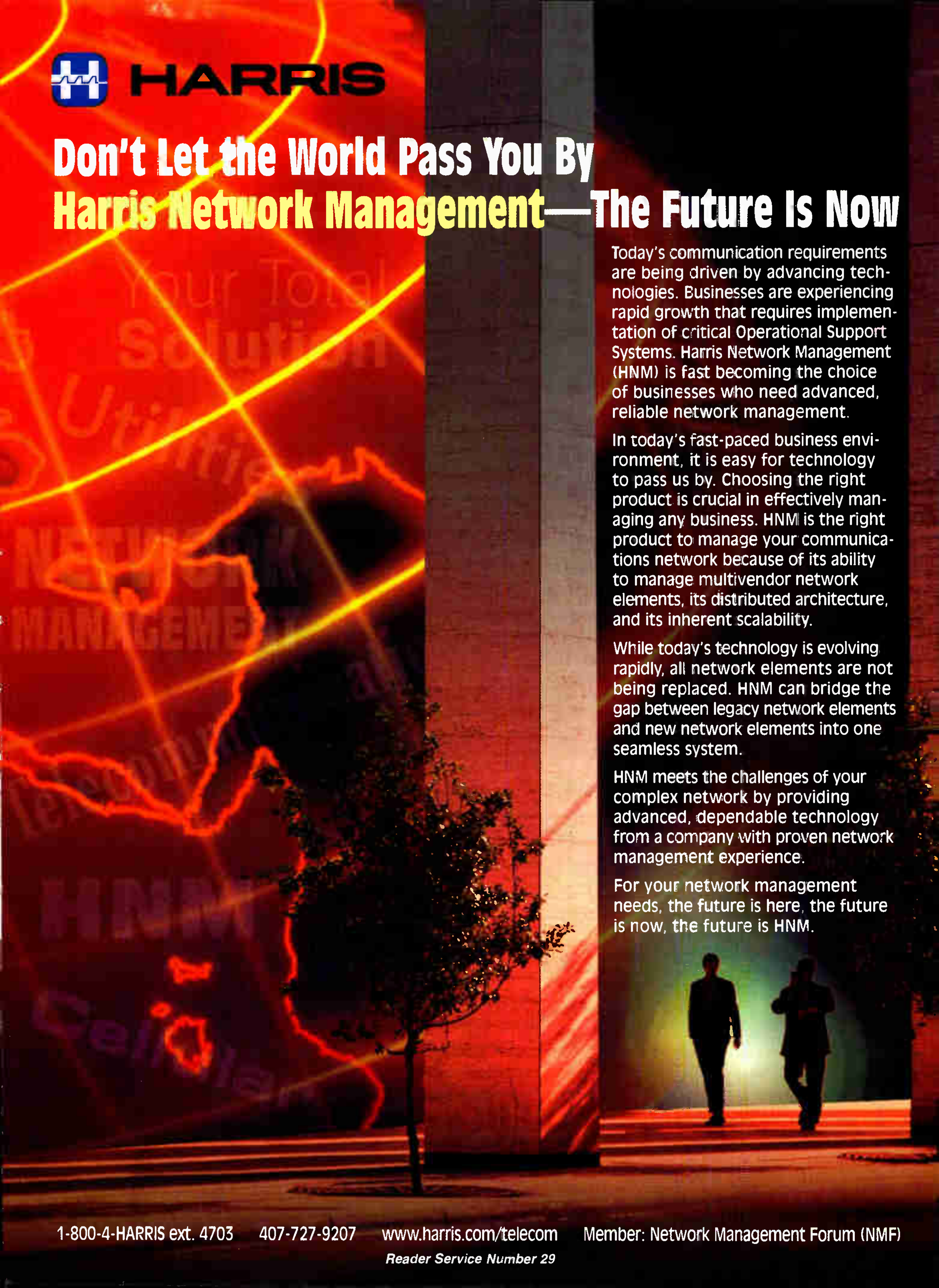
To get the work done, most subcommittees have created working groups to focus on specific areas of importance. For example, the BCT/E curriculum committee oversees the activities of seven working groups, one for each of the categories of the BCT/E program. In general, the training committee provides oversight and strategic direction, the subcommittees coordinate activities for a given area and the working groups create test questions, training content, rules, etc.

Current projects

The training committee has a tremendous workload. Some projects in progress include: Creating and launching two new certification programs (service technician and telephony); directing the future of *DigiPoints*; recommending new training programs in areas such as grounding and bonding, reverse system operation, emergency alert system (EAS), and others; updating BCT/E certification programs, revising the *Installer Manual* and installer certification programs; finding new ways to promote safe work practices; responding to Occupational Safety & Health Administration inquiries for public opinion about proposed rulemaking; and more. The committee has more projects than it can do with its current workforce. The SCTE general membership is clamoring for more training materials and programs. The rapid pace of change in technology demands that the training committee be more aggressive in the development and deployment of new training for the membership.

The committee is always looking for more people to help in specific areas. You don't have to be a "trainer," but you should believe in training and should desire to make a difference by providing training to the SCTE membership. If you have an interest and can spare the time, we'd love your help on the training committee. Please contact me at SCTE headquarters at (610) 363-6888 or in Denver at (303) 768-8667, or contact Jim Kuhns at (810) 578-9486 to learn how you can become active in the training committee. CT

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

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An Update on Data by Phone

By John Lynch

In 1995, the World Wide Web brought graphical, hypertext-linked Internet access to every PC equipped with a modem or LAN connection. Today, nearly every PC user wants a high-speed data connection for Internet e-mail and web searches and most users rely on ordinary modems to get one. This article explains the main telephone-based modem technologies that will provide data access over the next five years.

Today's "era of ubiquitous bandwidth" is a unique time in telecommunications history. The need for bandwidth has grown more rapidly than ever before, mainly because of the success of the Internet. In 1994, only 4% of U.S. homes were connected to the Internet. Now over 20% are on-line and demand is growing fast.

Although the basic building blocks of the technology for ubiquitous bandwidth have existed for decades, the market need has only recently reached critical mass. As more and more applications demand greater bandwidth, everyone—both users and PC makers—wants faster access to the Internet. It remains only for the local phone companies to deploy these new services.

In the '80s, the local area network (LAN) was adopted to interconnect computers at many corporate, governmental and educational sites. Now that LANs are commonplace, the wide area network (WAN) is becoming an indispensable link to connect an enterprise across longer distances. Initially, WANs carried voiceband traffic—voice calls or voiceband modem/fax transmissions. Users connected to a distant site via a modem to log on as a remote user or to FTP a few files. Using WANs to connect distant LANs was relatively uncommon, since the fastest modems operated at only 14.4 kbps. Now that 28.8 and 33.6 kbps modems are widely available, "modeming in" to a home office for remote access is a familiar fact of life for millions of PC users. And as voiceband modems with 56 kbps capacity have entered the market, more multimegabit broadband data access will soon be common.

Because phone companies rely on hundreds of millions of standard voice calls to generate most of their revenue, they will move carefully to provide new data services. The good news is that new broadband data services will save them money, the Telecommunications Act of 1996 permits greater local competition, and these new data services may rival even their reliable voice service business for new markets and profitability. The key to these new services are the modems that will be used to deliver them.

Voiceband modems

Voiceband modems are the most common type of modem, from the first 300 bps modems of 30 years ago to the latest 33.6 and 56 kbps models. These connect directly to the central office (CO) voice switch, can dial any number and work on any POTS line.

However, voiceband modems cannot exceed 56 kbps, they tie up one phone line (costing the subscriber more), they tie up a port on the CO voice switch, and users often stay online for hours rather than minutes (as for most voice calls). Thus, they cost the CO significantly more than voice calls, they degrade overall performance, and they force the phone company to upgrade their existing expensive voice switches.

The fastest voiceband modems available use K56flex, among the most widely supported 56 kbps modem protocols; it is supported by leading PC, modem and remote access server manufacturers and offered by over 650 Internet service providers (ISPs) worldwide. Voiceband modems are by far the most widespread; over several hundred million are in use and will no doubt remain the primary modem for Internet access for many years to come.

ISDN modems

Integrated services digital network (ISDN) is a digital network for voice and data communications at rates up to 1.544 or 2.048 Mbps. Basic rate ISDN (BRI) provides two 64 kbps B channels (for data or voice) and one 16 kbps D channel (for signaling: who's calling, number dialed, etc.). BRI modems also can use POTS lines, but the CO must have ISDN line cards installed, instead of typical POTS line cards, a substantial expense for the phone company.

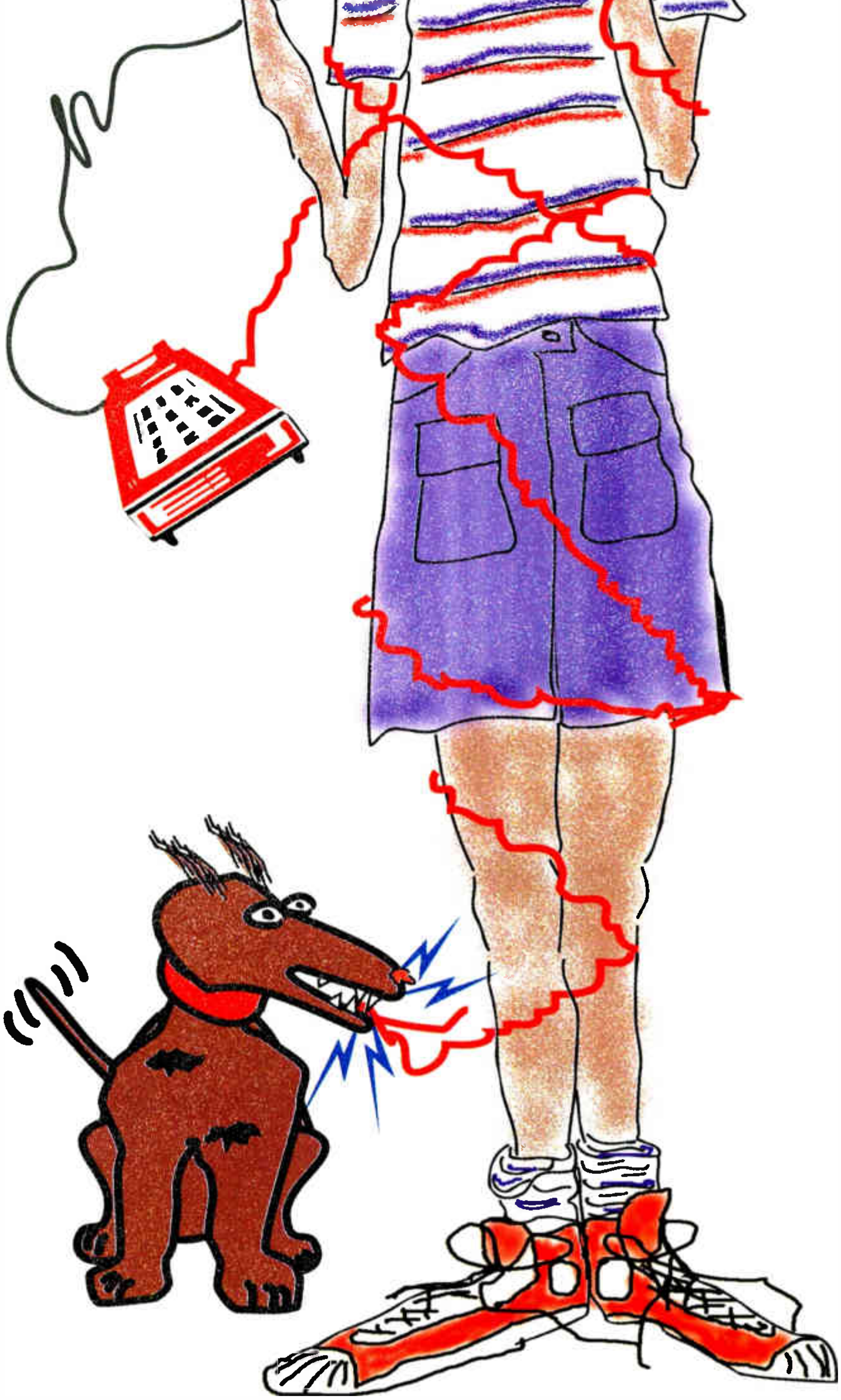
Two B channels can be combined into one 128 kbps data channel via the

"BONDING" technique (defined by the Bandwidth On Demand Interoperability Group), yielding a high-speed data pipe for select corporate customers. BRI can operate only up to 18,000 feet (3 miles) from the CO. Two interface techniques are used: the universal (U) interface plugs directly to the phone line; the subscriber/termination (S/T) interface requires a separate network termination (NT-1) unit to connect to the U interface at the phone line, but it allows up to eight BRI devices to share the line. Setting up a BRI channel can be complex, since there are so many options to select and configure. BRI is in many cases the best data access available at moderate cost. Although BRI has been available for over a decade, there are fewer than one million subscribers in the U.S. so far.

xDSL modems

Digital subscriber line (DSL) modems will save the phone companies money because they use existing copper lines in the local phone networks and can provide the highest data rates per user. Within five years, a significant portion of U.S. households will have high-speed data connections to the Internet via xDSL modems. All the various xDSL technologies have these features in common:

- A single local loop (the wires that transmit to the local CO) can provide both voice and data. Life-line voice is retained—the phone will work in a power outage, but the data connection will be down. Thus only one local loop per subscriber is required.
- Data modulated at up to 2 MHz can be passed over 18,000 foot local



BOTTOM LINE

Modems from a Telco Perspective

Cable modems nothwithstanding, the telephony industry still thinks it has the answers for computer-based telecommunications. The top three telco frontrunners? Voiceband, ISDN and DSL. Here's the lowdown:

- Voiceband modems. Voiceband modems connect directly to the central office (CO) voice switch, can dial any number and work on any POTS line. The catch? They can't exceed 56 kbps, they tie up one phone line and a port on the CO voice switch. They cost the CO significantly more than voice calls, degrade overall performance, and force the phone company to upgrade their voice switches.
- ISDN modems. Integrated services digital network (ISDN) modems pass voice and data at rates up to 1.544 or 2.048 Mbps. Basic rate ISDN (BRI) provides two 64 kbps B channels (for data or voice) and one 16 kbps D channel (for signaling: who's calling, number dialed, etc.). BRI modems also can use POTS lines, but the CO must have ISDN line cards installed, instead of typical POTS line cards, a substantial expense for the phone company. Setting up a BRI channel can be complex, since there are so many options to select and configure.
- DSL modems. Digital subscriber line (DSL) modems use existing copper lines in the local phone networks—a money-saver for telcos. In DSL technology, data passes between the PC and the ATM network. Voice passes between the POTS phone and voice switch. Thus, the phone companies don't need to install more local loops, don't have to buy more voice switches, and won't have degraded service due to data traffic.

loops to the subscriber. Typical ADSL will be "rate adaptive," meaning that the fastest connections depend on the quality of the local loop.

- The subscriber and CO are symmetric. A splitter on both ends separates the voice (below 4,000 Hz) from higher frequency data. All xDSL modems send high-speed data over conventional phone lines, and all use a DSL access multiplexer (DSLAM), a band of modems that connect the subscriber's ADSL modem to the local loop.
- Data passes between the PC and the ATM network. Voice passes between the POTS phone and voice switch. Thus, the phone companies don't need to install more local loops, don't have to buy more voice switches, and won't have degraded service due to data traffic. Subscribers get better data service, even if they're on-line all the time.

Of all xDSL forms, ADSL appears the most significant for mass deployment. ADSL sends data at a higher frequency than voice, so voice and data can coexist on the same local loop, which splits voice and data at both the subscriber and CO locations. Thus the phone companies can provide a high-speed data connection over the existing local loop, and they do not have to add new wiring. Many new services will exploit easier access to broadband data, such as digital video broadcasting. Ironically, ADSL was first developed for digital video to the home, but video alone did not drive up demand as the Internet has. Nonetheless, when ADSL is available, there will be virtually unlimited video sources available to the subscriber.

All these technologies offer improvements and some require new wiring or other hardware additions to operate. One large drawback still faces all phone companies. Because a modem user can make one call to an ISP and stay on-line for hours, operation of the CO voice switch can be seriously degraded. And subscribers still cannot rely on certain types of access, like BRI, for both data and voice, since they still need a POTS line for life-line voice service when the power fails.

As for cable modems, satellite modems and wireless modems, these technologies "broadcast" data to thousands of subscribers and therefore do not scale for mass deployment as well as "point-to-point" modems. Cable modems and satellite modems can send hundreds of megabits downstream (to a subscriber), but this high-speed bandwidth gets divided by the total of active subscribers, often hundreds or thousands, reducing the effective bandwidth to as low as conventional voiceband modems. For cable and satellite modems, the upstream connection (to the network) is difficult to provide, only 7% of the existing cable TV networks can support upstream data, and satellite transponders are costly. Wireless offers portability but is limited to voiceband speeds due to the limited amount of radio frequency bandwidth.

The universal need for faster access promises to drive further technological innovation, which in turn will permit bandwidth-hungry applications to meet the demand for increasingly complex feature sets. Modem makers have responded with a wide variety of options to provide higher-speed connections. Some modem protocol technology offers higher data speeds over ordinary telephone lines, so users don't have to pay extra setup or monthly costs for special lines, and telephone companies don't have to add new equipment at the central office.

Best of all, ISPs can deliver the graphics-intensive web pages, audio and video, and files their users need at near-ISDN speeds and at nearly twice the rate of the prevailing 28.8 standard. Some corporations may commit to a costlier technology like ISDN for their in-house telecommunications, telecommuting and remote access needs. Meanwhile, the vast majority of users, including most businesses, will continue to use the cheapest and easiest to install choice, voiceband modems, and their fastest incarnation, the new 56 kbps models, for the foreseeable future. CT

John Lynch is the vice president of Ariel's newly formed Computer Telephony Business. Prior to joining Ariel, he was director of modem and multimedia R&D at AT&T Bell Laboratories. During his 16-year tenure at Bell Labs he worked on a broad range of DSP products for PBX, video, and multimedia applications.

Status Report On ADSL Standards

By Debbie Sallee

Standards are essential to the success of an emerging technology. Setting and adhering to standards helps ensure interoperability, market acceptance and high-quality products. In contrast, a lack of standards weakens the industry by allowing a proprietary atmosphere to develop, stunting widespread acceptance and deflating competition, which, in turn, can drive up prices.

In industries such as telecommunications, standards become even more important as new technologies replace old ones. In such an industry, users accustomed to ubiquitous access to services demand the same access in the new services that are emerging. The lack of such is enough to turn the user off to the idea of the new technology, adversely affecting the success of that technology.

End user satisfaction

In a standard's development phase, the industry's governing body reviews competing technologies to determine which has the best performance level and establishes requirements. In addition, the complexity of the technology's implementation and the feasibility of its deployment are considered. It is an intense and rigorous process, designed to ensure end user satisfaction with the product or service and to provide the industry with the best vehicle to carry the emerging technology to success.

Another aspect of market success is the availability of components from multiple sources. Because the existence of standards results in a larger number of vendors supporting the same technology, competition is increased and prices are driven downward more rapidly, resulting in an enlargement of the overall market.

Perhaps the most important aspect of the standards process is the assurance of interoperability between products from different suppliers. For mass deployment to occur, equipment purchased from different vendors must work with one another. For example, with asymmetric digital subscriber line (ADSL) technology, a standard means that a customer who purchases an ADSL modem in Chicago can be sure that when she travels to Arizona, her computer will be able to access her home office.

Without standards, this universal access cannot be guaranteed. The resulting proprietary atmosphere translates into limited acceptance of a technology and confusion in the marketplace. Companies are often reluctant to enter a market where it is not clear which technology will be supported. This can lead to vendors being forced out of business, the expenditure of resources on duplicate designs or more costly designs capable of supporting dual standards, or companies never entering the market at all.

Reduced risk

There are two types of standards. De facto standards emerge when single or multiple vendors support a technology but are not active in any organized standards body. A de facto standard is in truth not a standard, but a proprietary design that is able to win some market acceptance. De facto standards increase risk for consumers because few vendors will offer

BOTTOM LINE

What's the Scoop On ADSL Standards?

For asymmetric digital subscriber line (ADSL) technology, a standard means that a customer who purchases an ADSL modem in Chicago can be sure that when she travels to Arizona, her computer will be able to access her home office. Without standards, this universal access cannot be guaranteed. The resulting proprietary atmosphere translates into limited acceptance of a technology and confusion in the marketplace.

So what's being done? In March 1993, the American National Standards Institute adopted the discrete multitone (DMT) modulation scheme as the standard line code for ADSL. The European Technical Standards Institute contributed an annex to the ANSI T1.413 ADSL standard to reflect European requirements, in effect creating one international standard.

The ANSI T1E1.4 working group is currently finalizing Issue 2 of the ADSL specification. Most of the work for Issue 2 is focused in the following areas: clarifications to Issue 1 text for multivendor interoperability, rate adaptation at startup, the transport of asynchronous transfer mode (ATM) cells over ADSL, extending the highest data rates to over 8 Mbps, and reducing the overhead for increased upstream capability.

the proprietary product, and often, another group of vendors will offer an official standards-based product. The consumer who chooses a de facto standard is often left in the cold when the standards-based product gains market support and forces the elimination of the de facto equipment.

Official standards, on the other hand, have widespread support and recognition by the industry and the government. So, while de facto standards may initially be deployed faster than organized standards, official standards bodies maintain a consensus around a single technology, reducing risk and increasing the momentum for that technology in the long run.

The importance of the standards process increases when more than one vertical market is responsible to provide a complete system. In the telecommunications industry, consumers purchase modems from retail stores and telephone companies provide services with equipment purchased from a variety of vendors. In order for the technology to work, all this equipment must be interoperable. That means dozens of vendors, making a variety of different equipment, must all support the same base technology. For vendors to enter the market, they must feel confident that their products will interoperate.

Integrated services digital network (ISDN) was one of the first xDSL technologies to become standardized. Consumers can now purchase ISDN modems from a variety of retail outlets and be certain that their modem will be compatible with the line card equipment from the telephone companies that sell them services.

At first, the ISDN market was one of mass confusion. Vendors raced to market with nonstandard line codes, such as AMI in the United States, 4B3T in Germany and ping-pong in Japan. However, once the standard was finalized, more equipment became available and more vendors entered the market. Once applications such as Internet access and SOHO started to drive the market, the need for interoperability, along with the benefits of having a choice of vendors, pushed the market to embrace the standard. The resulting low-cost equipment has all but driven out the sale of nonstandard solutions.

ANSI and ETSI

In March 1993, after many months of analysis, review and debate, the American National Standards Institute adopted the discrete multitone (DMT) modulation scheme as the standard line code for ADSL. Three technologies were tested for performance over copper telephone wires at Bellcore: DMT, carrierless amplitude/phase modulation and quadrature/phase modulation. The results clearly showed that the implementation of the new DMT line code was capable of outperforming the older single carrier technologies. The European Technical Standards Institute contributed an annex to the ANSI T1.413 ADSL standard to reflect European requirements, in effect creating one international standard.

Table 1: ADSL modem rates as specified in ANSI T1E1.413

Downstream Simplex	Up/down Full duplex
6.144 Mbps	640 kbps
4.608 Mbps	384 kbps
3.072 Mbps	160 kbps
1.536 Mbps	64 kbps — control

Table 2: ETSI Annex required data rates

Downstream Simplex	Up/down Full duplex
8.192 Mbps	640 kbps
6.144 Mbps	384 kbps
4.096 Mbps	160 kbps
2.048 Mbps	16-176 kbps

The ANSI standard is the only official standard for ADSL, and provides rates up to 6.1 Mbps using DMT line coding. At a minimum, each ADSL modem must provide 1.5 Mbps, but may offer the rates shown in Table 1 as specified in the ANSI T1E1.413. In addition, the ETSI Annex requires that the data rates in Table 2 be supported.

Current activities

Once a standard is completed, semiconductor and equipment vendors race to market with standard-compliant equipment. In the design process, much is learned about the new technology and ideas for improvement of the standard are put forth. This is true for the ADSL market. As vendors develop expertise with the new line code, potential enhancements and clarifications aimed at achieving interoperability are being identified and addressed by the committee.

In this regard, the ANSI T1E1.4 working group is currently finalizing Issue 2 of the ADSL specification. Most of the work for Issue 2 is focused in the following areas: clarifications to Issue 1 text for multivendor interoperability, rate adaptation at startup, the transport of asynchronous transfer mode (ATM) cells over ADSL, extending the highest data rates to over 8 Mbps, and reducing the overhead for increased upstream capability.

The current standards-based discussions of 8 Mbps simplex capability are addressing the European desire to accommodate the delivery of four 2 Mbps broadcast video channels. This additional bandwidth can be used to accommodate the overhead associated with ATM networks while maintaining 6 Mbps throughput. Additional flexibility in the data rates due to the multitude of channels can be achieved in 32 kbps increments, a feature that will be utilized in support of future ATM networks.

The discussions on the reduction of overhead are of significant value when deploying ADSL over the longer loops. It is generally accepted by the industry that transmission control protocol/Internet protocol (TCP/IP) over ADSL connections indicate that a ratio of 10:1 (downstream: upstream) is necessary. For example, a modem capable of delivering only 64 kbps upstream will only support a downstream data rate of 640 kbps, while a 640 kbps upstream capacity can translate into a 6.4 Mbps downstream capability. Since data rates decline as the distance increases, upstream capability on the longest loops has received a lot of attention.

DAVIC (Digital Audio-Visual Council) and the ATM Forum look to the ADSL standard developed by the ANSI T1E1.4 committee and the ADSL Forum for guidance and input to their work when it entails high-speed transmission over copper. CT

Debbie Sallee is the broadband operations strategic marketing manager for Motorola Semiconductor. With more than 13 years of experience in the electronics industry, Sallee has been instrumental in the creation of the ADSL Forum. She is on the forum's board of directors and currently chairs the forum's marketing committee. She can be reached at rzep90@email.mot.com.

Reader Service Number 6

Digital Measurement

Avoid Common Errors

By Kim K. Brown and Francis Edgington

As digital signals become more prominent in cable TV systems, those in the technical arena will require a new understanding of the nature and measurement of these signals. A common myth is that measuring analog power and digital power is the same. The nature of these signals is very different and as a result so is the measurement technique. Before we explore these differences let us first establish why an accurate power measurement is crucial to system performance. Consistent power measurements are the secret to aligning your system. Finding the power or level of a signal allows proper alignment of each amplifier and determination of its optimum operating point between carrier-to-noise (C/N) and carrier-to-distortion (C/D).

Incorrect interpretation of power and the resulting misalignment of the amplifiers may cause lasers to clip. A clipping laser produces higher peak level distortion products seen as fast moving sparkling patches on the subscriber's TV screen.

Technicians understand methods for measuring analog carrier power. With the new digital carriers, a number of current analog methods return varying and inaccurate results. By starting with a review of analog power we can then build upon our knowledge to learn digital power measurements.

Analog power measurements

Analog channels involve energy concentrated around a single frequency. The video information modulates onto the carrier between the horizontal synch pulses. These synch pulses are the only power that remains constant within each transmission since the rest of the video information varies with the picture content. For this reason, a power meter used to measure the signal would not settle on a single number but would bounce around. In the time domain the analog carrier shows a pulse at the peak RF carrier level. This is the horizontal synch pulse. Since this is the only consistent signal level related to the carrier power, we use it to measure the TV signal's level. See Figure 1 on page 50, which shows an analog channel in zero span (time domain).

Automatic settings

The National Cable Television Association defines visual carrier level as "the root mean square (RMS) voltage of a channel's visual (picture) carrier considered as a sine wave at the peak of the modulation envelope." The Federal Communications Commission definition is similar: "...expressed in terms of the RMS value of synchronizing peak for each cable TV channel." A cable TV analyzer or signal level meter (SLM) catches these synch pulses and reports levels by setting a large enough bandwidth. See Figure 2 on page 50, which shows and analog channel power using automatic settings.

Setting bandwidth too small does not allow the internal filters time to charge and respond to the synch pulse. Figure 3 on page 50 illustrates the response with resolution bandwidth set to 30 kHz. Note the resolution bandwidth is narrow and the visual level is 2.9 dB less than Figure 2.

The resulting measurement does not accurately reflect the carrier level. Some

> **BOTTOM LINE**
>
> **Tackle Digital Power Measurements**
>
> Despite common myth, measuring analog power and digital power is not the same. And, as digital signals become more prominent in cable TV systems, those in the technical arena will require a new understanding of the nature and measurement of these signals.
>
> With the new digital carriers, a number of current analog methods return varying and inaccurate results. By starting with a review of analog power we can then build upon our knowledge to learn digital power measurements, but we need to go beyond that as well.
>
> Manual marker readings and correction factors may lead to inaccurate, nonrepeatable measurements. You can avoid these pitfalls by understanding the measurement algorithm of your test equipment or using test equipment that understands it for you. There are cable TV analyzers available today that allow you to easily measure all of the emerging digital signals.


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Figure 1

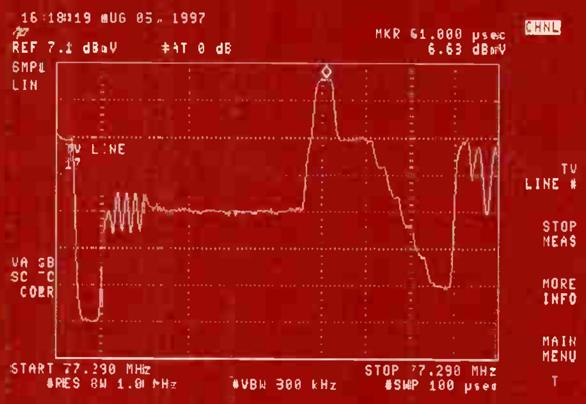


Figure 2

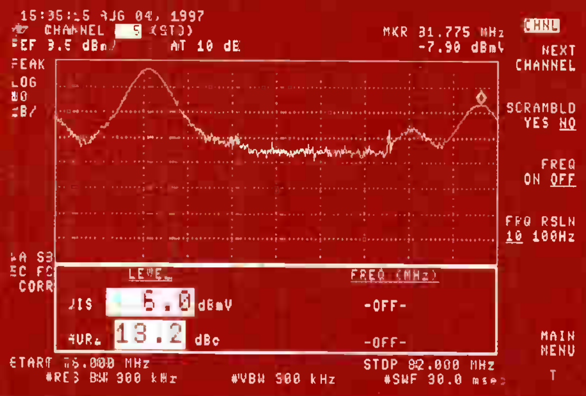
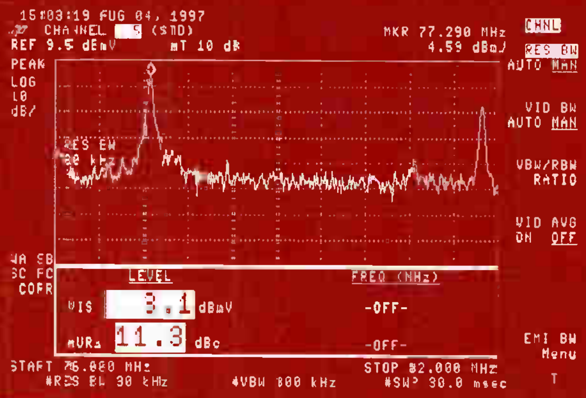


Figure 3



test equipment prevents this mistake by automatically configuring the instrument to catch these signals.

Digital power measurements

Digital signals have many types of modulation formats—quadrature partial response (QPR), quadrature phase shift keying (QPSK) and quadrature amplitude modulation (QAM). The energy of these signals spreads across a bandwidth. The modulation format determines the shape of the channel trace. An ordinary power meter inserted in

Figure 4

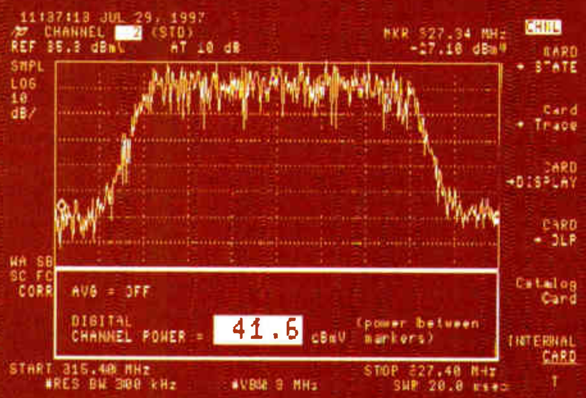


Figure 5

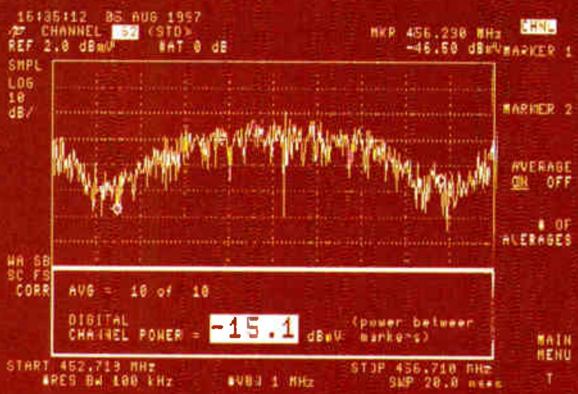
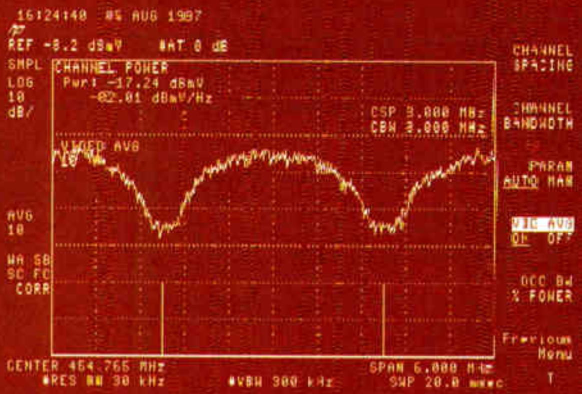


Figure 6



the system to read a randomly modulated digital signal reports a constant number. A spectrum analyzer measurement involves more computation. Power measurements, taken at each point in the channel, sum together to produce the carrier level. If the channel were perfectly square this task would be fairly easy. The level at the top of the signal multiplied by the bandwidth

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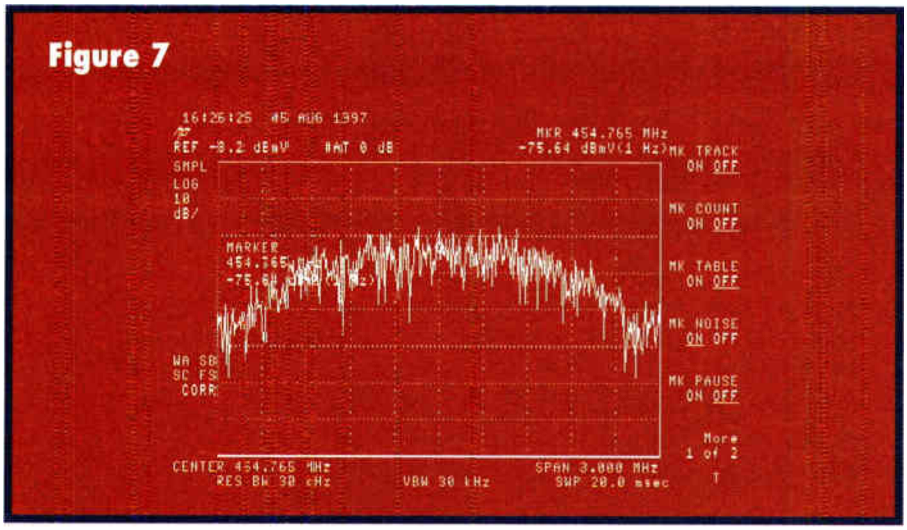

Figure 7

determines channel power. In reality, the signals slope off so power level requires iterative measurements. Figures 4 and 5 (on page 52) depict differently shaped digital signals measured using the average digital channel power features. (Figure 4 shows 64-QAM power measured using the digital power function of a cable TV analyzer. Figure 5 shows DMX power measured using the digital power function of a cable TV analyzer.)

A power measurement done this way corrects all known errors and gives a result that agrees with a power meter. In other words, it integrates power per unit of frequency to sum up the power in the digital carrier. Test equipment that performs these measurements and computations automatically has distinct advantages in accuracy and time savings over manual measurement techniques.

Common pitfalls

Without internal automatic computations, parameters can be set incorrectly or results can be interpreted incorrectly. Whether you are a user of manual measurements or one-button channel power measurements you must be aware of some common pitfalls:

- Channel power with video averaging. One-button channel power measurement of a spectrum analyzer returns an accurate value but the value is not consistent from sweep to sweep. Video averaging commonly remedies this bouncing measurement. In this case, invoking video averaging or reducing the video bandwidth produces a -2.5 dB error. Compare the results in Figures 6 on page 52 with the result from the digital power measurement in Figure 5. (Figure 6 shows a power measurement using channel power with video averaging turned on.) Video averaging is a linear function. Linear averaging of this logarithmic data generates the error.

> "A common myth is that measuring analog power and digital power is the same."

- Normalizing power calculated by marker functions. Using a noise marker is another common practice in measuring digital channel power. The noise marker normalizes the measurement bandwidth to 1 Hz and corrects for the known errors (2.05 dB) for the HP8591C cable TV analyzer. The result must then be normalized to the channel bandwidth using the formula:

Power in channel bandwidth =
10 log (channel bandwidth/1 Hz)

For example, if the channel bandwidth is 6 MHz, the correction factor is +67.78 dB. This works fine for a square flat digital channel. In the case of the DMX "haystack" trace, the power calculated by the noise marker represents only the top of the haystack. The power in the haystack sides is significantly different. If the full channel allotted bandwidth (3 MHz for a DMX signal) is used for the calculation, the power calculated will be about 3 dB high.

In our example (Figure 7 on this page, shows a DMX channel measured using marker function), the calculated power equals the measured level (-75.64 dBmV) plus 10 log 3 MHz. The result is -11 dBmV. This is about 4 dB too high. If the 3 dB bandwidth is used, then the power calculated by the same method is about 1 dB low. Selecting the appropriate bandwidth over which to normalize is an issue to be aware of for a nonflat digital carrier.

Using the peak marker with a correction factor is prone to the same errors. Analyzer bandwidth and sweep time settings also may lead to more errors in the amplitude reading.

Bursted signals

Bursted RF carriers present real problems to the untriggered analyzer. In some cases, when in zero span and tuned to the carrier frequency, setting the trigger mode to video trigger and adjusting the trigger level will allow measurements of the intermittent signal. Some conditions may require external equipment such as a burst carrier trigger generator or a bandpass filter. Measuring in a span and peak holding can cause a 5 to 6 dB higher channel power reading.

Avoid pitfalls

Manual marker readings and correction factors may lead to inaccurate, nonrepeatable measurements. You can avoid these pitfalls by understanding the measurement algorithm of your test equipment or using test equipment that understands it for you.

There are cable TV analyzers available today that allow you to easily measure all of the emerging digital signals. CT

Kim Brown is product manager, marketing and Francis Edgington is a customer support engineer for Hewlett-Packard in Santa Rosa, CA. Brown may be reached via phone at (707) 577-2936 or e-mail: kim_k_brown@hp.com. Edgington may be reached via phone at (707) 577-2017 or e-mail: francis_edgington @hp.com.

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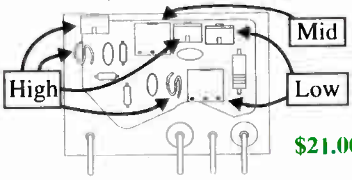

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Reader Service Number 126

DSL Is Not Just For Telcos

A New Twist on Copper Twisted Pair

By Bill Calk

Digital subscriber line (DSL) technology provides a broad range of solutions to meet both current and emerging broadband access needs. Today, a service provider can use existing cable infrastructure with inexpensive DSL modems to provide high-speed access when and where needed.

True, the copper twisted pair used by DSL usually is associated with telephone networks. It could, however, with the unbundling of services, prove cost-effective for cable providers looking for easy entry into the data services market. Copper is efficient, proven, affordable and available.

Although copper-based DSL technologies come in many flavors, they all share the basic technology for modulating signals in the form of digital bits over a copper twisted pair using powerful, active modems. The first widely used DSL technology is the now-familiar integrated services digital network (ISDN). Since its introduction, there have been a number of other DSL implementations, either proposed or actually placed into service.

Options

DSL technologies vary in a number of ways (see accompanying table):

1) Bandwidth varies from kilobits per second to megabits per second. Newer technologies tend to offer higher capacities, and higher bit rates tend to cost more for implementation.
2) Most DSL implementations require only a single pair; HDSL requires two. This is significant to the applications, since residences tend to have only one pair, while businesses can have more.
3) Symmetrical implementations provide the same data rate in both directions; asymmetrical technologies provide more bandwidth downstream than up.
4) Distance covered varies. The standard carrier service area extends 12,000 feet from a central office. Services offering less coverage than that provide higher bandwidth but potentially run into service problems.

> Copper is efficient, proven, affordable and available.

The choice of DSL technologies will be driven by the services to be provided. These in turn will vary with the customers being served. Residential customers may be most interested in services like a resurrected video-on-demand and high speed Internet access. These are asymmetrical services, in which a low-bandwidth request is made by the customer who receives high bandwidth content in return.

BOTTOM LINE

Making the Most of Copper

Looking for a way to control costs while delivering broadband digital services to your subscribers? You might take a lesson from the telcos, and consider digital subscriber line (DSL) technology using common twisted copper pair.

Advantages. It may not be a long-term broadband solution, but DSL can use existing infrastructure, extending the life of the local loop delivery system. It doesn't require costly switch upgrades (as with ISDN), and it can be implemented with the simple addition of DSL modems. In areas of high data usage, DSL multiplexers also can help prevent switch congestion.

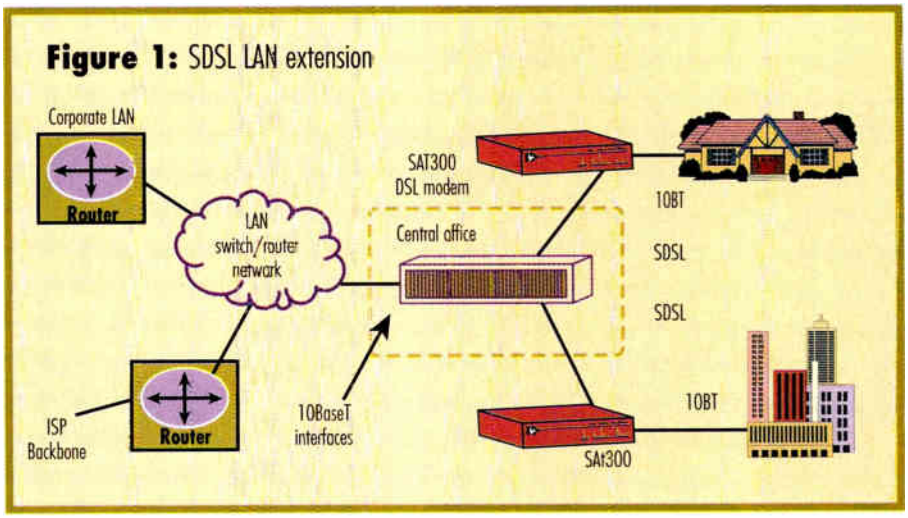
Follow the money. LAN extension for businesses can be a particularly profitable DSL application. LAN connections tend to be long duration, and often require high bandwidth both upstream and down. Businesses are usually willing to pay handsomely for this high-speed connectivity. DSL LAN connections can bypass the public switched telephone network (PSTN) switches, adding value by providing relief from long hold-time connections.

Residential customers tend to be very price sensitive, so the cost of these services must remain comparable to plain old telephone service (POTS) levels ($20-$30 per month).

Business customers, on the other hand, are more likely to use services such as remote local area network (LAN) access, LAN-to-LAN connectivity and videoconferencing. Because they both send and receive large amounts of data, they need a more symmetrical service, and are less sensitive to price. They also can accommodate facilities such as HDSL, which requires two copper pairs.

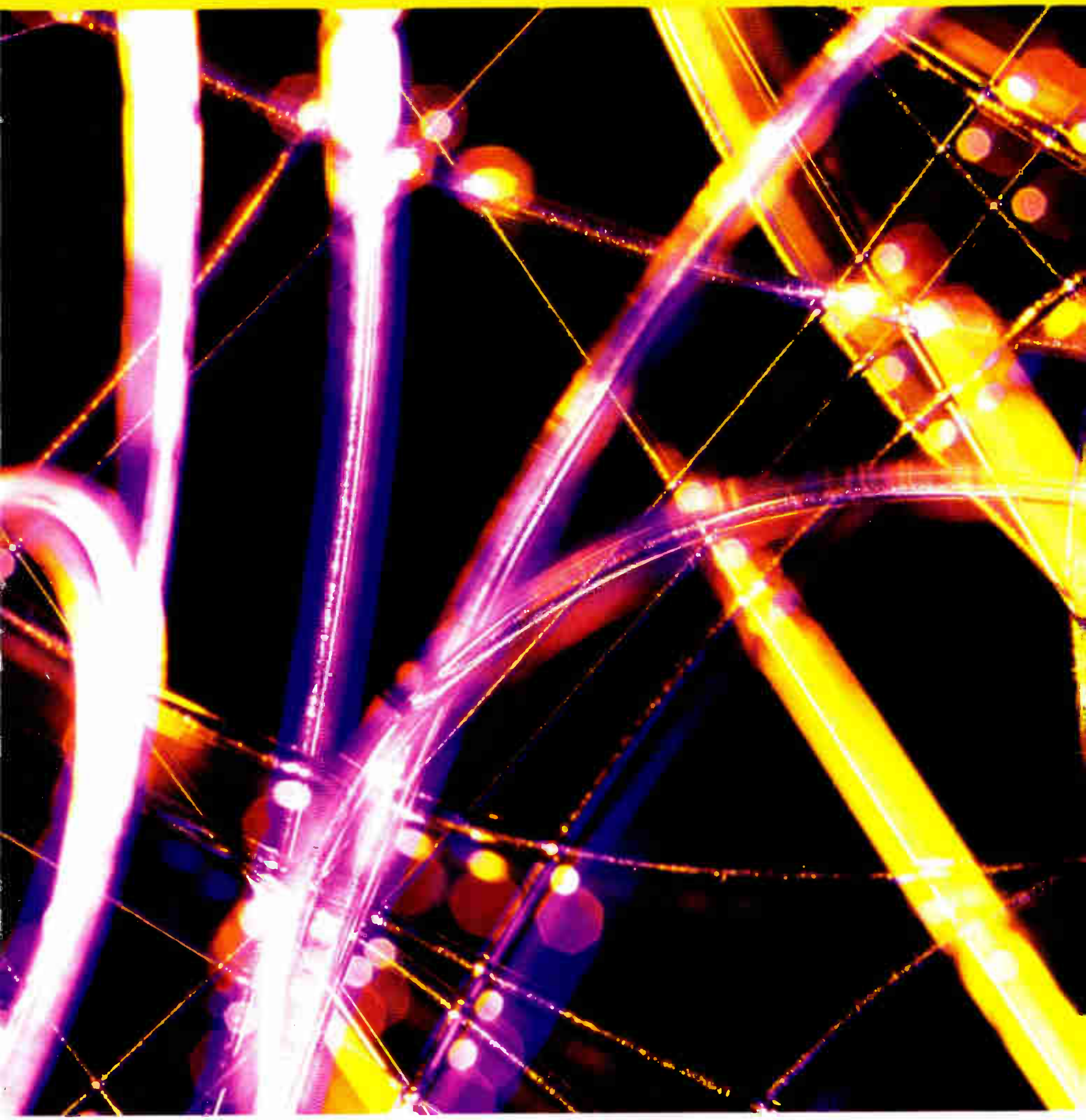
DSL may not be a long-term broadband solution, but even as a temporary expedient it can help keep costs under control. In most implementations, it can use existing infrastructure. DSL can extend the life of the local loop delivery system; it generally does not require costly switch upgrades (as with ISDN), and it can be implemented with the simple addition of DSL modems, allowing deployment only where the service is needed, rather than system-wide. In areas of high data usage, DSL multiplexers also can help prevent switch congestion.

Figure 1: SDSL LAN extension



Profits in LAN extension

LAN extension can be a particularly profitable DSL application. LAN connections tend to be long duration, and often require high bandwidth both upstream and down. In addition, business users are more willing to pay for the high-speed connectivity they need. SDSL provides 768 kbps (half of T-1) over a single copper pair, allowing remote users to function as if directly connected to the LAN. These DSL LAN connections can bypass the public switched telephone network (PSTN) switches, adding value by providing relief



from the long hold-time connections.

Some SDSL solutions provide the added value of media access control (MAC) layer bridging and Internet protocol (IP) routing functions within the modem itself. Another way to increase SDSL value is to multiplex Ethernet LAN traffic up to 56 separate signals onto a single frame relay DS-3. This approach allows extreme concentration of traffic with virtually no increase in infrastructure cost. (See Figure 1.)

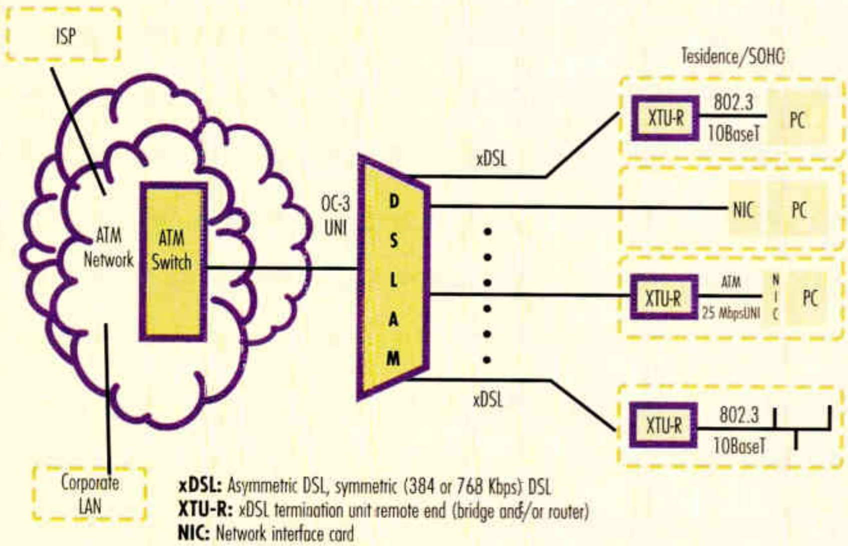
Moving up to ATM

For service providers with ATM capability, similar multiplexing can be performed on an even larger scale at an even lower cost per line. A DSLAM (DSL access multiplexer) is typically configured to handle up to 120 DSLs at a remote site, or 500 or more in a central office. The device multiplexes ATM cell traffic onto a high-speed facility, such as OC-3 or DS-3 and connects it to an ATM switch.

If the customer site is beyond the 12,000 foot service area, a DSLAM can be located in a remote digital loop carrier cabinet. Regardless of location, the DSLAM typically does not perform ATM adaptation, leaving that job to customer site units. It should also be noted that current technology makes no provision for path protection between the DSLAM and the ATM switch. Nevertheless, it has been estimated that DSLAMs will support four million to five million lines by the year 2000. (See Figure 2.)

There are several other more complex and expensive alternatives that can be used to create an ATM-based switching network. One of these is edge switching, in which ATM edge switches support up to six DSLAMs each. Although they feed the DSL traffic via redundant fibers to the networks ATM core via OC-3, the cost for edge switches and the low reliability of protection schemes makes this method unattractive. A better solution would be a service transport node which would support SONET ATM virtual path ring functionality and perform both switching and DSL access functions. This type of approach solves the path protection problem found in other ATM-based solutions, while supporting statistical multiplexing and back-hauling to centrally-based core switches.

Figure 2: xDSL multiplexers; or DSLAMs



Digital Services at a Glance

Technology	Symmetry	Data rate	# of pairs	Distance (ft)
ISDN	Symmetrical	160 kbps	One	18,000
SDSL	Symmetrical	384/768 kbps	One	18,000/12,000
HDSL	Symmetrical	1.544 Mbps	Two	12,000
		2.048 Mbps		
HDSL-2	Symmetrical	1.544 Mbps	One	10,000
		2.048 Mbps		
CAP	Asymmetrical	6.144 Mbps downstream	One	12,000
ADSL		640 kbps upstream		
DMT	Asymmetrical	6.144 Mbps downstream	One	12,000
ADSL		640 kbps upstream		
RADSL	Asymmetrical	.032-9 Mbps downstream	One	Varies with
		.032-1.5 Mbps upstream	data rate	

Key:
ISDN = integrated services digital network
SDSL = Single-pair digital subscriber line
HDSL = High bit-rate digital subscriber line
CAP ADSL = Carrierless amplitude/phase modulation asymmetrical digital subscriber line
DMT ADSL = Discreet multitone modulation asymmetrical digital subscriber line
RADSL = Rate adaptive asymmetrical digital subscriber line

The future according to DSL

As demand grows, more sophisticated solutions can be implemented as they are justified, providing even more economical, more reliable service. DSL will work with existing switches, yet can interface effectively with the most modern ATM switches. In short, it provides the flexible migration path that providers need to face the competitive future. CT

Bill Calk is program marketing manager, Network Services Division, at ADC Telecommunications, Inc. He can be reached at (972) 680-6920 or by e-mail at bill_calk@adc.com.

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Reader Service Number 123

Is Digital Hardware Ready for Cable?

By Graham S. Stubbs

High-speed Web access and high-quality digital TV delivery are the two primary business drivers which promise to make 1997 a watershed year in our industry in terms of business direction and technology. The industry is preparing to move quickly on both fronts, driven by opportunity and by competition.

The technical preparation falls to operators to ensure that the transmission plant has the capacity and meets the performance requirements for digital. It is up to manufacturers to design high-speed digital equipment which will operate in the cable environment, much of whose distribution infrastructure is already in place. Led by CableLabs, the industry has focused on characterization of the cable plant—identifying the types and magnitudes of impairments likely to impact digital transmissions.

This article discusses the testing of products intended to bring these digital services to the consumer through cable. Automated test systems are now available to simulate one-way and two-way hybrid fiber/coax (HFC) plant with the various impairments already characterized by system testing. The testing process will help determine whether digital products are ready for cable.

Transmission impairments

Digital services will be introduced into a cable (HFC) medium which has long been optimized for the distribution of analog TV signals. The methods of designing, equipping and maintaining cable plant for the downstream delivery of analog signals are well understood, as are the transmission impairments and their effect on quality of service. The industry has yet to accumulate a comparable wealth of experience with upstream delivery of signals. Despite the availability of two-way components and plant for more than 25 years, the implementation of two-way services has been too fragmented to provide, with confidence, knowledge of what to expect when customer satisfaction depends on highly-reliable two-way operation. The following discusses, separately, downstream and upstream impairments.

Downstream impairments

Impairments to digital signals transmitted downstream include those to which analog signals are most susceptible and some which have little effect on analog. Impairments include signal distortions such as intermodulation products and interfering signals such as CW (carrier wave) and impulse ingress. For comprehensive testing, the following impairments are important:

- Broadband noise
- Discrete frequency interference
- Impulse interference
- Second order intermodulation (composite second order or CSO)
- Third order intermodulation (composite triple beat or CTB)
- Hum and AM-noise modulation
- Microreflections and echoes
- Phase and FM noise
- Fiber-optic clipping

For contrast, the table on page 66 compares the relative sensitivity of the quality of analog and digital services to some of these impairments. [1]

Upstream impairments

Digital signals directed upstream are subject to the same kinds of impairments as downstream signals; however, there are some important additional considerations: [2]

- The funneling effect which accumulates noise and other impairments from many sources connected to the upstream path system.
- Signal level uncertainties attributable to individual transmitters at each subscriber termination.
- The bursty nature of primarily digital upstream signals.
- Common path distortions resulting from intermodulation of downstream signals, falling in the upstream bandwidth.

These unique factors complicate simulation of upstream impairments and create the need for versatility in the test system design. CableLabs recently reported the

> **BOTTOM LINE**
>
> **Testing Techniques**
>
> Prepare your system for digital services by implementing testing. Some testing techniques include field testing, laboratory testing, using a centralized test facility and using an automated test set. Test early to be cost-effective.
>
> Other testing strategies include accurate characterization of cable plant impairments, developing product specs that account for signal transmission impairments and testing new digital products to make sure they work in a real-world HFC arena.
>
> To test thoroughly, keep in mind the following impairments:
>
> - Broadband noise
> - Discrete frequency interference
> - Impulse interferences
> - Second order intermodulation
> - Third order intermodulation
> - Hum and AM-noise modulation
> - Microreflections and echoes
> - Phase and FM noise
> - Fiber-optic clipping

results of long-term studies to characterize return path impairments. [3]

Testing strategies

Successful deployment of digital services requires:

- Accurate characterization of cable plant impairments.
- Development of product specifications with sufficient margin to account for signal transmission impairments.
- Testing of new digital products to verify they will work in the real world HFC environment, with particular attention paid to the cost impact of the test strategy on the overall product development process, and with emphasis on repeatability of measurement data. Testing early in a development program, with consistently repeatable results, is generally a cost-effective strategy.

The alternative strategies for testing include:

- Field testing
- Laboratory testing
- Access to a centralized test facility
- Use of a customized integrated, dedicated and automated test set

TMTS: system simulator

The need for HFC system simulators has evolved in the past few years from requirements for controlled subjective testing of signals which were primarily analog, to an urgent need to verify that new products designed for digital services will really perform. [4, 5] CableLabs and several major equipment suppliers today are using Transmission Medium Test Systems (TMTS), designed and constructed by PECA Inc., to provide a controlled test environment for evaluating the performance of analog and digital products. The TMTS simulates a set of critical transmission and reception impairments like those encountered in the forward and reverse transmission paths of representative HFC plant. The primary purpose of the TMTS is to facilitate laboratory testing of new products to assure compliance prior to product release and field deployment.

How does it operate?

The TMTS accepts and generates signals from 50 MHz to 1 GHz in the forward direction, and from 5 MHz to 40 MHz in the return direction. The signals are subjected to impairments which can be varied over a wide range of magnitudes. Impairments are added in a programmable fashion, either singly or in combinations. Performance degradation attributable to the transmission impairments is measured and recorded at the subscriber unit and at the headend. The TMTS incorporates equipment which generates calibrated levels of impairments, and also provides sections of actual trunk and feeder equipment.

A conceptual drawing of a complete TMTS is illustrated below:

A brief description of each component follows:

1. *Headend equipment under test*—This is the headend processing portion of the product being tested, which communicates through the TMTS with the corresponding test subscriber equipment.

(Some examples of headend digital processing equipment are QAM modulators and digital routers.)

2. *Subscriber equipment under test*—The subscriber equipment can range from a TV monitor for subjective testing, to an interactive digital terminal, to a high-speed Web-access modem.
3. *Cable headend*—The headend component receives an IF or RF signal from the headend equipment under test, upconverts it (if IF), and combines other analog and digital signals to represent a fully-loaded service.
4. *Carrier impairments*—These carrier impairments, such as phase and FM noise, hum and AM noise modulation, and simulated dynamic multipath, are derived from calibrated components and sources applied directly to the test signal.
5. *Forward link equipment*—Any of four possible link (trunk) paths can be selected:
   - Through connection
   - RF trunk cascade
   - Fiber-optic link
   - Auxiliary
6. *Forward impairments*—Additional forward impairments are generated and added to the signal from the test source:
   - Broadband noise
   - Discrete interfering carrier
   - Impulse interfering carrier
   - Second order intermodulation (CSO)
   - Third order intermodulation (CTB)
   - Fiber-optic clipping
7. *Return link equipment*—Mirrors the four alternative forward paths, but in the 5-40 MHz band.
8. *Return impairments*—Broadband noise, impulse noise, discrete and interfering carrier noise generated and added to the upstream test signals. Fiber-optic clipping is generated by loading the active return path components.
9. *Reflections*—Single or multiple microreflections in the 20 to 5,000 nanosecond range to either the forward or return path signals are added.
10. *Distribution equipment*—The distribution path simulates a medium-density cable plant, and employs actual cable, amplifiers and taps. (Return path AM noise and hum modulation are applied in this component.)
11. *Automated control and testing*—All signal routing, level settings, impairments, instrumentation, measurement and recording within the test system are both manually controlled, via front panel controls, and automated, from an external computer via a GPIB interface. The TMTS, when under automated control, provides the means to ensure reliable and verifiable repeatability of all test scenarios. Test scripts and test result files can be created and later used to configure the TMTS to repeat prior tests and use historical test results as comparisons of current or future test results:
    - Signal generators
    - Spectrum analyzer
    - Noise generators
    - Noise measurement test set
    - Dynamic ghost simulator
    - Power meter
    - Pulse function generator
    - Arbitrary waveform generator

A comparison of the relative sensitivity of the quality of analog and digital services to some impairments.

Service	Broadband Noise	CSO	CTB	Impulse Noise
Analog video	H	M	M	L
Digital video	M	L	L	H
High-speed data	M	L	L	M

H = Highly susceptible M = Moderately susceptible L = Least susceptible

Cable is ready for digital

The business case having already been made for the industry to move ahead with high-speed Web connectivity and digital television, the technical issues must now be dealt with to assure high quality of service. Characterization of HFC plant is already well-advanced, as is the standards-setting process for high-speed cable modems.

Verification that the new digital products operate well in the face of the many possible HFC impairments requires use of test systems which accurately simulate cable plant. The TMTS approach provides a versatile platform for the evolution of test methodologies CT.

Acknowledgments

PECA Inc. of Bensalem, PA, was selected to design and build test systems for CableLabs, General Instrument and others. The writer is grateful to Ralph Douglass, president of PECA, and to John Abraham, consultant in cable modem testing.

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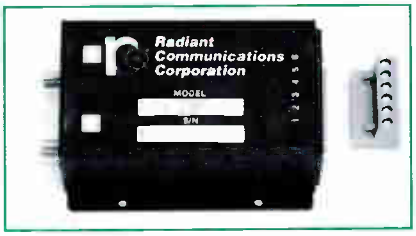

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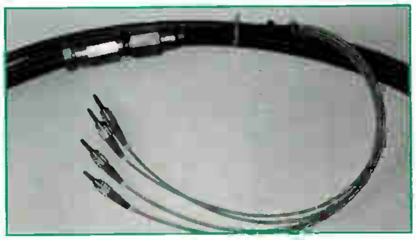

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Reader Service Number 180

PCS Tele

How the
Industry is
Leaping into the
Wireless Market

Telephony over cable

This article was adapted by "CT" Assistant Managing Editor E. Brooke Gilbert from articles written by Barbara Lee and Art Cole, which originally appeared in Phillips Business Information's "Wireless Business & Technology" magazine.

For the cable industry in particular, the opportunity to branch into wireless services has become doubly important with the threat of satellite and telco organizations eating into TV delivery profits. Quite naturally, cable companies eagerly are looking at the wireless arena, particularly the personal communications services (PCS) market, as a way to shore up the bottom line in an increasingly competitive environment.

How will cable operators compete?

Take three well-known cable operators, add their strengths to telephony operator Sprint Corp. and what results is a consortium ready to tackle the evolving PCS market.

The partners of Sprint Corp., TCI, Cox and Comcast have opened the doors to cable and wireless. The cost of purchasing licenses for the Sprint PCS network has thus far been approximately $2.7 billion, a figure that does not begin to reflect the huge cost of infrastructure installation, system loading and marketing.

Obviously, any company setting out to make an impact in the PCS market today must choose its partners carefully. What value does Sprint Corp. see in its three cable partners?

First of all, a cable company has a pre-established, highly visible presence in the markets in which it operates. In San Diego, where one of the first Sprint PCS networks is operational, cable company Cox enjoys a good rapport with its customers. That made it a logical choice to debut the service.

The PCS end of the business is able to leverage off the cable contacts and service reputation. In addition, it is possible for the cable company to offer incentives that encourage PCS subscribership. For example, although most customers are not aware of the inside business particulars of the Southern California/Nevada Cox/Sprint PCS partnership (the market is divided 51% Cox and 49% Sprint), Cox subscribers know that they receive a $3 discount on their TV cable bill each month, as long as they remain Sprint PCS customers.

In other markets, local cable advertising for PCS service could be made available to the PCS partner at a discount. Once again, viewers/customers may be unaware of the partnership, but they are being educated by the promotions, nevertheless.

Cable companies and telephone companies can—and will—learn about their markets from each other. In logistical and legal issues, as well, a cable/wireless relationship has definite advantages. For instance, due to its affiliation with a local, entrenched cable company, a PCS supplier often is able to overcome site acquisition problems and operate its service in places where it was not otherwise able to gain entry. ➤

BOTTOM LINE

PCS Partnerships: All Things Being Equal

Cable operators will best fair in this new wireless marketplace by considering what strategies to take. One is to form alliances with leading telecommunications carriers. This kind of partnership has its advantages and disadvantages. It offers access to national and international networks and provides a close tie with a recognized brand name.

What are the drawbacks? Cable would have a negotiating disadvantage and a certain loss of control if its partner is a large organization.

Cable companies may also want to try joining forces with other cable operators rather than aligning with a telecommunications provider. Uniting with other cable operators could give operators more control over the wireless network, provided the operators agree to an equal partnership. This approach could result in spotty regional or national coverage, and it still will leave operators facing competition from telephone interests.

Any cable operator planning on breaking into the PCS market will need access to either the new PCS spectrum or existing cellular blocks.

Technical synergies

Many of the greatest partnership advantages are derived through technical synergies. Initially, Cox Cable began experimenting with using coaxial cable plants as a backbone for wireless communications as early as 1989.

In order to achieve RF propagation at 1900 MHz with low-power and low-height antennas, Cox PCS has been testing the feasibility of transmitting PCS over the existing Cox cable system in the San Diego area by using wireless transceivers known as cable microcell integrators (CMIs) and headend interface converters (HICs).

The CMI strung from an existing aerial cable connects into the cable plant and converts the signal from 1900 MHz to the cable frequency. Then, the HIC splits off the PCS signal from the rest of the cable TV signal, sending it on to the base station, base station controller and the rest of the PCS and landline network.

In this manner, Cox's existing cable signal operates concurrently with the PCS signal, with no discernible interference between the two signals, according to Bruce Crair, vice president and general manager of Sprint PCS, Southern California and Nevada.

Because the cable-based system's centralized modulation has its major electronics in one place, as opposed to telephony's off-site high tower locations, CMIs that are hung on aerial cable will reduce maintenance problems and travel time to and from sites. They also eliminate the cost of purchasing tower sites and building out infrastructure.

Simulcasting a single frequency over several CMIs allows a much larger area to be covered while greatly reducing the number of base stations required to operate the PCS system. Furthermore, these CMIs can be moved easily up and down the cable to pinpoint the ideal transmission site. These CMIs are more portable, less expensive and more easily replaced than traditional PCS tower sites.

The Beginnings of PCS in Cable

In December of 1994, Sprint Corp. formed a consortium with three of the nation's largest established cable TV companies to create a totally digital PCS network that will operate naitonally under a single brand name—Sprint PCS.

The partnership, 40% owned by Sprint Corp., 30% by TCI (Tele-Communications Inc.), 15% by Cox Communications and 15% by Comcast Corp. and its affiliates, have purchased PCS licenses that cover the continental United States, Alaska, Hawaii, Puerto Rico and the Virgin Islands.

Sprint PCS, which had launched service in nine cities between December 1996 and February 1997, plans to have networks in 65 cities operating midyear. Within two years, the jointly owned Sprint PCS company expects to have created a network that provides service along many major highways and in all major cities in the United States.

How Will Cable Fair in the Wireless Market?

Advantages

- Existing broadband network—access to the home
- Allows rapid market entry
- Relatively inexpensive to deploy—half the cost of a traditional cell site
- When upgraded to hybrid fiber/coax (HFC), advantages include bidirectional capability and added bandwidth

Disadvantages

- One-way service
- Must upgrade network to backhaul wireless services
- Intense competition
- Lack of PCS licenses

According to Crair, more than 50% of the geography that Sprint PCS covers in San Diego, which represents 56% of the population in the same area, can be covered by an operating CMI system. "The key to successful implementation is the condition of the cable plant, the existing topology and the market of the area," he said. In terms of performance, both partners see additional advantages in more value for the customer, not only in discounts but in the bundling of services that eventually will be available.

Cable pros and cons

Small cable companies have an advantage over competitors vying for supremacy in the wireless arena—an established broadband network. This backbone can be used as the headend, delivering digital information to and from the CMIs peppered throughout the plant or directly into the home for wireline services.

One of the biggest advantages that cable systems have in starting up wireless services is the speed at which it can be done. On a technology level, establishing a wireless network using the cable as backhaul is a no-brainer: simply install CMIs, throughput the cable plant and equip the headends with appropriate processing gear similar to that found in cellular networks.

The network allows the cable operator to enter the wireless market quickly and cheaply. CMIs can be installed easily on the cable plant, with associated HIC processing gear at the headend. This avoids the costly and time-consuming process of erecting towers and dealing with zoning boards.

"The strategy is to put as little out into the plant as possible," says Mike Burke, engineering manager of PCS at Cox Communications. "Concentrate the advanced technology into the headend."

At a cost of about $10,000 each, the CMIs quickly are bolted onto the cable line and can be operational immediately.

"The CMIs only take a few minutes to install," says Chris Cole, marketing manager for telecommunications systems at Sanders Cell Communications Systems. "Once the headend equipment is installed, you can go online with the first CMI you put in."

However, according to Guylain Roy, sales and marketing director of PCS Solutions, a Vancouver-based equipment provider, a standard 2.5-watt CMI attached at the height of a typical above-ground cable line will cover only about 2,500 square feet. This means that cable operators with mostly underground or sparse above-ground lines will have to make other arrangements if they expect full coverage of a service area.

"There is no absolute 'one does all' configuration," he says. "To create a sensible RF footprint, it might be necessary to have a conventional site deployment, even if this is not the most cost-effective approach. The cable plant might be suitable in some areas and not in others."

Meanwhile, at the headend, the system is run from a headend control unit (HECU). "It's essentially a PC software onboard that controls the HIC, which is the real hardware interface between the PCS base station and the cable plant," says Cox's Burke.

To reach subscribers, several modulation systems are currently on the table. However, the system of choice in this operation appears to be code division multiple access (CDMA), patented by Qualcomm of San Diego.

Bundled services

Just as Sprint PCS has been packaging landline long-distance service along with its wireless offering, key players believe that cable soon will be able to offer bundled services along with the Sprint PCS package. Tom Murphy, Sprint PCS spokesman, believes there is

A New Breed of Power Amp

In tune with PCS's code division multiple access (CDMA) technology, Warren, NJ-based, Anadigics has developed an off-the-shelf, low-cost Gallium Arsenide (GaAs) power amplifier intended for use with PCS 1900 MHz CDMA applications. Specifically, the power amplifier serves as a core active device building block for 1850 to 1910 MHz CDMA cellular phone transmitter functions.

The product is composed of a 5V three stage class AB GaAs metal-semiconductor field-effect transistor (MESFET) amplifier requiring an external -3.6V supply to establish the gate bias voltages. Featuring an integrated bias control circuit, the user can implement temperature compensation or reduce the power dissipation during idle periods and low power transmit levels.

Attracting Customers

A major factor in the successful roll-out of PCS services will be timing. With cable's existing infrastructure, operators have an advantage in getting to market first.

"There are a lot of people with PCS spectrum, and more and more are getting it with the completion of additional (FCC spectrum) auctions," says Sanders Cell Communications Systems' Chris Cole, manager for telecommunications systems. "So there is a bit of a race to market here, and I believe the winners will be the ones that get the PCS handsets into the hands of consumers and get them using the services. Those will be the brand names associated with the business. Those will be the ones that won't have to fight a vigorous battle to get consumers to change service partners."

With wireless services offering enormous potential payoffs and relatively easy startup, new market entrants such as cable are eagerly gearing up for the long haul.

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a definite advantage to the consumer because the Sprint brand represents a nationally known name and is recognized for quality communications through advanced technology. "Previously," says Murphy, "wireless communications have

> "Cox's existing cable signal operates concurrently with the PCS signal, with no discernible interference between the two."

not been a very user-friendly product. The consumer must be aware of whose service they are on, in what locations the phone will function, whether or not electronic IDs can be cloned and if he or she can be eavesdropped on...just to name a few concerns."

"It does not speak well for the cellular industry when consumers are afraid to use their phones," Murphy continues.

To most observers, wireless services will only be a part of the package offered by cable operators. PCS and cellular delivery will most likely be packaged with any number of wireline, cable and mobile services. Cable is driving the beginnings of a long evolutionary process. CT

Barbara Lee is a contributing editor for "Wireless Business & Technology." Also contributing to this article is Art Cole, editor of "Video Technology News" and assistant managing editor of "CableFax Daily."

Take a Closer Look At Color Tests

By Gary Andrews and Randy Wilson

Color tests have been a Federal Communications Commission proof-of-performance (POP) test requirement since June 1995. Because color tests are substantially different than the familiar RF tests, there has been considerable confusion about test requirements and processes. This article reviews the test requirements and provides information to help avoid common measurement errors.

Requirements

In 47 CFR 76.601, the FCC requires that cable operators perform color tests at least once every three years "at the output of the modulating or processing equipment (generally the headend) of the system" on "a minimum of four channels plus one additional channel for every 100 MHz, or fraction thereof, of cable distribution system upper frequency limit." To ensure subscriber quality, however, it is a good idea to perform the tests more often and more extensively. We recommend testing all channels, performing the tests at least annually or when new equipment is placed in service and evaluating performance in the field in addition to the headend.

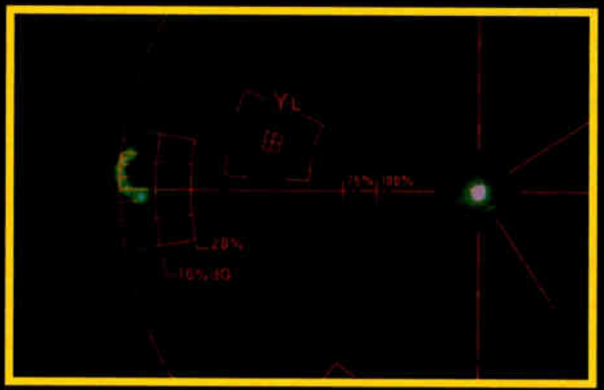
In 47 CFR 76.605, the FCC requires that three aspects of the video signal be measured: differential gain (DG), differential phase (DP), and chrominance-to-luminance (C/L) delay. Let's take a closer look at these requirements.

Differential gain "...which is measured as the difference in amplitude between the largest and smallest segments of the chrominance signal (divided by the largest and expressed in percent), shall not exceed ±20%." Differential gain is commonly measured using a waveform monitor. Although the rules say ±20%, the calculation required always gives a positive number. Another way to state the requirement, based on the calculation, is that differential gain cannot exceed 20% peak-to-peak. This is not the same as ±20%.

When making measurements, pay careful attention to the test equipment specifications. A different definition of differential gain may have been used. For example, a specification of ±3% means the instrument's internal differential gain should not exceed ±3% relative to the lowest packet on the linearity staircase. The equivalent measurement uncertainty using the FCC's definition could be as much as (1.03-0.97)/1.03 = 5.8%—a substantial portion of the allowable tolerance.

Differential phase "...which is measured as the largest phase difference in degrees between each segment of the chrominance signal and reference segment (the segment at the blanking level of 0 IRE), shall not exceed ±10°." This definition requires that the phase of the lowest packet of the linearity staircase be used as a reference, so other packets can be measured relative to it. This isn't a problem for most automated test equipment or for vectorscopes that display DP as a function of time. However, a standard vector display does not differentiate between linearity staircase packets, making

Figure 1: Differential phase as measured on a vectorscope with a differential phase/differential gain scale



The gain and phase are adjusted so that the burst vector is aligned with the 180° point on the graticule circle. Differential phase is the maximum radial deflection of the trace from that point.

Figure 2: Proof-of-performance color tests

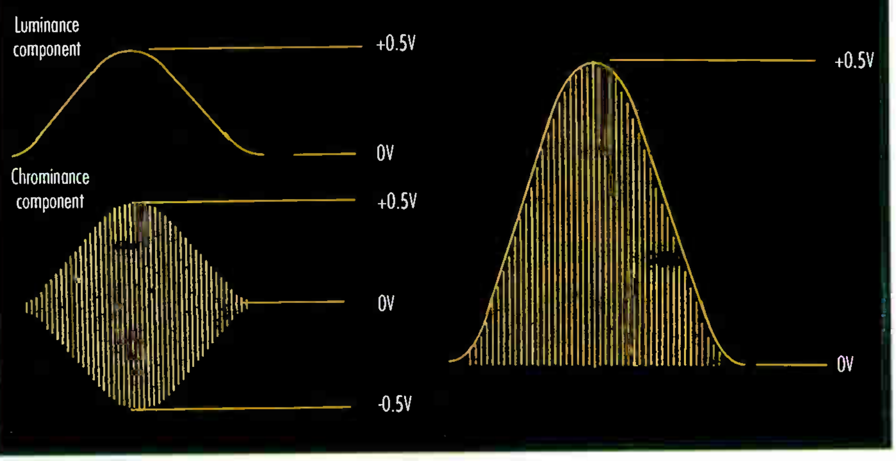
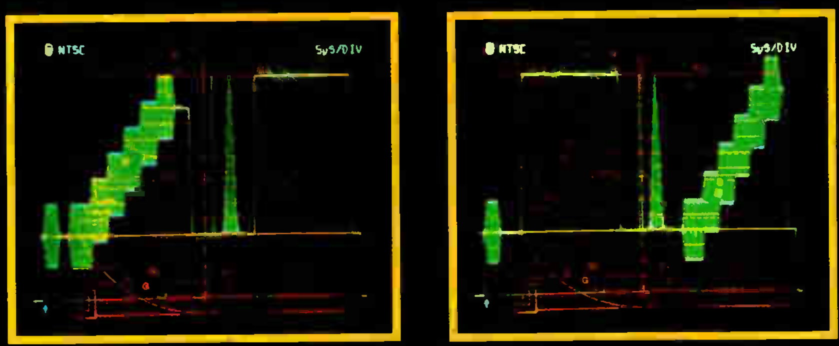


Figure 3: FCC composite test signal (left) and NTC-7 composite signal (right)



The modulated staircase and modulated 12 1/2T pulse are both found in the FCC and NTC-7 composite test signals—commonly available in VITS lineups. Unlike the FCC signal, the NTC-7 linearity staircase exceeds 100 IRE, which can cause clipping in the modulator.

it impossible to locate the reference packet. Fortunately, the phase of the linearity staircase is usually the same as the color burst. If so, the phase reference on the vectorscope can be adjusted using color burst. When the linearity test signal is applied (or, if the vectorscope has line select capabilities, the vectorscope is set to the line containing the test signal), maximum deviation from the burst phase should not exceed ±10°. Figure 1 shows -6° of differential phase.

C/L delay "...which is the change in delay time of the chrominance component of the signal relative to the luminance component, shall be within 170 nanoseconds." In most instances, this is a straightforward measurement. However, if the C/L gain (not specified by the FCC) isn't near unity, or if the signal is noisy, it becomes very difficult to make this measurement using manual techniques. This is another instance in which test equipment with automated features simplifies what could be difficult using manual methods.

Sources of test signals

Two test signals are used for POP color tests. The modulated staircase contains a constant amplitude and phase chrominance signal added to a stepped luminance signal. Use it for measuring differential gain and differential phase.

The test signal used for C/L delay measurements is the modulated 12-1/2 T pulse, shown in Figure 2 on this page. It consists of a 1.56 µS luminance pulse added to a 1.56 µS chrominance pulse. C/L gain and delay are evaluated by examining the baseline of the resulting waveform.

If vertical interval test signals (VITS), provided with nearly all over-the-air and most satellite feeds, are present and of sufficient quality, use them for the color tests. Incoming VITS provide the most practical way to evaluate the entire signal path.

Two types of composite test signals are commonly available in VITS lineups: FCC and NTC-7. The FCC signal is preferable because the peak of chrominance does not go above 100 IRE. The chrominance component of the NTC-7 signal exceeds 100 IRE and may be clipped by the descrambler or modulator, resulting in incorrect differential gain test results. If only the NTC-7 signal is available, you may be able to adjust modulation depth so clipping doesn't occur — or insert your own test signal into the modulator. Figure 3 on page 75 shows the FCC and NTC-7 composite test signals.

If an appropriate test signal isn't available on satellite feeds, or requirements are not met using the incoming VITS, you have the choice of inserting a test signal into the modulator (bypassing the satellite receiver) or temporarily setting the satellite receiver to a transponder that has an appropriate VITS. If you don't have authorization to

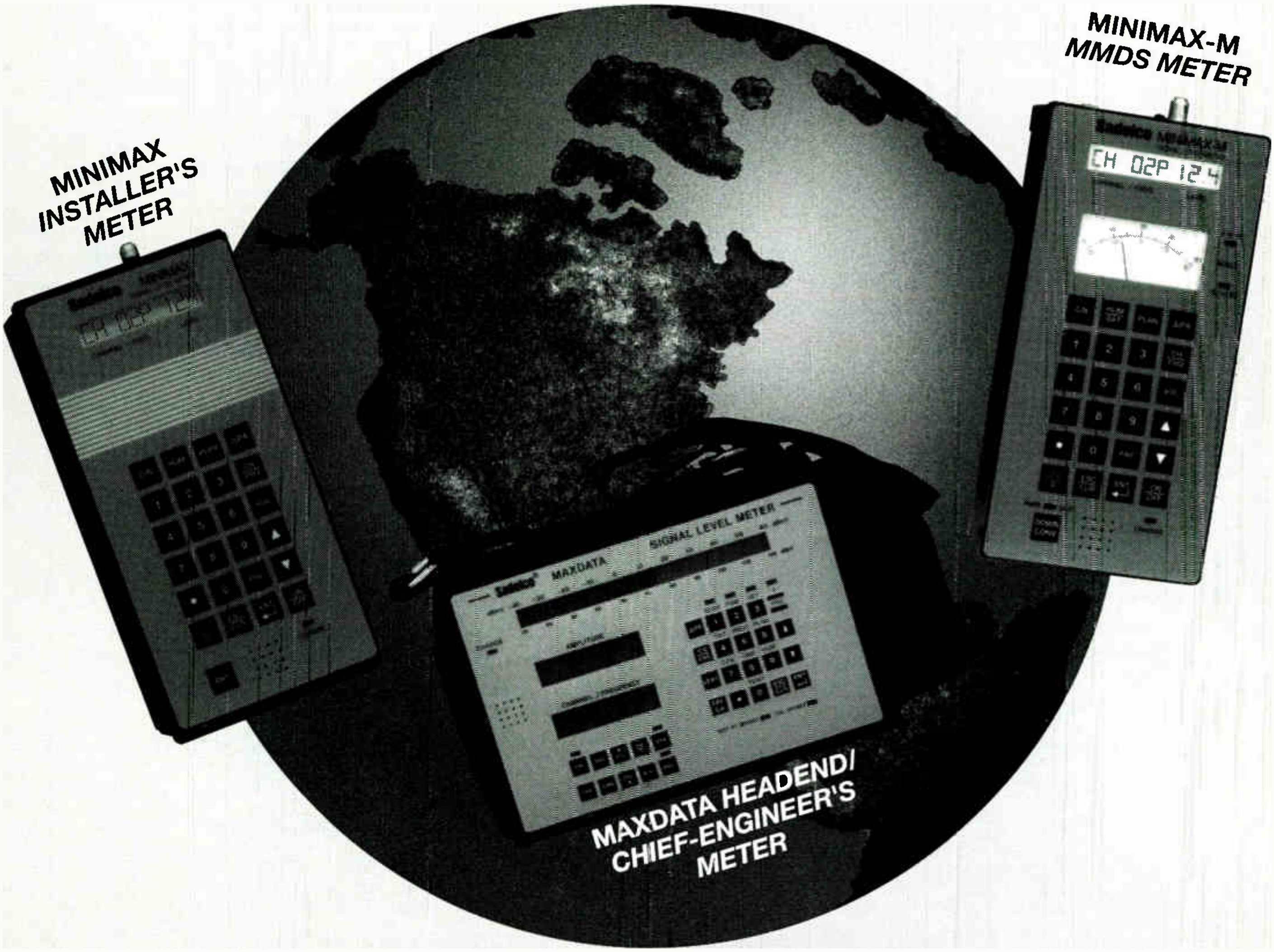
BOTTOM LINE

Understand Color Test Rules

A close look at the FCC regulations, then a look at common test procedures often show something very interesting—the test methods don't match the test requirements! Even seasoned engineers can be confused by some aspects of the tests:

- The maximum differential gain requirement is actually 20% peak-to-peak, which is different than the often quoted ±20%.
- Differential phase is measured relative to a reference packet — very tricky to do using a standard vectorscope.
- Commonly used test signals from program providers can cause your system to appear to be out of tolerance when it isn't.
- Incidental carrier phase modulation (ICPM) can cause your differential phase results to indicate that you're out of spec when you're actually easily within spec—or vice versa!

A thorough understanding of the rules, signal parameters and measurement processes is required for accurate results.



MINIMAX INSTALLER'S METER
MINIMAX-M MMDS METER
CH 02P 124
MAXDATA
SIGNAL LEVEL METER
MAXDATA HEADEND/ CHIEF-ENGINEER'S METER

carry the signal on the "test" transponder, take the channel out of service during this process.

For VHF over-the-air channels, an agile modulator can be used to drive the processor or demodulator. Measure the performance of the modulator first, then measure overall performance relative to it. UHF over-the-air channels take a little more ingenuity (most agile modulators won't cover the UHF band). Often, the local broadcaster will provide a VITS if requested. Alternatively, you can use a simple mixer circuit and oscillator to heterodyne the output of a spare modulator to the desired UHF frequency.

Measurement accuracy largely depends on the performance of the test demodulator, the devices used to make the measurements and operator skill. A precision demodulator is essential for accurate results. A demodulator that has synchronous detection will provide the most accurate measurements of differential gain and C/L delay. With synchronous demodulation, you also can measure incidental carrier phase modulation (ICPM). If ICPM is present, you get the most accurate differential phase test results by subtracting

"Measurement accuracy largely depends on the performance of the test demodulator."

the measured differential phase from ICPM on a packet-by-packet basis. Alternatively, use a demodulator with envelope detection for accurate differential phase measurements.

The sound trap in the demodulator must be enabled for color measurements. Tests that do not include the effects of the sound trap will yield incorrect C/L delay results. Most measurement grade demodulators specify the maximum amount of differential phase, differential gain and C/L delay they might introduce into the signal. This should be as low as possible. If extremely accurate results are needed, request a calibration certificate from the demodulator manufacturer. Known errors can be subtracted from your measurements — if you can show proof of their magnitudes. CT

For more information on these tests and other baseband measurements, refer to the book "Television Measurements — NTSC Systems" from Tektronix (PN25W-7049-2).

Gary Andrews is the owner of Television Measurement Services. He can be reached at (503) 628-3764 or tvms@compuserve.com. Randy Wilson is an applications engineer for Tektronix Inc. He can be reached at (503) 627-5473 or randy.l.wilson@tek.com.

Proof-of-Performance Revisited

By Steve Windle

With all of the hype and angst related to activation of the return path, there may be some distraction from what was not long ago the big topic of discussion, proof-of-performance (POP). While most of us are very familiar with the requirements, a brush-up on the requirements and how they can be met efficiently may be helpful. The Federal Communications Commission requires that specific tests be performed on a regular basis to prove that the cable network is performing according to technical standards. This article will discuss the scope of these tests and suggest techniques and types of test equipment that can make this job easier.

Maintaining compliance with the technical standards requires a consistent preventive maintenance program. While the FCC requires specific tests twice per year and a written record of the results, there is some groundwork required on a continuous basis. This means continuous testing of system frequency response, levels, carrier-to-noise ratio (C/N), hum, distortions and leakage. In addition, it means making sure the calibration is maintained on the test equipment to be used in the tests.

FCC requirements

The technical standards in the CFR (Code of Federal Regulations) Section 76.605 generally ensure that cable subscribers receive good quality pictures. Most of the tests must be performed at six-month intervals and in the coldest (January, February) and hottest (July, August) months of the year.

All subscriber terminals are to be in compliance, and proof tests are to be performed at six widely separated subscriber terminal test points, plus one for each additional 12,500 subscribers above 12,500. (For instance, 12,501 to 25,000 subs means seven test points; 25,001 to 37,500 means eight test points.)

At least a third of the test points must represent performance at subscriber terminals most distant from the headend in terms of cable length. In addition to proof testing, operators must be ready to show compliance on demand. A current listing of all channels carried must be on hand, and the proof test data must be kept on file at the operator's local business office for five years. The standards are contained in the accompanying table on page 84.

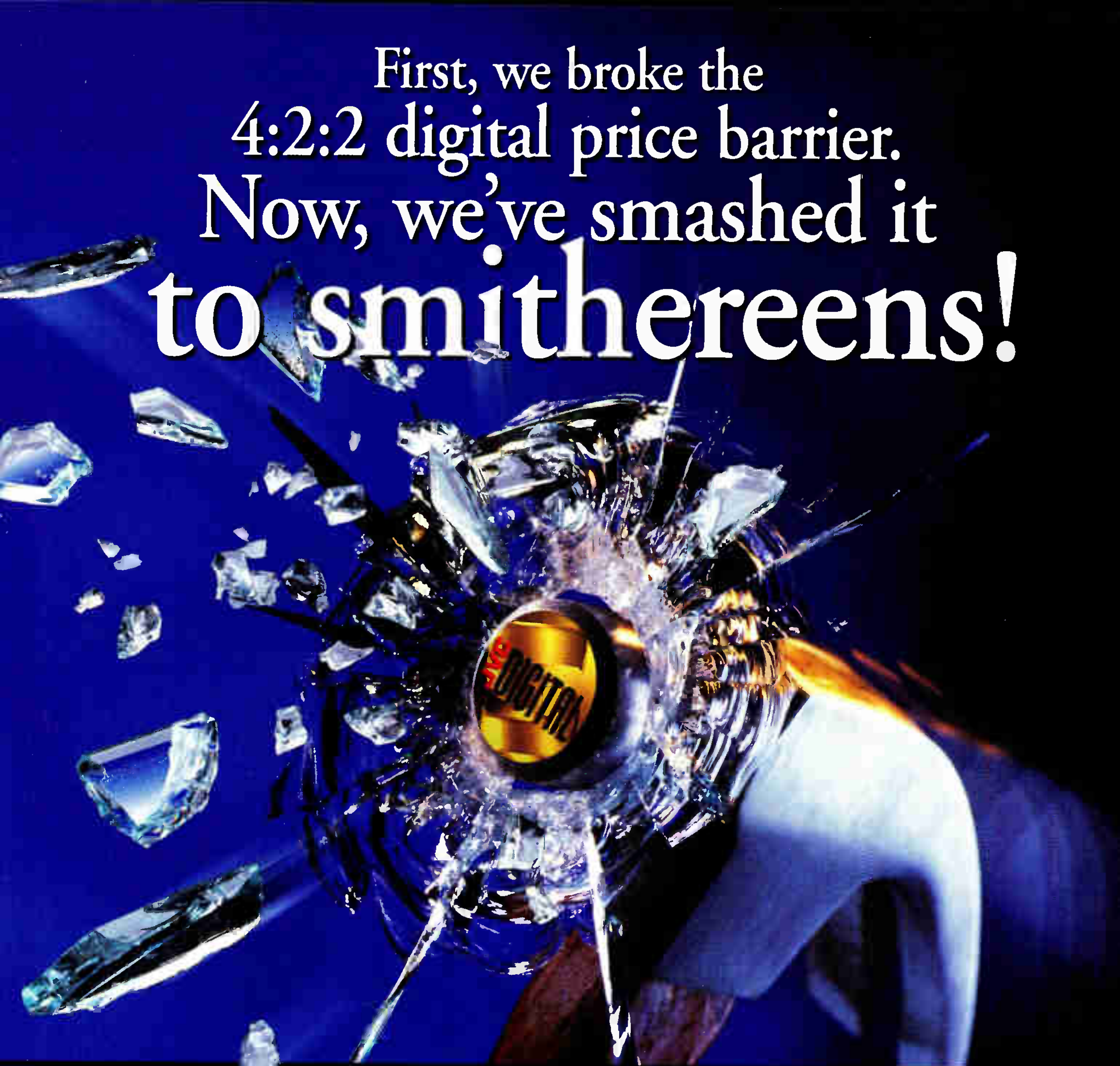
Test equipment alternatives

The instruments used to perform the test must be identified in the records, with make, model and most recent date of calibration (traceable). In addition, a description of the test procedures used and a statement of the qualifications of the person performing the tests must be kept on file.

Signal level meters (SLMs) can be used for a number of the FCC tests, but because they cannot perform all of the field tests, a laboratory grade spectrum analyzer is commonly used for most tests other than the signal level and 24 hour tests. Many SLMs now available will automatically perform visual and aural carrier level measurements with a timed on/off condition to conserve battery life. Some of these units are small enough to be enclosed in a pedestal for the duration of the test.

Frequency counters designed specifically for measuring visual and aural carriers in a

> **BOTTOM LINE**
>
> **"Oh Yeah..."**
>
> Remember proof-of-performance? It's that set of tests that the FCC requires twice per year. While you've been concentrating on cleaning up your return path, might you have been neglecting the forward path? While the return path is very important to the future of your network, the forward path is where the bread is right now.
>
> Compliance with standards set forth in the Code of Federal Regulations is required year-round. This means a conscientious preventive maintenance program is required, and test equipment calibration must be maintained.
>
> Specific test equipment and PC application software smoothes the road to compliance.



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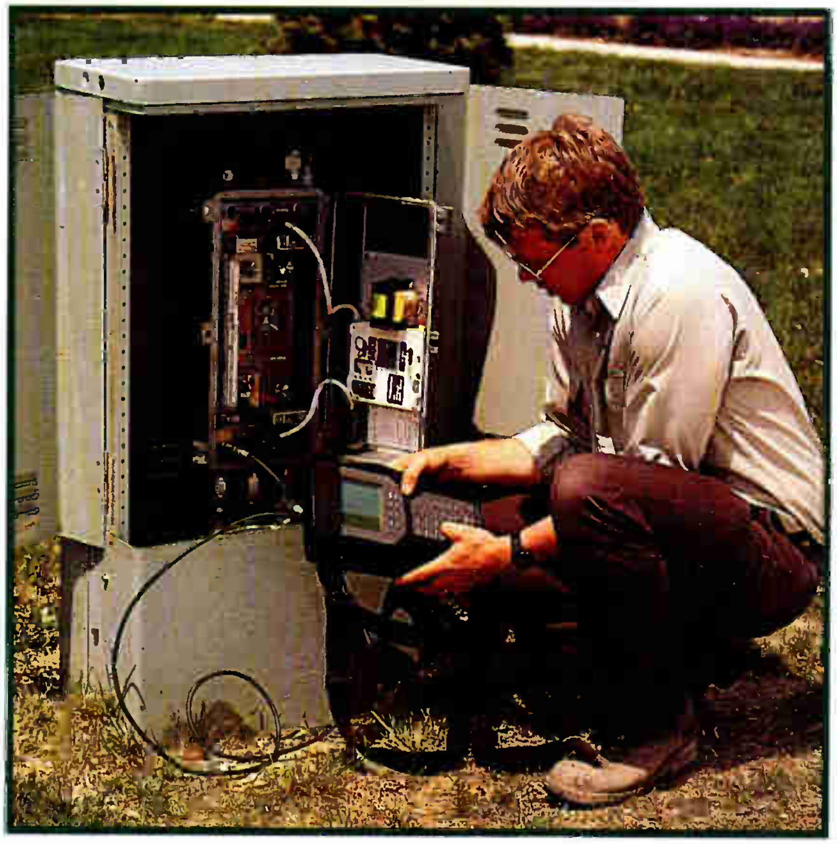

cable TV environment are available. The standard specifies a measurement of the offset between the visual and aural carriers. Most spectrum analyzers now being used for proof tests are capable of making this measurement with the accuracy required. This is not a 24-hour test, and the measurement can be made fairly easily along with the rest of the prescribed measurements.

Spectrum analyzers have become a staple instrument for cable TV systems. The broad spectrum of test capabilities makes it indispensable, but it most commonly is used in the headend. Many innovative techniques have been implemented to administer the proof tests in the field by accommodating the instrument's lack of field portability, including special truck mounting apparatus and long test leads. Of course the manufacturer says the analyzer is field-portable, but they weigh 30 pounds and require an automobile battery to operate independent of main power. Because of this lack of portability, most spectrum analyzers remain in

Reader Service Number 260

FCC proof of performance standards

Measurement	Location	Schedule	Number of channels to test	Limits
Aural carrier frequency offset	Headend and subscriber terminal[1]	Twice each calendar year	4+ channels[2]	4.5 MHz, ±5 kHz
Visual carrier amplitude	Subscriber terminal[1,3]	Twice each calendar year	All channels	0 dBmV @ subscriber terminal output; +3 dBmV @ end of 100-foot drop
Visual carrier level variance (24-hour test)	Subscriber terminal[1,4]	Twice each calendar year	All channels	<8 dB over 6 months including 24-hour period; <3 dB from channel to channel within 6 MHz nominal separation; within (10+n) dB of any other video carrier
Aural signal level	Headend and subscriber terminal	Twice each calendar year	All channels	>10 dB and <17 dB; >6.5 dB for baseband converters
Frequency response characteristic	Subscriber terminal[1,5]	Twice each calendar year	4+ channels[2] lower channel boundary	±2 dB from 0.75 to 5 MHz above
Carrier-to-noise ratio	Subscriber terminal[1]	Twice each calendar year	4+ channels[2]	43 dB
Coherent disturbances	Subscriber terminal[1]	Twice each calendar year	4+ channels[2]	>51 dB for standard channel allocation; >47 dB for HRC
Isolation[6]	Subscriber terminal[1]	Twice each calendar year	4+ channels[2]	>18 dB and prevent reflections
Hum	Subscriber terminal[1]	Twice each calendar year	One channel[7]	<3%
Chroma delay	Headend	Every three years	4+ channels[2]	<170 nanoseconds
Differential gain	Headend	Every three years	4+ channels[2]	<±20%
Differential phase	Headend	Every three years	4+ channels[2]	<±10 degrees

[1]Testing at the subscriber terminal should be done at the output of the converter unless noted otherwise.
[2]Measurements should be taken on at least four channels, plus one additional channel for every 100 MHz of cable distribution system upper frequency limit (five channels for systems between 101-216 MHz, six channels for systems between 216-300 MHz, seven channels for systems between 300-400 MHz, etc.)
[3]The visual signal level must be measured at the subscriber terminal and at the end of a 30 m (100 -foot) cable drop that is connected to the subscriber tap.
[4]The 24-hour test must be performed at the end of a 30 m (100-foot) cable drop that is connected to the subscriber tap.
[5]Prior to Dec. 30, 1999, this can be measured after the subscriber tap and before the converter that is provided and maintained by the cable operator. As of Dec. 30, 1999, the amplitude characteristic shall be measured at the subscriber terminal.
[6]This test may be bypassed, if manufacturer's specification representing the results of a test of at least 500 units, or the results of cable system lab tests of at least 50 units are available. Thorough record keeping is recommended in all cases.
[7]A single unmodulated carrier may be used for testing this requirement.

the headend, and are only taken (with the utmost care) for the proof test. Some spectrum analyzers have special options available that add the ability to make the baseband video tests that are required once every three years. The performance of these measurement options would be considered marginal by most headend technicians, but it is adequate for making the measurement to FCC standards.

In many cases pre-amplifiers will be needed to bring the low test point levels up into measurement range. In these instances, a bandpass filter is recommended to ensure that instrument front end overload doesn't occur, resulting in the appearance of intermod products on the spectrum display that are not really present at the test point.

PC application software

There are a variety of application software packages available for documenting the results of the proof test, and keeping track of FCC related data. The offerings available from test equipment companies focus mainly on the test results, while other independent packages include other data such as subscriber complaint tracking information. Usually there is a linking capability between the test equipment packages and the more comprehensive independent packages, to enable a transfer of the data. Most test equipment packages export data to popular spreadsheet programs or can format the data to ASCII.

Data management software packages improve efficiency by eliminating the need for the technician to write down all of the test data and keep track of the paper. An additional savings is in re-entry of test data into a PC for use in a spreadsheet to assist in determining compliance with the standards. Not only is the re-entry task eliminated, but so are potential transcription errors. The graphing and sorting of data provided by the application software makes further analysis, beyond the FCC requirements possible, and can reveal the location of trends toward failure. This means that a potential outage could be averted by appropriate action as a result of the findings.

Getting the job done

In spite of all the attention currently being given to the reverse path and digital services, the basics still need attention. The FCC mandated proof-of-performance tests are a basic part of making sure the customer gets good cable TV service. These tests are not difficult to perform, but can be time-consuming and in some cases involve at least a momentary interruption of service (composite triple beat test) that results in a requirement to make the test in the wee hours of the morning. While many test equipment improvements have simplified these tests, there is still room for more simplification and efficiency. CT

Steve Windle is CATV product marketing manager at Wavetek. He can be reached at (317) 788-9351.

In-Service Tests: Using Any Analyzer

By Gary Andrews

Several techniques are available to measure carrier-to-noise ratio (C/N) and in-channel response with the test channel in service. However, results are often limited by the measurement processes or characteristics of the incoming signal. This article reviews common in-service measurement techniques and describes methods to perform in-channel response and C/N tests, in service, using virtually any spectrum analyzer — including "generic" analyzers with no cable TV specific features.

Carrier-to-noise ratio

The current Federal Communications Commission requirement for C/N is 43 dB. If you provide set-top converters to your subscribers, tests should be conducted at the output of a representative converter. The assumption is that C/N will be slightly worse at the output of the converter than at the tap. In practice, signal processing circuits in the converter and/or modulator may dramatically affect test results. Conducting C/N tests under actual operating conditions (in-service) avoids the confusion caused by such processing circuits. C/N measurement methods include the following:

Automatic using the guard band: Measures noise in the guard band between the channel under test and its lower adjacent channel. The assumption is that there is no signal present in the guard band (approximately 1.25 MHz below the visual carrier of the channel under test), leaving only noise. There are three concerns about this method:

1) The guard band is not included in the FCC's definition of noise (between the visual carrier frequency and 4 MHz above the visual carrier).

Filters in modulators or processors may not adequately attenuate signals in the guard band, resulting in a portion of the video signal being interpreted as noise.

2) The frequency response of the set-top converter may roll off in the guard band (causing nice, but incorrect, C/N test results).

Gated measurements: Available in some newer analyzers and signal level meters, this method measures noise during the vertical blanking interval of the video signal, on so-called "quiet lines." This requires that quiet lines be available and that noise on the incoming signal be insignificant compared to noise generated by the cable system. In many cases, either quiet lines are not consistently available or there is enough noise on the incoming signal that the test results are more a reflection of the program provider's signal than the performance of the cable system. A simple "quiet line inserter" can be installed in the video signal path to provide known quiet lines for the measurement.

In-service C/N tests using any spectrum analyzer: C/N tests can be done in service, using most commonly available spectrum analyzers, by installing a notch filter in the video path. For example, a 2.75 MHz notch filter placed at the video input to the modulator will remove video signals at

> **BOTTOM LINE**
>
> **Accurate In-Service Tests**
>
> We all love the idea of performing tests without taking channels out of service. In-service testing not only minimizes subscriber disruptions, it minimizes labor costs during proofs while eliminating some common causes of measurement errors. The problem is, we either don't have the expensive, automated test gear or, if we do, we get inconsistent or inaccurate readings when using it. It's not the test gear's fault! In many cases it's noise and/or distortion on the incoming signals.
>
> The solution is to locally insert "quiet lines" and a frequency response test signal into the video's vertical blanking interval so the automated gear has something clean to measure.
>
> Lacking the latest automated test gear, a high level vertical interval test signal (VITS) and a dynamic notch filter in the video path can be used for accurate, in-service testing. This does not require a full-fledged VITS inserter. A device to meet these basic requirements can be economical enough to allow use on all test channels.

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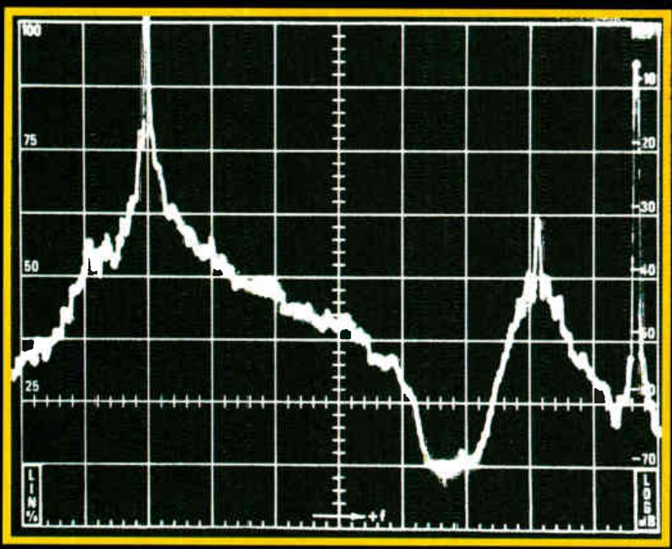
Figure 1: Frequency spectrum with notch filter in place



that frequency. Figure 1 shows the response with a notch filter installed. To measure C/N, use your standard technique but be certain to make the noise portion of the measurement 2.75 MHz above the visual carrier. Because video signals, relative to the peak of the visual carrier, are quite low, a 50 dB deep filter typically allows noise measurements of less than -60 dBc.

There are some caveats associated with this technique:

1) If the program contains closed captioning or other data services, a "dynamic filter" that passes vertical blanking interval data and enables the notch filter only during active video should be used.

2) The filter will degrade the picture. In practice, the degradation is small enough that, for the duration of proof-of-performance tests, it is an acceptable trade-off when compared to taking the channel out of service.

Measurement range may be limited by picture content and vertical blanking interval signals. In practice, C/N measurements beyond 55 dB are routinely achieved.

In-channel response

Current FCC requirements state that in-channel response, often referred to as channel characteristics, is measured at the end of a 100-foot drop cable connected to the subscriber tap. Starting in the year 2000, in-channel response will be measured at the subscriber terminal. Current requirements are ±2 dB from 500 kHz below to 3.75 MHz above the visual carrier. Test methods include the following:

Gated measurements: Some newer test instruments perform in-channel response tests by sampling the signal only on specified lines during the vertical blanking interval. This provides in-service measurement capability using standard test signals. It requires that the video from the program supplier includes appropriate high quality vertical interval test signals (VITS). Commonly available test signals include multiburst, sin(x)/x and ghost cancellation reference signals. Lacking suitable test signals, or if the incoming signal is not of high enough quality, appropriate VITS can be inserted locally.

In-service tests using any analyzer: In-channel response can be measured with the channel in service by inserting a high level test signal into the vertical blanking interval of the video signal and using the peak hold mode of the spectrum analyzer to display the response of the channel under test. The analyzer scan rate should be slow enough

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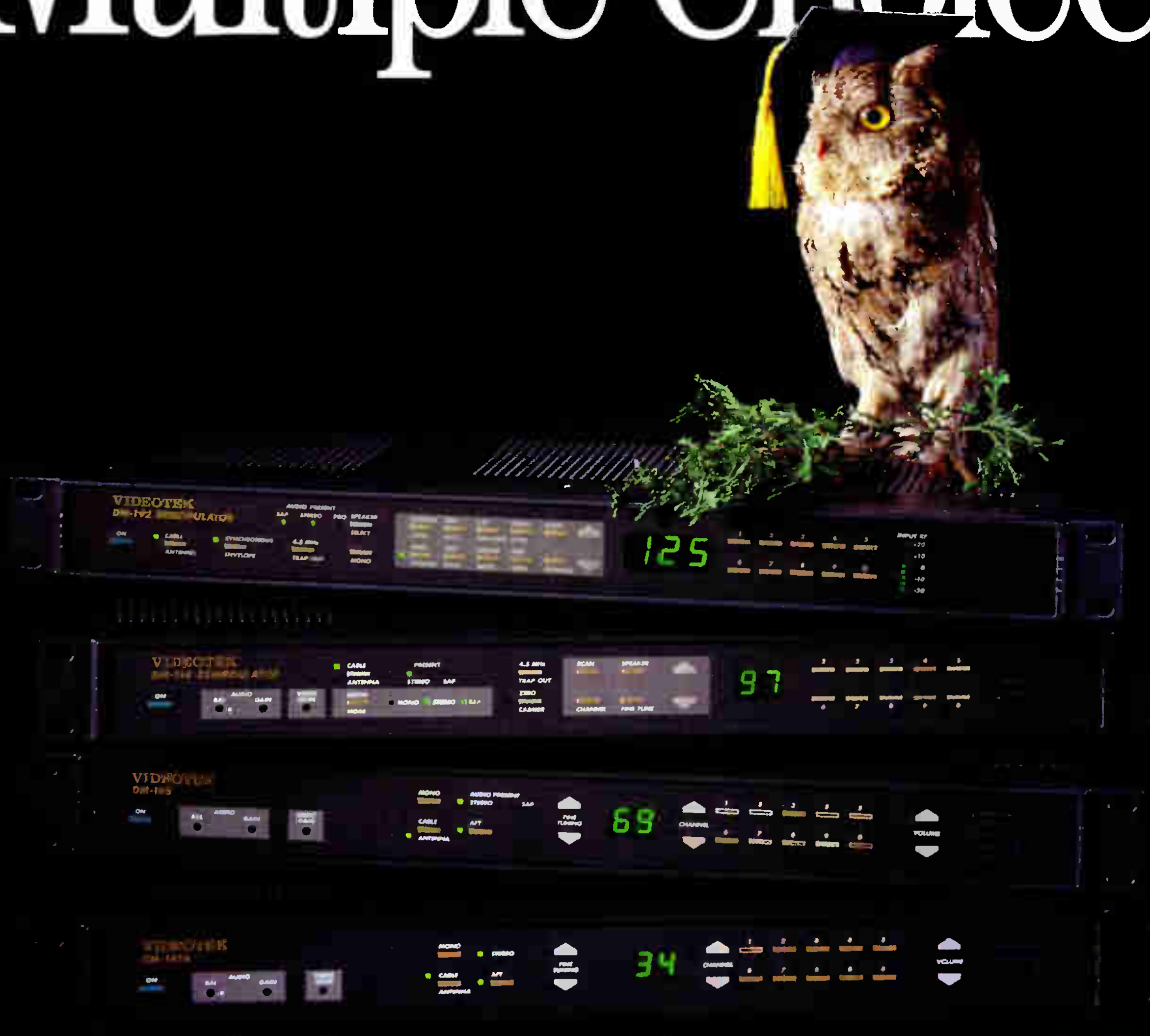

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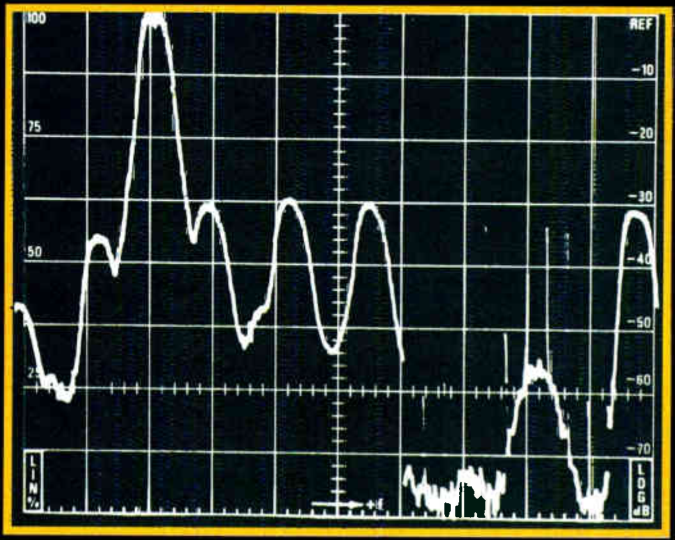
Figure 2: Capturing a high level multiburst signal



to produce a solid line. Figure 2 shows a typical display during the process of capturing a high level multiburst signal. Once captured, the response can be measured using graticule lines or markers. Hint: If your analyzer has automatic in-channel response test capabilities using full field test signals (an out-of-service technique), try using the automatic mode with a high level VITS inserter. With some instruments it works well and provides automated in-service test capabilities!

Two out of three of the proof-of-performance tests that normally require taking channels out of service can be performed in-service using virtually any spectrum analyzer. By using in-service test methods for C/N and in-channel response, the only operation required at the headend during proofs is to turn off the test channels during coherent disturbance tests, which can done via radio or cell phone using readily available remote switching devices. In-service techniques have the further advantage of avoiding problems caused by processing circuits in the headend and/or set-top converter. CT

Gary Andrews is the owner of Television Measurement Services of Hillsboro, OR. He can be reached at (503) 628-3764 or tvms@compuserve.com.

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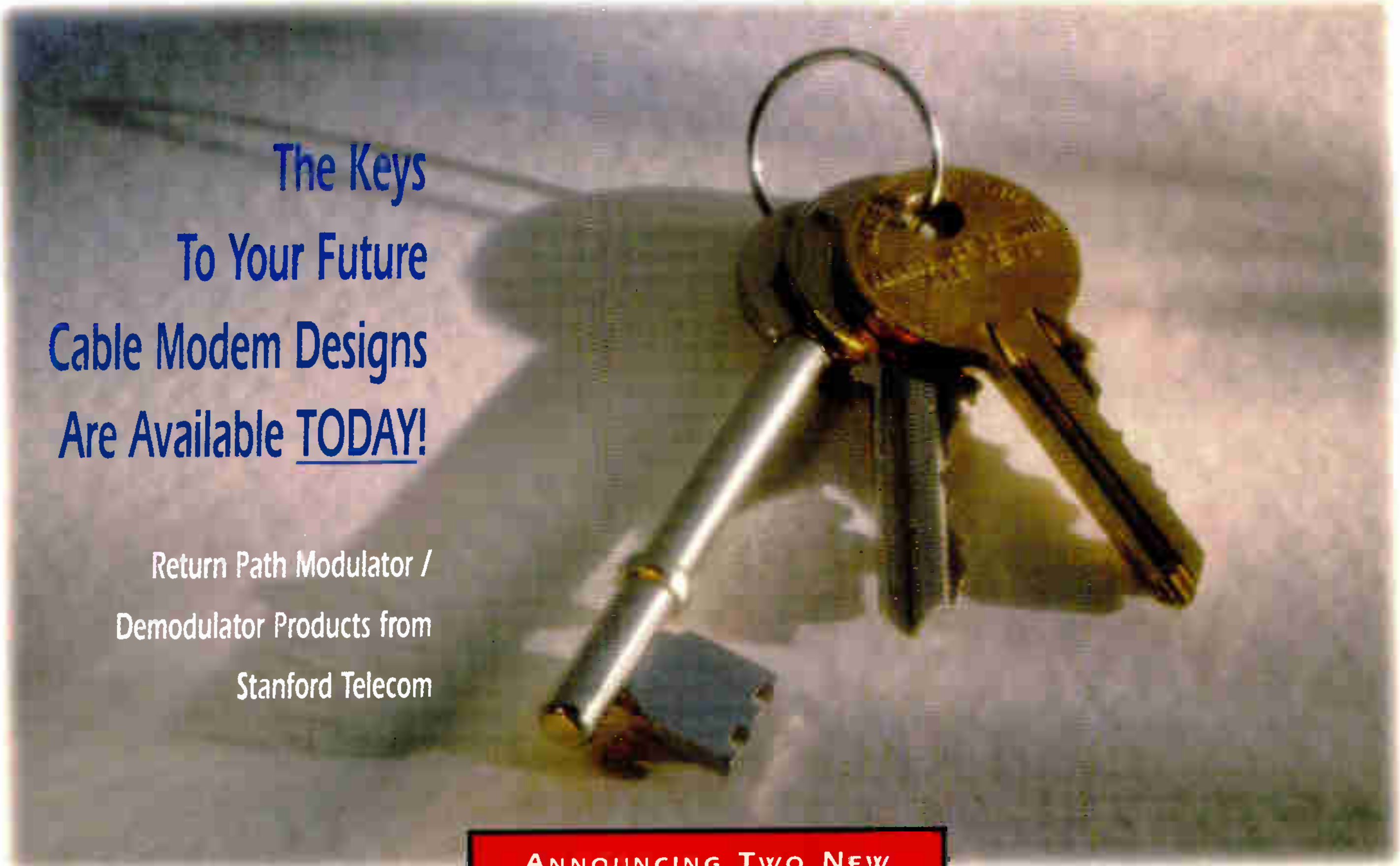

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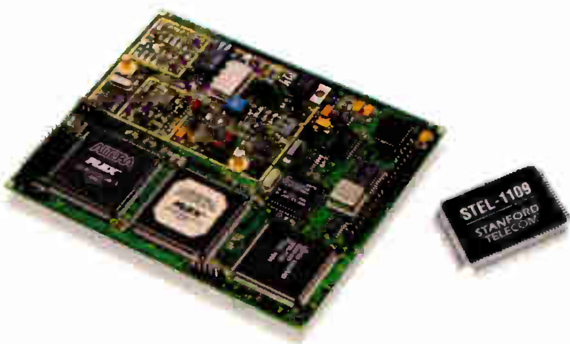

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Reader Service Number 148

THIS IS A TEST

A Look at EAS Distribution Systems: Part 1 of 2

By Williom G. Robertson

Editor's note: This two-part series looks at four types of distribution systems for the emergency alert system (EAS): RF, IF, baseband switching and text messaging. In this installment, RF and IF are examined. The remaining two systems will be discussed in the next issue of "CT."

The Federal Communications Commission ruling mandating that many of the nation's cable systems comply with the new emergency alert system (EAS) ruling created some technical challenges for cable operators as well as more than a bit of confusion. For a broadcaster to implement an EAS on a single channel is one thing, but for a cable operator to do it in a multichannel environment is quite another. Operators need to know the various EAS distribution methods that currently exist for multichannel environments.

The connections of the EAS receivers and encoder/decoders won't be reviewed because these units are required regardless of the type of input or switching method deployed in the headend and throughout the plant. Figure 1 on page 94 shows the basic functional blocks necessary when implementing an EAS system in a cable operation. The EAS receivers and the encoder/decoders will be the same for all systems. It is only in the EAS distribution equipment where fundamental differences exist between the various solutions available. For the cable operator, this means evaluating advantages and disadvantages of each type of system and deciding which will work best for a particular facility.

Four basic types of EAS distribution systems are currently available and in use. They are, from simplest to most sophisticated: RF, IF, baseband switching, and text messaging. In this first installment, we will look at the RF and IF schemes.

To help understand the application of each distribution system, we will apply each to the simple four channel cable system shown in Figure 2 on page 94. This system represents the typical signals found in a contemporary cable system. It combines three elements normally found in a cable system: two satellite, an over-the-air signal and a local origination signal. These different signals are combined at the combining network and then sent on to the plant. (Forthcoming analog/digital hybrid systems are not addressed.)

RF comb generators

The RF method of emergency alert distribution is the simplest system available for a multichannel TV provider (Figure 3 on page 94). This type of system is commonplace because units were typically included with many turnkey cable headends purchased from one of the two large headend manufacturers of the time.

These units generate a broad RF output that, when viewed on a spectrum analyzer, resemble the fingers of a comb. These fingers tend to fall on the center video frequencies of each channel moving up the spectrum. In this way, any TV set or set-top converter will see a picture and be able to display it regardless of the channel to which it is tuned. A critical point of these systems is they completely replace the signal or signals coming from the headend. One may try to place low-pass or band-elimination filters in the output in an attempt to selectively isolate certain channels, but any future channel realignment may thwart those efforts. Also, the inclusion of filters in line along with their inherent phase and amplitude distortions are suspect.

These simple, single page displays would not be acceptable and, therefore, not able to comply with the FCC's rules and regulations. More sophisticated RF systems provide for a video input that could be connected to a character generator (CG) or other video device with the appropriate alerting information. A CG updated with the information coming from the EAS receiver and encoder/decoder would be the minimally acceptable system that would comply with the new EAS ruling. The new FCC regulations mandate that the EAS units are tested at least once a week.

In RF systems these tests will equate to destructive tests, because the entire system must be taken down for the duration of the test. Furthermore, there may be little, if any, provision for remote triggering of the system. The only way to trigger the device is by way of the EAS encoder/decoder or actual physical presence at the headend to press the activate button. RF systems are typically inexpensive and they are very easy to wire.

Intermediate frequency

Typically, there are two stages to modulating a baseband signal (that is, converting it from separate audio and video signals to the RF channel). The first stage combines the audio and video, and moves the composite signal to a common or intermediate frequency (IF). The second stage then upconverts the IF signal to the desired output frequency.

Most modulators, at minimum, are equipped with an IF loop, a small piece of external coaxial cable linking the modulator and output converter stages. As the name implies, IF alerting systems work in the IF

BOTTOM LINE

EAS: From Simple to Sophisticated

Even though the FCC has extended the deadline for cable compliance with the emergency alert system (EAS), it pays to understand your options. The four basic types of emergency alert system distribution methods are: RF (simplest), IF, baseband switching and text messaging (most complex). Make sure that you evaluate each method for EAS distribution before choosing one for your facility.

Here is a quick recap of the RF and IF systems:

- **RF method**—The simplest available for a multichannel TV provider. These units generate a broad RF output. any TV set or set-top converter will see a picture and be able to display it regardless of the channel to which it is tuned. The systems completely replace the signal or signals coming from the headend. This methods is typically inexpensive and easy to use.
- **IF method**—The output from an EAS IF modulator is switched into the IF loops of the headend processors and modulators during an EAS alert.

Figure 1: Basic EAS receiver and encoder/decoder combination pack

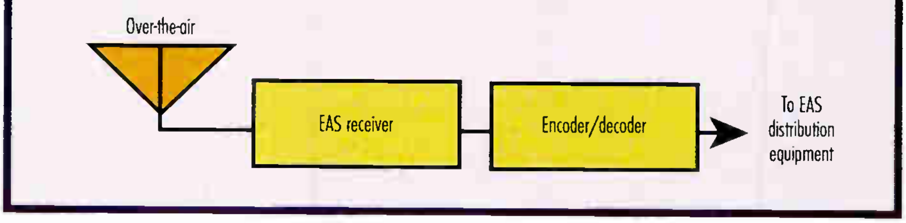


Figure 2: Simple four-channel cable system

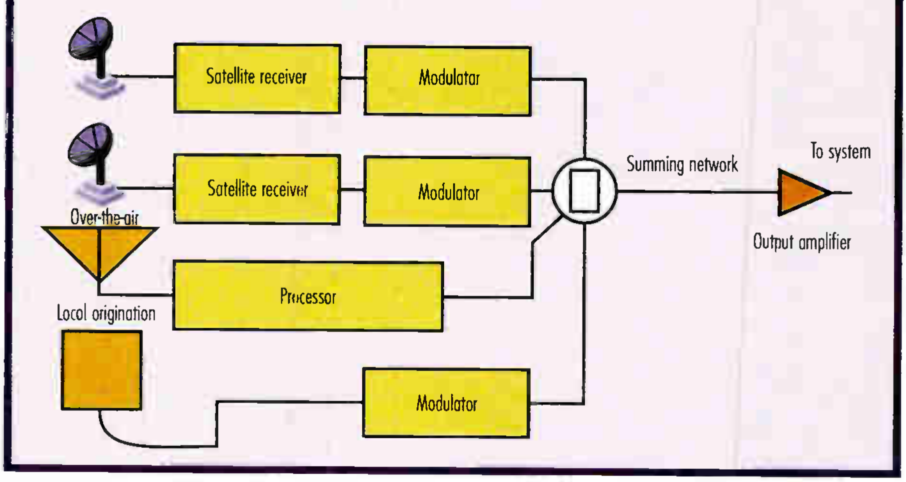
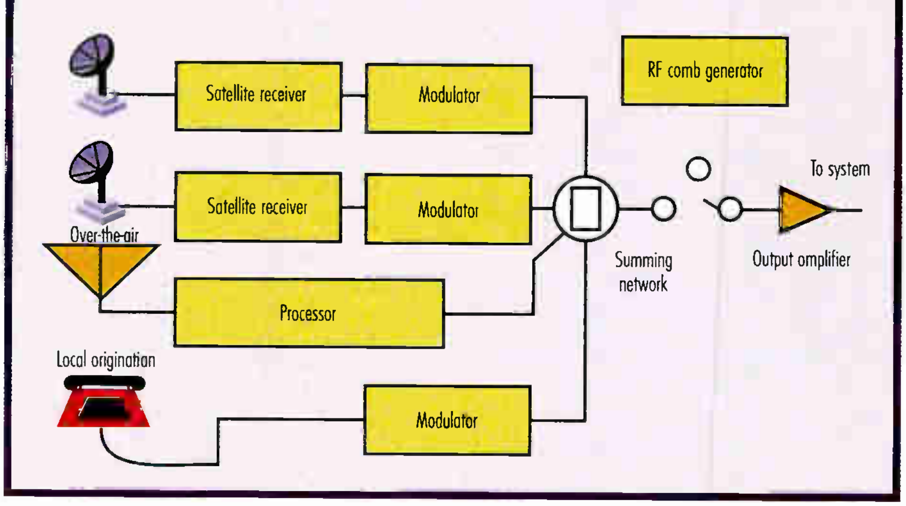


Figure 3: Simple four-channel RF comb generator alerting system



loop and in conjunction with some type of switch to change the signal presented to the output converter stage. While several different types of IF systems exist, (with one composite IF loop, where audio and video are combined, or with dual audio and video IF loops) the application is the same for both types. By adding a switch in this loop, either of what are normally two different inputs can be switched into the second stage and subsequently will be upconverted to the desired output channel frequency.

Other modulators have provisions for alternate IF inputs and, when activated with a proper control signal, the alternate IF signal can be directed to the output converter stage and ultimately to the output channel. These two different modulator types are labeled as

Refurbished IRD's VCII's VCRS's PLUS

switchable
DSR 1500
vcrs & mpeg I

Standard
2001's VCII
$699

DSR 2200

DX 647
VCII
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SA 9660
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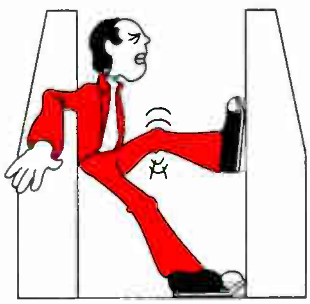

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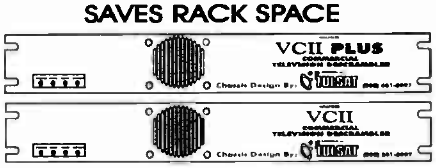

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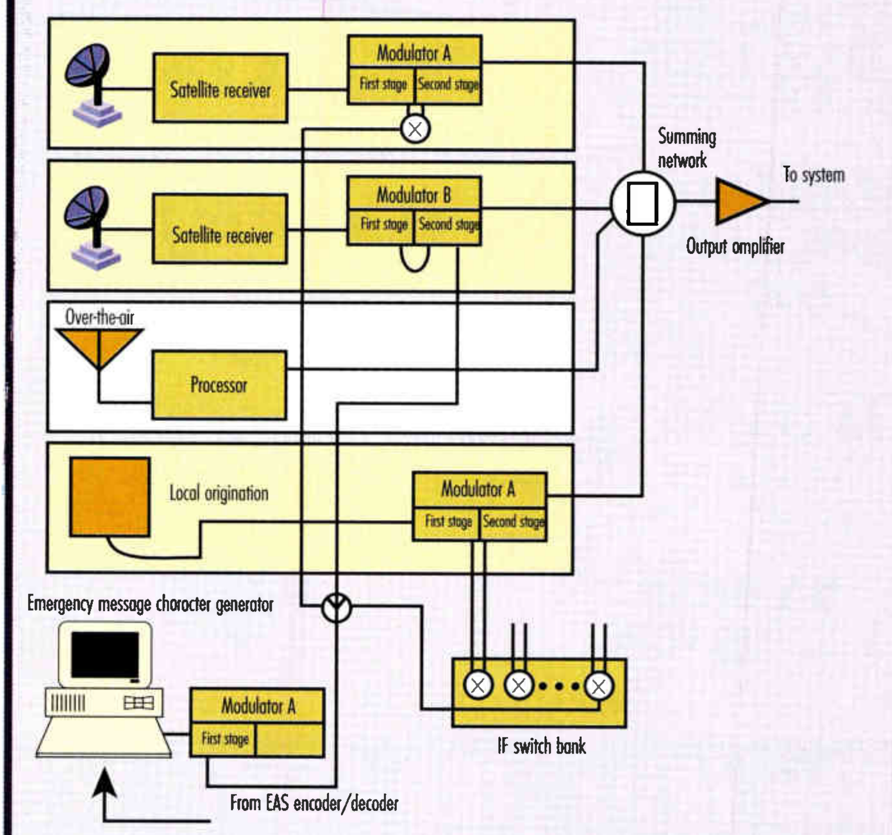
Figure 4: Simple four-channel IF switching EAS



Modulator A and Modulator B in Figure 4. Either method produces the same results: A different input is presented to the output converter stage, and thus whatever is present on this auxiliary IF signal is presented to the outputs.

The reader should be aware that an IF system, like the aforementioned RF system, relies on nonsynchronous switching. In other words, the picture will likely roll, and set-top converters may take some time to re-establish sync and display an output. A rather unprofessional appearance to say the least.

Another drawback to the IF solution is that there is no way to separate the audio and video portions of the message. The video and audio signals are tied together and there is no way to facilitate a separate, audio-only message. In a dual channel IF system (separate audio and video IFs), the signals are separate, but a control system that could discern which switch is which would be necessary.

Presently, there are two different wiring schemes for IF systems. One uses small IF switches placed in the IF loop and usually in the back of the modulators. The other relies on a bank of switches placed in a rack with the requisite wiring coming to and from the modulator. Obviously, by placing a device on every channel, there will be a large number of connections, but the connections and cabling are of the garden variety F-connectors and 59 Series, respectively.

Many times over-the-air signals are heterodyned or processed to shift their frequency for transmission on the cable. This is normally done to move the over-the-air UHF signals down frequency using simple downconverters. These devices also may have an IF loop in which a switch could be placed. Importantly, processors, modulators or any channel that does not have either an external IF loop or the alternate IF input must resort to one of the other methods of EAS distribution.

Next time: A look at baseband switching and text messaging. CT

William G. Robertson is chief technical officer with Frontline Communications. He can be reached at (801) 464-1600 or w.robertson@frontlinecom.com.

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14. ___ Fiber Optic Manufacturer
15. ___ Data Network
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40. ___ Cable Tools
41. ___ CAD Software, Mapping
42. ___ Commercial Insertion/Character Generator
43. ___ Compression/Digital Equip.
44. ___ Computer Equipment
45. ___ Connectors/Splitters
46. ___ Fleet Management
47. ___ Headend Equipment
48. ___ Transmission/Switching Equipment
49. ___ Networking Equipment
50. ___ Vaults/Pedestals
51. ___ MMDS Transmission Equipment
52. ___ Microwave Equipment
53. ___ Receivers and Modulators
54. ___ Cable Modems
55. ___ Subscriber/Addressable Security Equipment/ Converters/Remotes
56. ___ Telephone/PCS Equipment
57. ___ Power Supps. (Batteries, etc.)
58. ___ Video Servers

E. What is your annual cable equipment expenditure?

59. ___ up to $50,000
60. ___ $50,001 to $100,000
61. ___ $100,001 to $250,000+

F. In the next 12 months, what fiber-optic equipment do you plan to buy?

62. ___ Fiber-Optic Amplifiers
63. ___ Fiber-Optic Connectors
64. ___ Fiber-Optic Couplers/Splitters
65. ___ Fiber-Optic Splicers
66. ___ Fiber-Optic Transmitter/Receiver
67. ___ Fiber-Optic Patchcords/Pigtails
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69. ___ Fiber-Optic Cable
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71. ___ up to $50,000
72. ___ $50,001 to $100,000
73. ___ $100,001 to $250,000+

H. In the next 12 months, what cable test & measurement equipment do you plan to buy?

74. ___ Audio Test Equipment
75. ___ Cable Fault Locators
76. ___ Fiber Optics Test Equipment
77. ___ Leakage Detection
78. ___ OTDRs
79. ___ Signal Level Meters
80. ___ Spectrum Analyzers
81. ___ Status Monitoring
82. ___ System Bench Sweep
83. ___ TDRs

I. What is your annual cable test and measurement equipment expenditure?

84. ___ up to $50,000
85. ___ $50,001 to $100,000
86. ___ $100,001 to $250,000
87. ___ over $250,000

J. In the next 12 months, what cable services do you plan to buy?

88. ___ Contracting Services (Construction/Installation)
89. ___ Repair Services
90. ___ Technical Services/ Eng. Design

K. What is your annual cable services expenditure?

91. ___ up to $50,000
92. ___ $50,001 to $100,000
93. ___ $100,001 to $250,000
94. ___ over $250,000

L. Do you plan to rebuild/ upgrade your system in:

95. ___ 1 year
96. ___ more than 2 years

M. How many miles of plant are you upgrading/ rebuilding?

97. ___ up to10 miles
98. ___ 11-30 miles
99. ___ 31 miles or more

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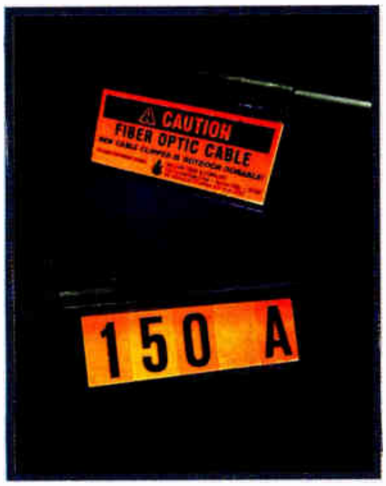


Aerial Cable Markers

Identify your aerial cables with William Frick and Company's new Clipper aerial cable marker. This dielectric black marker withstands UV exposure as well as other elements. Information can be displayed on both sides of the durable marker. Application involves just clipping it on. Diameter and length of the clipper varies.

Reader service #311

New Monitors for GI Product

AM Communications has developed new monitors for the General Instrument StarGate, BLE and Mini-Bridger products utilizing the FlexStat design module. These technologies are being developed specifically for domestic and international efforts AM and GI are supporting. The new transponder technology is compliant with AM's Omni/Stat element management system, and provides industry essential functionality such as frequency agility, downloadable protocol and application specific software.

The module is a business card size unit that contains all of the circuitry required to perform common status monitoring functions. The unit was designed so that I/O conditioning and expansion can be accomplished easily and inexpensively in the host equipment. The module core includes advanced features such as frequency agile RF modems, downloadable firmware and programmable I/Os.

Reader service #306

Fusion Splicer

Aurora Instruments has developed the FW312 automatic fiber-optic fusion splicer. The splicer provides extremely low splice losses with single-mode fiber in a self-contained package.

According to Aurora, the splicer achieves an average splice loss of 0.016 dB with matched single-mode fiber, and its loss estimates are accurate within 0.02 dB 90% of the time. The process, including automatic fiber cleaning, alignment, gapping, fusion and loss estimation, typically takes as little as 35 seconds.

All accessories and parts, including built-in heat shrink oven, precision cleaver, RS232 data port, battery, charger, power cord, cleaning materials, spare electrodes, canned air, manual and fiber strippers, are included in the self-contained ruggedized case.

Reader service #310

Monitoring Products

Videotek has introduced new products including the new 192-channel DM-192 with synchronous or envelope detection, and the VTM-200 multiformat on-screen monitor that turns an ordinary SVGA computer screen into a picture monitor, a waveform monitor, a vectorscope and an audio monitor. The VTM-200 is 3/4-inch high and can accept NTSC, PAL and 601 serial digital inputs.

As well, the company has lowered prices on its popular DM-154 demodulator (with direct-entry keypad, stereo and SAP outputs and aural composite out) and cable TV testing package that includes a composite video analyzer with auto-measure, a precision agile demodulator, a vertical internal test signal generator and an auto-measure system integration kit.

Reader service #305

Singlemode Connector

Seiko Instruments' Fiber Optics Group has introduced a new quick assembly, singlemode fiber-optic connector compatible with both FC and SC connector styles. The SUP-1 universal connector features pre-assembled, one piece crimp technology and uses a proprietary, funnel type pre-radiused ferrule.

The termini, crimp ring and hood are the same for both the FC and SC connectors and the termini is structured to allow easy attachment and removal of the housing for easy assembly into either an FC or SC connector housing.

Reader service #304

Feedthrough Bushings

The new feedthrough bushings developed by Telecrafter are for use in installing single cable or dual cable and they accommodate telephony, a messenger or both—now or at a later date. Each of the extra cable passageways remains sealed until it is needed for use. Constructed of weather-resistant, UV-stabilized polyethylene for longest life, the products are available for single or dual cable installations.

Reader service #308

An Alternative to Towers

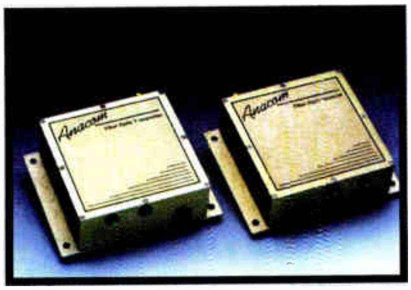
Sanders, a Lockheed Martin Co., has introduced its personal communication service (PCS)-over-cable product, an RF extension system that offers wireless network providers an alternative to time-consuming and expensive tower-based architectures. Thiscode division multiple access (CDMA) system employs distributed transceivers with interconnectivity provided by the cable TV infrastructure.

Reader service #309

Remote Control Ease

Contec has introduced the first simple remote to operate General Instrument's CFT2200 and DCT1000 advanced converters. The product, called RT-SR21, was developed with a simple design, clean layout, large and well-spaced keys, a one touch power button that simultaneously turns on the TV and converter, and point and press programming. Contec offers three remote controls that operate advanced analog and digital set-top units.

Reader service #312



Fiber-Optic Link

Anacom Systems Corp. has developed a new fiber-optic transmitter and receiver pair that offers a low cost method to transmit the RF signal between the antenna and the base-station.

This new system allows wireless broadband systems equipment suppliers to deploy the minimum amount of equipment at the remote antenna site.

The AC 102 is an RF to fiber converter designed to operate transparently in wireless and RF systems.

Reader service #302

New Coring Tool

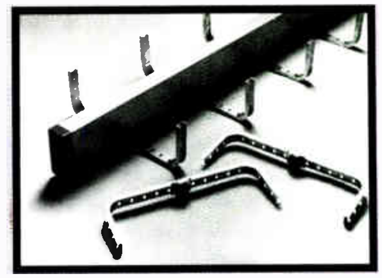
Lemco Tool Corp. has introduced a one-step, multifunction coring tool. The new tool will combine jacket removal, coring, stripping and center conductor pointing in one tool. Lemco also released the L-Tool, a new method of forming the conventional 12-inch float bottom expansion loop in cable plant. Conservative estimates indicate that it will double the life of expansion loops, according to the company. Independent testing by coaxial cable manufacturers confirms that this method of loop forming does, in fact, extend loop life in cable plant.

Reader service #307

Remote Fiber Test System

The remote fiber test system (RFTS) developed by Wiltron Company and Anritsu Corp. tests fiber up to 200 km from a central location. Integrating access, test, fault location, and an operations system (OS), the RFTS monitors fiber network, performs tests; detects and locates faults, and breaks, without shutting the network down.

Reader service #303



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Reader service #301

Note: The videotapes are in color and available in the NTSC 1/2-inch VHS format only.

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

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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.

- *Cable System Technology Meeting Subscriber Expectations*—Margaret Combs (moderator), Jonathan Kramer and Thomas Robinson take issue with what cities want and need in order to deal with cable operators properly. It clearly defines a "key role" that technical managers can and should play to help ensure good relations with the franchising authorities. (45 min.) Order #T-1113, $30.

- *Current Events in Cable TV Technology: Fiber Optics, HDTV, PCN and Outage Reduction* featuring Thomas Jokerst (moderator), Edward Callahan, James Chiddix and Thomas Elliot—This program compares the new Star Star Buss (SSB 500) and fiber-to-feeder architectures, as well as factors that will drive advances in fiber-optic technology. This program offers a unique vision of how we will use our increased bandwidth in the future, including HDTV, personal computer networks, possible 16:9 NTSC and how new consumer equipment may drive the services we must provide. (78 min.) Order #T-1114, $45.

- *BCT/E Certification: An Overview of Technical Certification and Related Category Examinations* featuring Marvin Nelson and Leslie Read—This presentation is geared toward candidates in the BCT/E Program and those entering the program. It provides both an overview of the requirements for each category and insight into key topics of importance. Types of questions that will be found on the examination are provided, along with a candid discussion of the types of answers that the respective committees expect. (70 min.) Order #T-1115, $45.

CALENDAR

September

3-5: Ninth Annual Telco-Cable conference—The Battle for the Digital Broadband Consumer, Washington. Contact (800) 822-MEET.
7-10: HFC '97, High Integrity Hybrid Fiber/Coax Networks second annual technical workshop sponsored by the Society of Cable Telecommunications Engineers and IEEE Communications Society, Phoenix, AZ. Contact Anna Riker, registrar, (610) 363-6888.
9: SCTE Regional Training Seminar, "OSHA/Safety," Albuquerque, NM. Contact SCTE National Headquarters, (610) 363-6888.
9-10: National Technology Transfer Center's technology marketing course, Wheeling, WV. Contact (800) 678-6882; e-mail: train@nttc.edu.
10: SCTE Old Dominion Chapter, technical seminar and testing session, "Return Proof and Fire-Up and BCT/E Tutorial - Category III, Transportation," Richmond, VA. BCT/E and Installer certification exams to be administered. Contact: Margaret Fitzgerald, (800) 231-0237.
10-11: National Technology Transfer Center's commercializing technologies course, Tallahassee, FL. Contact (800) 678-6882; e-mail: train@nttc.edu.
11: Society of Cable Telecommunications Engineers Satellite Tele-Seminar program, "Video Transport (Part Two) and Return Spectrum Issues (Part One)," Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact: SCTE national headquarters, Janene Martin, (610) 363-6888, ext. 220.
15-17: ICSPAT/DSP World 1997, International Conference on Signal Processing Applications and Technology, San Diego. Contact Jennifer Call, (415) 278-5239.
21-26: ISS '97: World Telecommunications Congress, "Global Network Evolution: Convergence or Collision?" Toronto, Canada. Contact Victoria Lord, (416) 588-2420.

October

6-7: Society of Cable Telecommunications Engineers regional training seminar, "Introduction to data communications," Toronto, Canada. Contact SCTE national headquarters, (610) 363-6888.
8-10: Private & Wireless Show, Dallas. Contact JoAnn Vysocky, (713) 975-0030.
14-16: Mid-America Cable Show, Kansas City. Contact (913) 841-9241.
20-22: Eastern Cable Show, Atlanta. Contact Southern Cable Television Association, (404) 255-1608.
20-22: 20th Annual Newport Conference on Fiberoptics Markets sponsored by KMI Corp., Newport, RI. Contact Carole McCormick, (401) 849-6771; e-mail: kmi@ids.net.
22: SCTE Big Sky Chapter, technical seminar and testing session, Laurel, MT. BCT/E and Installer certification exams to be administered. Contact: Marla DeShaw, (406) 632-4300.

Planning Ahead

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.
Jan. 8: SCTE Satellite Tele-Seminar Program, "Data Over Cable (Part Two)," Galaxy 1R, Transponder 14, 2:30-3:30 pm. Eastern Time. Contact: SCTE National Headquarters, Janene Martin, (610) 363-6888, x220.
Jan. 28-30: SCTE Conference on Emerging Technologies, San Antonio, TX. Contact: SCTE National Headquarters, (610) 363-6888.

CABLE TRIVIA

By Rex Porter

Our historical guru (aka Editor Rex Porter) has provided trivia questions on the cable industry.

Your answers need to be postmarked or faxed to us by the 20th of the month of the issue date that the specific trivia test appears in. The first person who sends in the most correct answers will be the award winner. Your answers need to be sent to: The Trivia Judge, *Communications Technology*, 6565 E. Preston, Mesa, AZ 85215 or fax (602) 807-8319.

Trivia #16 answers

1) HBO
2) Bell Atlantic
3) Georgia Cable, Wometco and Continental
4) Newhouse Broadcasting merged its 1.4 million customers with Cablevision Systems of Long Island.

Trivia #17

1) Said to be the first broadcaster in cable, he ran Cox Communications in the early years of cable. His name:
   A) Leonard Reinsch
   B) Bill Bresnan
   C) Leonard Tow
   D) Ted Turner

2) The first major bank to lend money to cable TV was:
   A) First Boston
   B) The Bank of New York
   C) Wells Fargo
   D) Bank of America

3) At the 1984 SCTE Cable-Tec Expo in Nashville, an important paper, "Reliability in CATV Data Communication" was presented. It discussed the STAR topology, CSMA and token passing packet techniques. Also, the seven layer OSI open system interconnect model was discussed. This presentation was made by:
   A) General Instrument
   B) Scientific Atlanta
   C) Burnup & Sims
   D) Hughes Communications

4) Cable systems were first required to submit annual proof-of-performance testing to the FCC in the year:
   A) 1977
   B) 1968
   C) 1970
   D) 1973

5) In 1971, the FCC made CBS spin off cable and syndication interests. So, CBS simply formed a new company, with CBS officers and directors holding the stock of:
   A) Teleprompter
   B) Viacom
   C) CableCom General
   D) Triad Communications

The winner for Cable Trivia #16 will be announced in a future issue. CT

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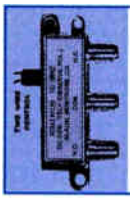

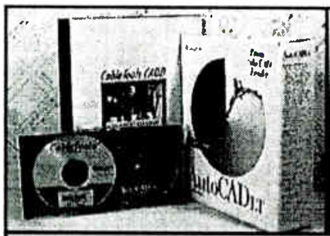

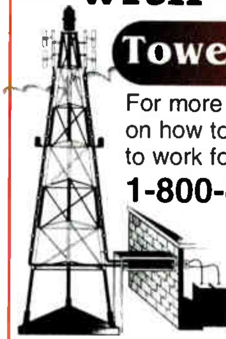

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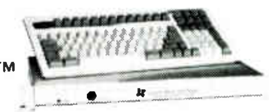

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Troubleshooting the Drop System: Part 1

This month begins a new series. The material is adapted from NCTI's Installer Technician Course, complemented by performance training suggestions to reinforce the material in a hands-on classroom setting. The answers to last month's quiz are also provided. © NCTI.

Problems in the drop system still occur that adversely affect the customer's appreciation of broadband services. It is therefore crucial that these problems are corrected in a timely fashion with as little inconvenience to the customer as possible.

A successful troubleshooting regime is comprised of six steps: 1) identifying the problem, 2) analyzing the problem to determine possible causes, 3) locating the source of the problem using the "divide and conquer" method, 4) diagnosing the problem source, 5) repairing as necessary, and 6) testing to confirm the problem is fixed. Routinely following these steps saves time in the long run and ensures resolution of the problem. This series begins with troubleshooting hot chassis conditions.

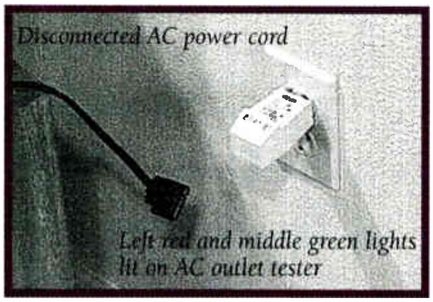

Figure 1: AC outlet tester indicating hot and neutral wires are reversed

Hot chassis condition

It is possible to receive an electrical shock or see a spark while connecting or removing coaxial cables from the TV set, VCR or set-top terminal. These are symptoms of a "hot chassis" condition, which can be caused by: 1) improper wiring of a polarized receptacle; 2) cutting the wide blade on the TV set, VCR or set-top terminal power cord plug and incorrectly plugging it into a polarized or non-polarized AC wall outlet; 3) plugging an adapter incorrectly into a non-polarized receptacle; or 4) an internal problem in the TV set, VCR or set-top terminal. These conditions cause an application of AC voltage to the chassis ground.

Before assuming that the TV or another customer premises device is the cause of a suspected hot chassis condition, use an AC outlet tester or a VOM to verify the AC wall outlet has proper wiring polarity. Testing procedures are different for each of the three types of AC receptacles. The following describes how to identify and isolate the cause of a hot chassis condition at polarized three-hole AC wall outlets. Always adhere to your system's policies for testing AC wall outlets.

- A *polarized three-hole receptacle* has two slots of unequal length, plus a third hole for the AC power cord's grounding prong. To check the wiring polarity of a three-hole receptacle with an AC outlet tester, simply plug the device into the receptacle, as shown in Figure 1. Next, check the indicator lights against the device's chart of test results.

Using a VOM to check wiring polarity requires multiple measurements between different pairs of holes. A properly wired polarized three-hole receptacle must have all of the following: 1) no significant voltage between the long slot and ground hole; 2) 115 VAC ±10% between adjacent slots; and (3) 115 VAC ±10% between the short slot and ground hole.

A VOM reading of 115 VAC ±10% or any significant voltage between the long slot and the ground hole indicates improper wiring polarity (Figure 2). No AC voltage between adjacent receptacle slots indicates no AC input voltage. No AC voltage between the short slot and the ground hole also indicates no input AC voltage or improper wiring. If the outlet is faulty, do not connect any AC power cords to it and tell the customer to not use the outlet until it is repaired by a licensed electrician.

Figure 2: VOM (digital multimeter) indicating improper wiring polarity

Next month's installment will cover identifying and isolating the cause of a hot chassis condition at polarized two-slot receptacles.

Hands-on performance training

Proficiency objective: Check the wiring polarity of a polarized three-hole AC receptacle to determine if it is causing a hot chassis condition.

Ensure that you have enough three-hole polarized AC outlets for your number of students to practice on. You may want to have some outlets incorrectly wired. (If so, make sure these outlets are appropriately labeled so they are *only* used for testing purposes.)

Demonstrate checking a three-hole polarized receptacle using a VOM and/or AC outlet tester (depending on your system's preference).

Emphasize the importance of never using any faulty AC wall outlet.

Have students practice checking polarity of three-hole outlets using a VOM and/or outlet tester.

Verify that each student can correctly check wiring polarity of a three-hole polarized AC receptacle using a VOM and/or AC outlet tester. CT

Answers to last month's quiz:

1) - B; 2) - E; 3) - D; 4) - C; 5) - B; 6) - C; 7) - E.

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CT997

By William W. Riker

Facing Challenges

With the next millennium just around the corner, the broadband industry is now concerned with facing the challenges of a new era. The challenge of improving cable's image by providing better customer service, and the possibility of increased competition from other service providers, these factors are today's realities. In light of the coming era, three questions come to mind:

1) What new technology will be on the forefront of the telecommunications evolution?
2) How do we best face these new challenges in the most efficient and economical way?
3) Where do we get the training we need to keep up with it all?

The Society of Cable Telecommunications Engineers is working harder than ever to provide the best possible technical training and information to industry personnel, thus ensuring a better future for everyone involved at every level—from installers and service technicians to headend engineers.

Training materials

With the recent publication of our *1997 Technical Publications and Videotapes Catalog*, the Society now offers the most comprehensive collection of training materials we've ever had in our 28-year history. Publications and videotapes are sorted by technical areas of study and cross-referenced for your added convenience.

With emerging technologies driving our industry's future now more than ever, increased attention is being drawn to issues such as standards development, interactive services and digital technology. New additions to our already extensive list of training materials in an improved, easy-to-read format make the 1997 catalog a convenient, practical compendium of the A-to-Z of broadband telecommunications.

Since being recognized by the American National Standards Institute in September 1996, the Society has greatly increased its focus on technical standards development. Standards are a major focal point of SCTE, and an up-to-date list of our current standards can also be found in our newest catalog. All Society standards documents, both preliminary and adopted, are listed in one place. Categories include drop, mainline, "F" connector and on-premises specifications, test procedures, material management/inventory and digital video.

Ahead of the learning curve

Data transmission was the primary focus of our 1997 Conference on Emerging Technologies in January. The importance of this relatively new technology to our industry was staunchly confirmed at Cable-Tec Expo '97 this past June, which featured workshops and informative tutorials detailing this subject.

SCTE is now offering the newly revised "Return Path" package. Three videotaped sessions from Expo '97 have been added to this package, including *Cable Modem Technology*, *Return Path Problems and Their Solutions* and *Making Two-Way Work, Part Two*. Together, these informative programs provide an in-depth look into the realm of interactive applications.

Cable Modem Technology offers tips on deploying this progressive technology and compares today's other interactive service providers to those that can offer the speed and convenience of a broadband network.

Return Path Problems and Their Solutions deals with the real-world concerns of determining system dynamic range, component selection, laser clipping, choosing system operating levels, alignment, long loop ACG and the allocation of power on a per-service basis.

Making Two-Way Work, Part Two, a sequel to the popular Expo '96 workshop, continues an even deeper exploration of the key issues encountered when activating a return path. Methods of activation, and the time and resources necessary for a successful endeavor are described.

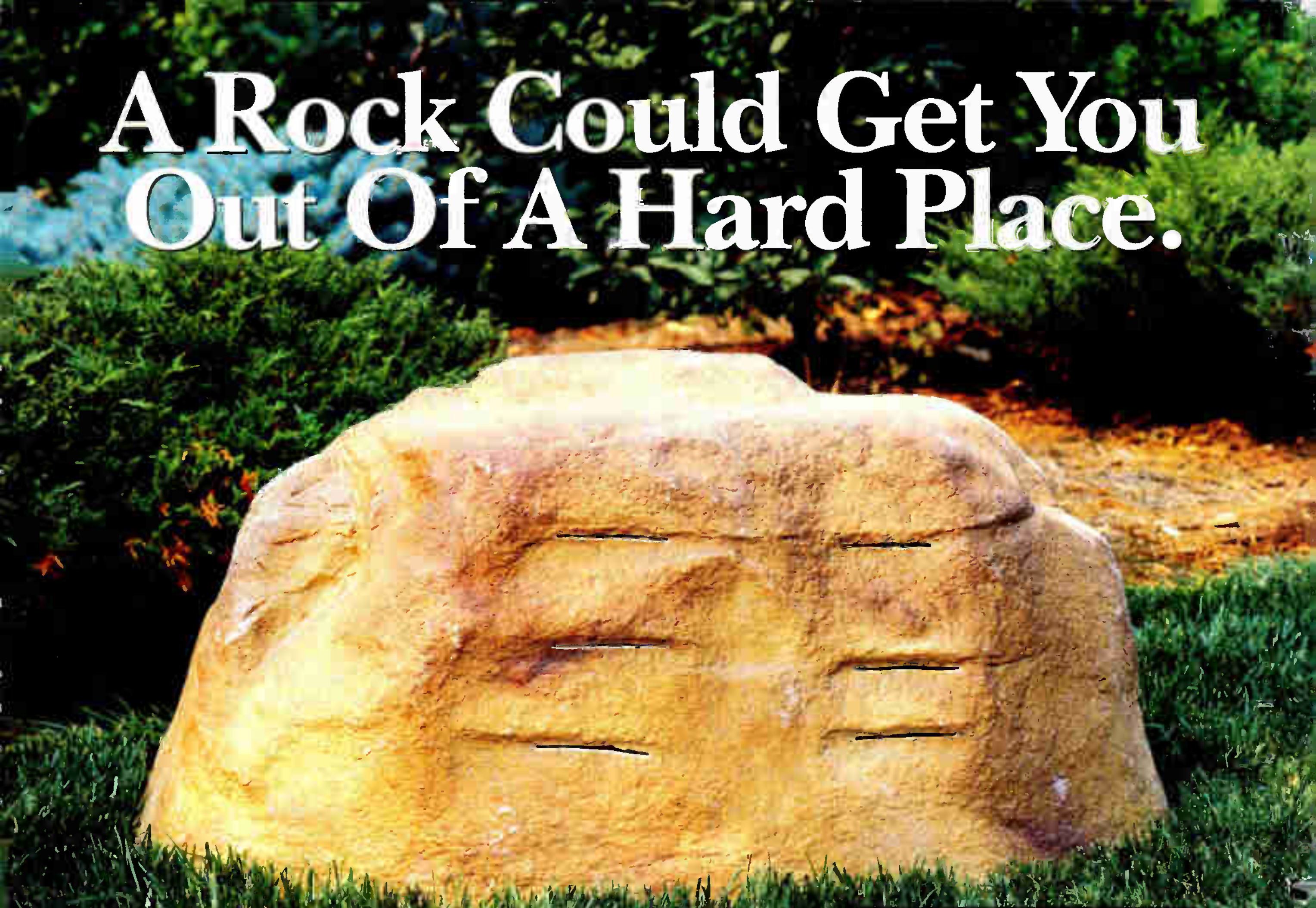
Four other innovative Expo '97 workshops are also now available on videotape from SCTE. They include *Preparing for Digital Deployment*, *Digital System Deployment and Measurements*, *Managing Your HFC Upgrade* and *Inside Wiring Options*.

The *1997Cable-Tec Expo Proceedings Manual* is also featured in our publications catalog. The two-volume set features all of the informative tutorials from the Pre-Conference Sessions, Engineering Conference and Expo Workshops. This handbook is an exciting resource filled with exclusive information on such topics as digital deployment, cable modem technology, audio issues, powering and new revenue opportunities. An introduction to our two new certification programs, set to debut this fall, also is included in this latest proceedings manual.

The all-inclusive "Basic Broadband Technology Course," is designed to advance system personnel from entry level employees to nationally certified broadband technicians. This acclaimed series includes 24 videotapes and a copy of William Grant's popular textbook, *Cable*.

The Society is striving to keep up with industry trends; as we gain more information, we pass it along to you: the people who are working hard every day to ensure that broadband telecommunications will continue to be a competitive force in the 21st century. CT

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



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