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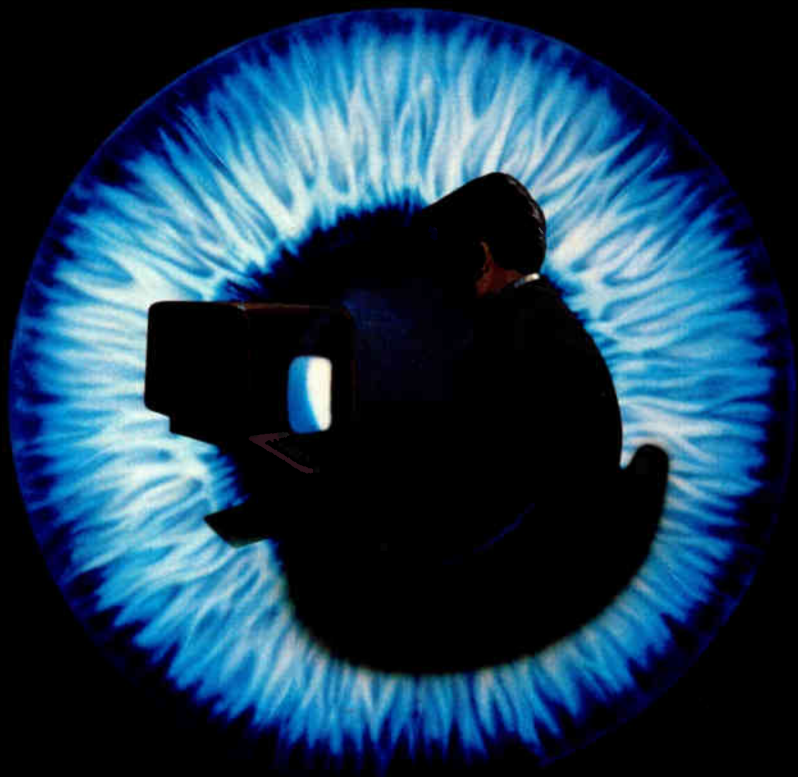

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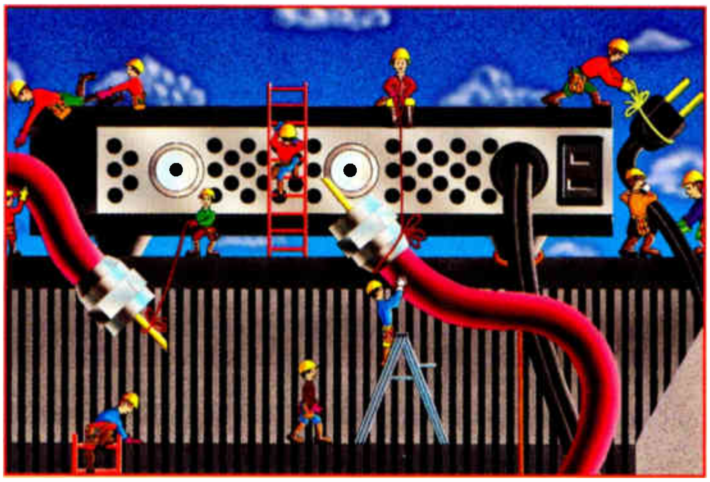
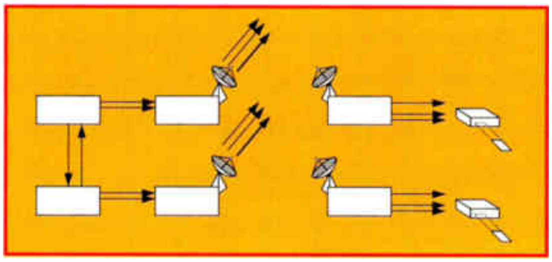
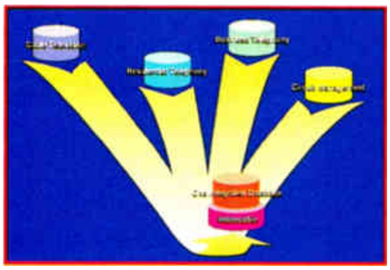

Geri Saye

Back to Basics 131



Conditional access 74



Transaction management 102

Fiber management 128

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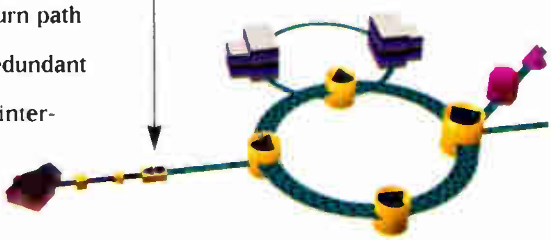

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EDITOR'S LETTER

Information superhypeway

Can we come down out of the clouds yet? For the better part of the past couple of years we have been wading through the hype of a so-called information superhighway — something that isn't even close to existing outside of the imaginations of the media and corporate PR types. I think it started a few years back as an idea of now-Vice President Al Gore, who was promoting the concept of an advanced data network linking schools, libraries, hospitals, businesses and homeowners. This soon became known as the National Information Infrastructure. The media took over from there and supernonsense seems a more appropriate description of some of the stuff this still nonexistent thing is already supposed to be able to do.

What is it?

On the surface it sounds like a great idea, but just who is going to pay the estimated $200 billion it will cost to build the required infrastructure? But before I get ahead of myself, maybe this would be a good time to define the information superhighway.

First, what it isn't: It isn't interactive video games; pay-per-view or video-on-demand movies; or on-line services such as CompuServe, America Online or Prodigy. For that matter, it also isn't the Internet.

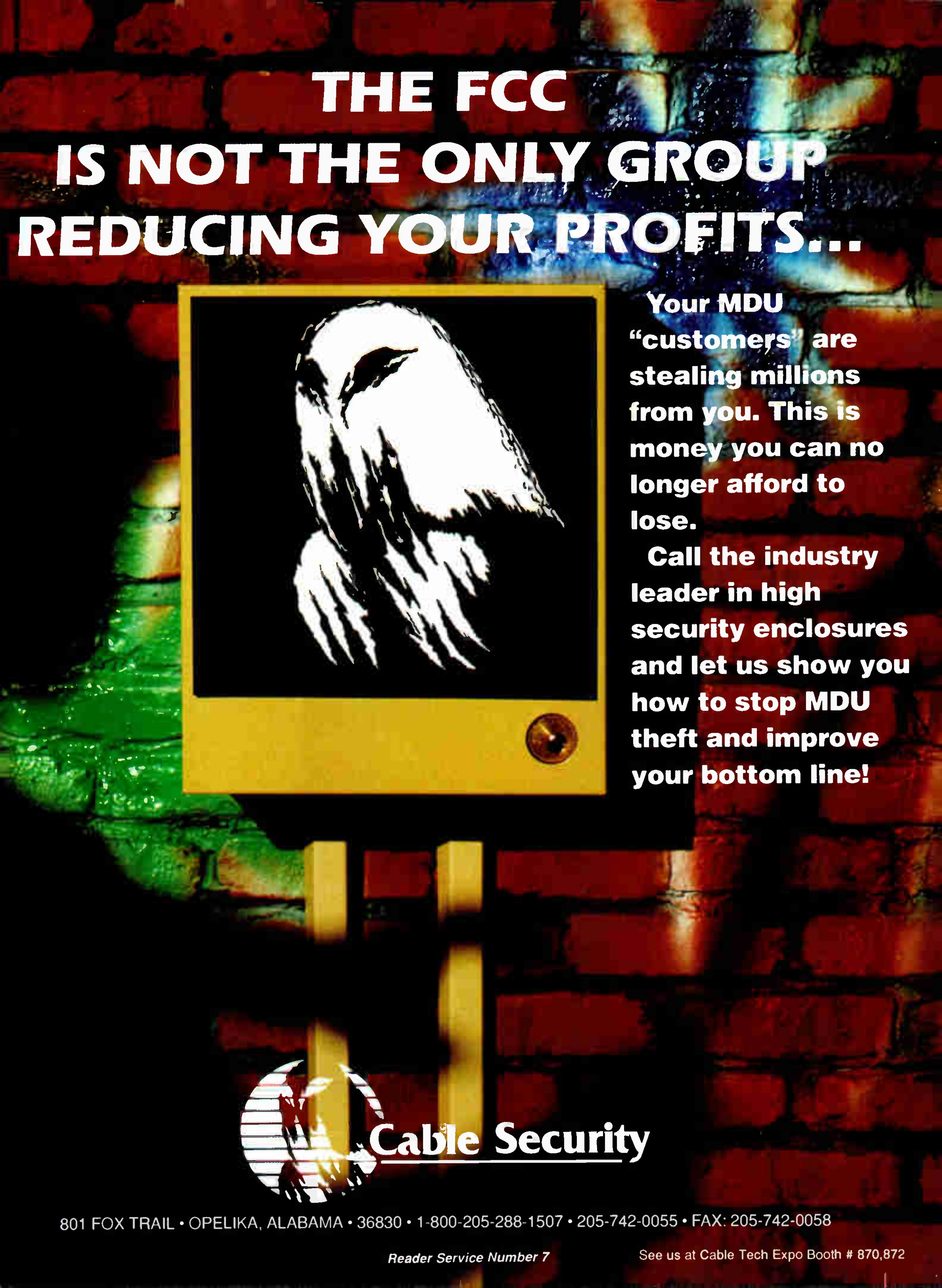
What it is, in my opinion, is simply the next generation of communications. Period. It's far too soon for anyone to try to define it any more clearly than that. And as the next generation of communications, it will be more than the wired networks of cable TV, telephone or electric utilities. It also will include wireless networks made up of satellite and over-the-air transmission.

Cost isn't the only thing bringing us back to reality. There also has to be a market for advanced communications. According to a study conducted by the research firm of Shepardson Stern & Caminsky (*Cable World*, May 9, 1994), 67% of Americans have never even heard of the National Information Infrastructure, and 49% don't think that an information superhighway should be an important government priority.

Another research firm, Odyssey, found that the market for new media is far from homogeneous (*Broadcast Engineering*, April 1994). In other words, the general public won't automatically and uniformly embrace every new media technology that comes down the road. The cable industry should know about that. We've had the ability to provide two-way communications via our networks since the early 1970s, yet a substantial market for interactive services has not developed during that time.

It's time for all of us to realize that the next generation of communications won't happen overnight. We'll get there eventually, but it will be an evolutionary process. It'll have to be driven by what the market wants and its willing to pay for, not by hype or imaginary technology promises.

Ronald J. Hranac
Senior Technical Editor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Clearing up bonding/grounding

I am writing to bring to your attention an apparent error in the article "Bonding and grounding CATV drops," which begins on page 82 in your March edition.

In the paragraph under the heading "Bonding and grounding alternatives," on page 84, and in the third paragraph from the end of the article, under the heading "Grounding only to CATV ground rod," on page 85, the authors state that Sections 250-83 and 820-40 of the NEC permit grounding only to a CATV ground rod. (The authors note under the second heading cited, but not the first, that it is a practice that is "not recommended.")

The authors' statements are misleading in two ways. First, the wording "grounding only to a CATV ground rod" does not convey the intention of the code, which is that the cable ground not be isolated but rather be bonded into a grounding electrode system.

The authors both correct and contradict themselves in the paragraphs under the heading "Ground rod to electrical power ground rod" on page 85, where they describe how the cable ground rod should be bonded to the building ground rod. As soon as you bond to another electrode, however, you are not using "only a CATV ground rod" to ground with but rather using a grounding system consisting of more than one grounding electrode as the code intended.

The other problem with the statement "Sections 250-83 and 820-40 permit grounding only to a CATV ground rod" is that it does not portray the status of ground rod usage as outlined in this section of the code. Namely, that of a ground-source of last resort, to be used only after one has exhausted the NEC's long list of other, preferable grounding sources, and found none of them available.

Section 820-40, the part of the NEC that describes how the cable drop is to be grounded, lists the following as ground sources to be used before resorting to a ground rod: 1) the building or structure grounding electrode system; 2) the grounded interior metal water piping system; 3) the power service accessible means external to enclosures; 4) the metallic power service raceway; 5) the service enclosure; 6) the grounding electrode conductor or the grounding electrode conductor metal enclosure; and 7) the grounding conductor to the grounding electrode of a building or structure disconnecting means that is grounded to an electrode.

If one cannot find any of the above, Section 820-40 recommends grounding to one of the individual electrodes described in Section 250-81. (None of which is a ground rod.) If none of those is available, the code recommends grounding to an effectively grounded metal structure.

Finally, if one has sought all the

ground sources mentioned previously and found none of them available, the code recommends that the cable be grounded to a ground rod, in accordance with Section 250-83. This ground rod, per 820-40(d), should be connected by a No. 6 or larger bonding jumper to the power grounding electrode system (not simply the electrical power ground rod, as the article implies).

However in Section 820-40(d) the NEC seems to be in contradiction with itself. It has recommended in 820-40(b) that you drive the ground rod as a last resort because a grounding electrode system was not available. Now that you have driven this ground rod, the NEC recommends that you bond it to the grounding electrode system. It would seem the code needs to clarify itself on this point.

The authors refer to Section 250-83, but do not point out that in that section it is clearly stated that use of a ground rod to provide a building or structure ground is permitted only when none of the electrodes mentioned in 250-81 is available. Section 250-81 states that any ground rods used should be bonded into the grounding electrode system.

Grounding with a ground rod alone is not permitted by the NEC. Grounding to a ground rod and bonding it to the building grounding electrode system is permitted but only in cases where none of the numerous other ground sources mentioned previous to it in Section 820-40 is available. (And, as noted above, the NEC's logic in this regard seems to be faulty.)

Having said that, I still wish that the authors of the article had described the line of reasoning that justifies driving a CATV ground rod and bonding it to a building grounding electrode when one could simply ground to the building grounding electrode or grounding electrode system. Both would be more in accordance with the NEC and safer, than in the two-ground-rods-bonded-together scenario they explain in detail. One infers from the article that it is a method without justification or recommendation, but nonetheless worthy of depiction, so that those who may wish to avail themselves of it will be doing it the right way.

Jock Crawford
Georgia Cable TV
and Communications

VDT violation: Bell Atlantic implicated

WASHINGTON, DC — The NCTA filed comments with the Federal Communications Commission (FCC) claiming Bell Atlantic has violated the video dialtone (VDT) requirements of the '34 Communications Act by constructing VDT facilities in its Dover (Tom's River), NJ, system before receiving the necessary approval from the FCC, as reported by *CableFAX*. The regional Bell operating company filed a 214 application Dec. 15, 1992.

The association's filing comes in response to recent news reports in which Bell Atlantic's Larry Plumb said substantial construction already has occurred for the Dover system. Plumb contended some fiber is installed and only electronic components need to be inserted to make the network video-ready. Furthermore, NJ-based Futurevision, which plans to compete with Adelphia by offering interactive services on Bell Atlantic's network, also is waiting for the commission's approval. The FCC's Reed Hundt recently told a House appropriations subcommittee he temporarily has reassigned two cable services bureau staff members to the common carrier bureau to help expedite VDT processing.

People's Choice TV launches in Houston

HOUSTON — People's Choice TV began offering 42 channels of cable programming, via high frequency microwaves, to most homes within a 50-mile radius of downtown Houston. The company says about 850,000-900,000 of 1.4 million households will be able to receive the service.

While the basic package of 39 channels will cost $19.75 per month, the company charges $124.95 to install the antenna on a subscriber's house. This compares with Warner Cable in Houston, which charges $22.58 per month for its comparable expanded service and $44.22 for installation of an unwired house and $23 for a home already wired. Houston is the second city where People's Choice TV is available. It is available already in Tucson, AZ, to 280,000 households, where it has 21,000 subscribers. Also, it has the rights to operate in St. Louis, Kansas City, Phoenix and Baltimore.

Jones, BCE change terms

ENGLEWOOD, CO — Jones Intercable and BCE Inc. modified the financial terms of their proposed strategic alliance, *CableFAX* reports. Jones will drop the price Canada's BCE will pay for a 30% stake in the MSO by 5%, offsetting a cash flow shortfall at Jones caused by FCC rate cuts. Under the new terms, BCE will invest $400 million, buying a 13% interest, or 2.5 million newly issued shares at $22 per share and 7.5 million shares at $27.50 per share. The new pact requires BCE to spend $261 million in two stages, plus an additional commitment of $139 million instead of $275 million in two stages under the previous plan, with an additional commitment of $125 million.

US West, Oracle expand alliance

LOS ANGELES — US West announced expanded projects with Oracle Corp. involving interactive information services for businesses, education and consumer markets. This agreement expands and accelerates an accord the companies announced last May.

In that agreement, the companies said they would integrate Oracle's information management software (including data base and messaging technology) and US West's advanced telecommunications technologies to provide low-cost information services to millions of subscribers. Since then, joint marketing and technology teams have worked on these applications for several distinct markets. The new agreement adds real-time audio and video capabilities of the Oracle Media Server to the companies' joint efforts. US West is installing the Oracle Media Server at its laboratory facilities in Boulder, CO, to define appropriate media server hardware and gateway configurations that could be used to deliver such services as movies-on-demand.

☛ Time Warner cable announced that as a result of the recent round of cable regulation instituted on March 30, 1994, it will begin a nationwide hiring freeze throughout

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Reader Service Number 25 See us at the Cable Tec Expo Booth # 503, 505 the company and cut capital expenditures by $100 million in 1994.

☛ Raychem Corp. reported eamings of $1 million (2 cents per share) for the third quarter of fiscal 1994 vs. eamings of 400,000 (1 cent per share) in the corresponding period of fiscal 1993. In other news, the company announced a joint venture with AT&T Network Cable Systems to develop and manufacture sealed cable termination blocks for sale by both companies into global telecommunications markets. Each company will maintain a 50% interest in the new entity, to be known as Access Network Technologies, to be located in Fuquay-Varina, NC.

☛ Zenith Electronics Corp. reported a $10 million improvement in operating results for first quarter 1994, compared with first quarter 1993. Total revenues in the quarter were $297 million in 1994, compared with $290 million in 1993. The first quarter 1994 net loss narrowed to $11.9 million (32 cents per share) from a first quarter 1993 net loss of $21.8 million (72 cents per share).

☛ Seagram raised its stake in Time Warner from 14.2 to 14.6%.

☛ AT&T reported a quarterly net income of $1.09 billion, a 17% jump from $936 million in 1993.

☛ Bell Atlantic reported first quarter 1994 eamings of 89 cents per share, a 17.1% increase from 76 cents per share for the same period last year.

☛ C-COR Electronics Inc. reported for the third quarter ended March 25, 1994, net income of $472,000 on sales of $17,828,000. This compares to net income of $819,000 on sales of $14,467,000 for the third quarter of the previous year.

☛ General Instrument Corp. (GI) and Motorola Inc. reached an agreement to facilitate the availability of GI's DigiCipher II digital satellite and cable TV systems, which feature digital audio coded with the Dolby AC-3 algorithm. Motorola will manufacture a stereo AC-3 decoder IC designed by GI in cooperation with Dolby Laboratories. Samples will be available in the second half of 1994. In other news, GI announced that it is working with Oracle Corp. to ensure compatibility between the Oracle Media Service and Jerrold's Linx computer-based module.

☛ PacBell reportedly will offer 70 or more channels, video-on-demand, banking, push-button shopping and video games in Santa Clara County, CA, by the end of the year. The company plans to be in as many as 490,000 households by 1996.

Membership drive winner announced

On May 2, a drawing was held at the Society of Cable Television Engineers national headquarters for the purpose of choosing a winner in its 1994 Membership Drive Contest. The contest is part of this year's celebration of the Society's 25th anniversary.

The SCTE is happy to announce that the grand prize winner is George DeVoll of Oroville, CA. DeVoll is a system engineer with Viacom Cablevision and has been a member of the Society for seven months.

Applications were included in the March and April issues of *Communications Technology* magazine, or were available by calling SCTE national headquarters' contest department. Every member who recruited a friend or co-worker into the Society's membership was eligible to win a free registration, lodging and up to $500 in travel expenses to St. Louis for Expo '94.

Twenty-two entrants responded, recruiting the following new members. SCTE welcomed the following: James Austin, Frank Brady, Mark Carangi, Phil Chafin, Rick Constanti, Stephen Cook, Tyler Coolidge, Harold Corkin, Darrell Cotner, Michael Dale, Ken Derrico, Tracy Ellenbecker, James Elliott, R. Mike Elmer, James Glover, Kevin Haire, Randy Halverson, Henry Hartman, Joe Holland, John Jamison, K.S. Lo, Dennis Lybeck, Rodney Murden, Paul Orlando, Dwight Phelps, Wilfredo Rodriguez, Bryan Saiz, Gary Schumacher, Tom Schurkamp, Robert Tucker, Paul Washburn, John Wilding, Roy Williams and Larry Young

BCT/E program endorsement update

As a proponent for the technical training of telecommunications personnel, the Society welcomes the endorsement of its Broadband Communications Technician and Engineer (BCT/E) Certification Program by important industry leaders. SCTE seeks to ensure that organizations are aware of the benefits and advantages that participation in the program will bring to their company.

A company will support the program for the following reasons: It is the only certification program in the cable industry that evaluates the technical knowledge and skills of employees; it increases the level of technical professionalism in the industry; it ensures that technical employees are qualified and are able to perform with high productivity in today's more complex technical environment; and it improves customer relations through better service due to increased knowledge and technical skills.

The following is a list of organizations that endorse the Society's Broadband Communications Technician and Engineer (BCT/E) Certification Program. Indicating their support for this industrywide program, which ensures that technical personnel are qualified and perform with high productivity, are:

- ATC
- Buckeye Cablevision Inc.
- California Cable Television Association
- Colony Communications
- Cable Telecommunications Association
- Continental Cablevision of Ohio Inc.
- FCC

→

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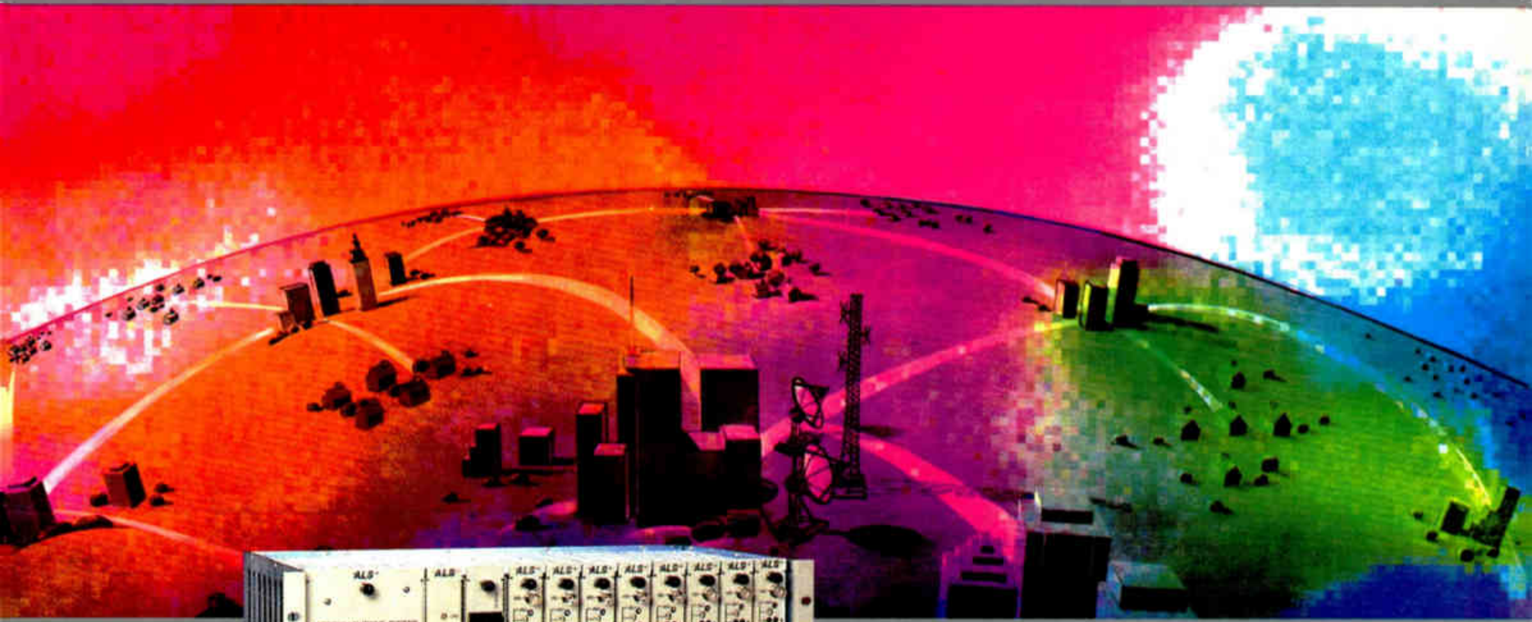

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- New Jersey Cable Television Association
- National Cable Television Association
- Oklahoma Cable Television Association
- Pennsylvania Cable Television Association
- Southern Cable Television Association
- Trilogy Communications Inc.
- Viacom Cablevision
- Women in Cable

Focus on safety and telephony

Telephone technology and safety in the CATV workplace, issues receiving a great deal of attention in the telecommunications world, were the focus of recent meetings of local SCTE chapters.

Among the topics discussed at the Greater Chicago Chapter's March 24 safety meeting were: working around high voltages, pole climbing safety and rescue techniques, and an OSHA update. Participants had the opportunity to enroll in American Red Cross Standard First Aid and CPR certification classes. "Fifteen attendees received certification in first aid and 18 attendees earned certification in CPR," reports Robert Shugarman.

In further SCTE chapter news, 51 people attended the Mount Rainier Chapter's March 24 meeting in Mercer Island, WA. "Telephone basics" was presented by Rhett Caltrider of ANTEC, who spoke on telephony applications, architectures, SONET and CISN. Bob Harris of C-COR spoke on fundamentals of fiber optics.

The SCTE New Jersey Chapter held its March 31 meeting in Wayne, NJ. Fifty-two attendees participated in a technical session focusing on telephony. David Lieberman of CAP Gemini spoke on trends and directions of cable and telephone convergence. Don Culbertson of AT&T discussed the hows and whys of telephone wiring, and Ray Kerr of Commonwealth Telephone explained cable and telephone convergence in regard to network switching.

Defensive driving was the topic at the SCTE West Virginia Mountaineer Chapter's March 22 meeting. Jim Brown and Jack Stines of Triax and Mike Prestera of the West Virginia Safety Council presented the course, which "taught attendees how to recognize and avoid accidents before they happen," reports Secretary Steven Johnson. He also reports, "There was good audience participation and 30 attendees will receive certificates of completion from the Safety Council."

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Network management for new architectures

By Guy Sucharczuk
Product Manager, Network Management Systems
Harmonic Lightwaves

Video-on-demand (VOD), interactive programming and advertising, on-line information services, and video dial-tone capabilities are just a few of the new services that will place greater demands on cable system networks. With these demands comes the need for increased system reliability, more accurate monitoring and cost-effectiveness for total system management and control.

To be competitive in the convergence universe, cable systems will need to provide their customers the same level of reliability they have come to expect from other utilities. One of the keys to accomplish this is with network management.

Need for network management

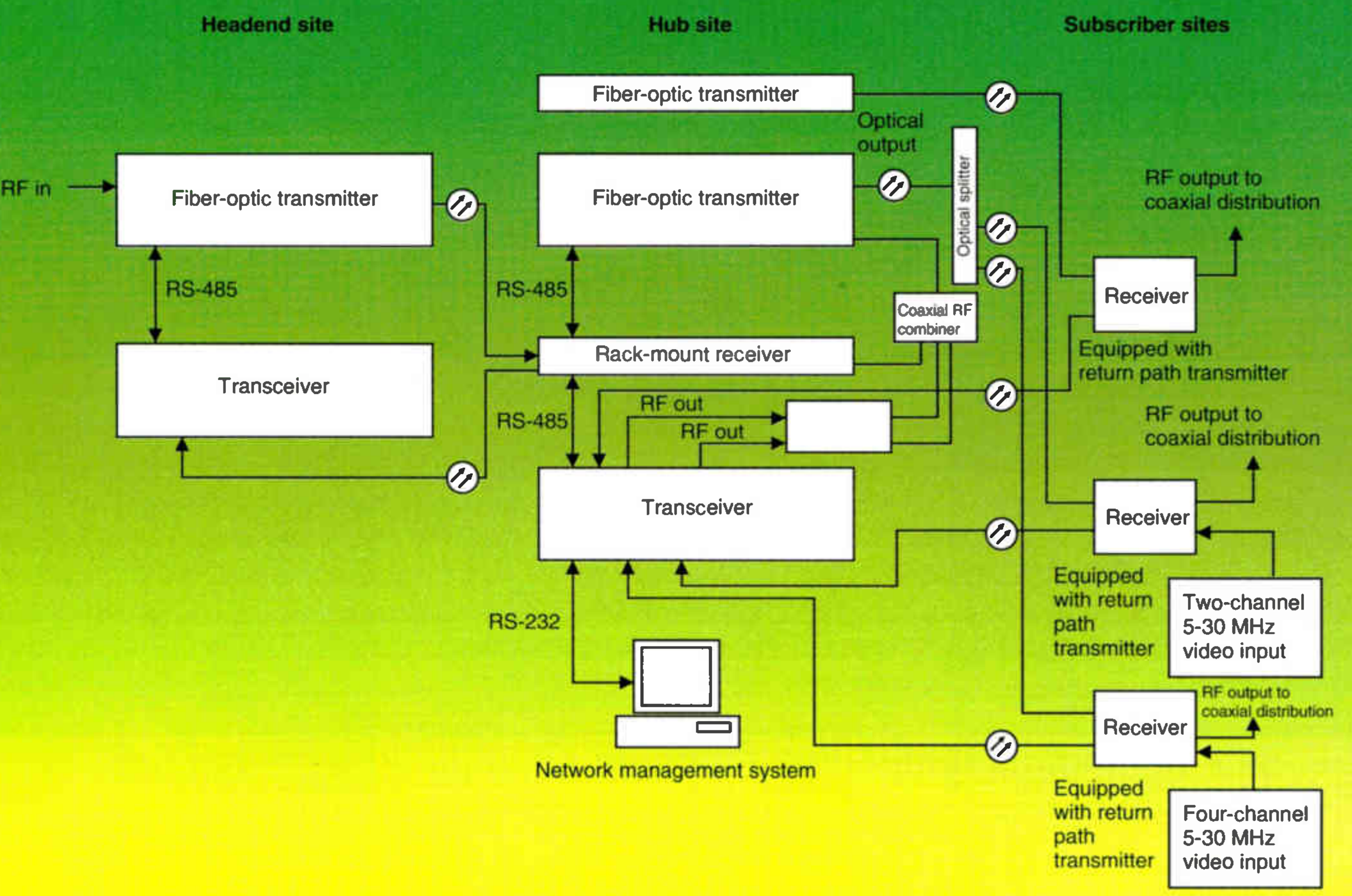
As system architectures become more fiber-enriched and fiber moves closer to the home, network management is becoming a vital part of systems operations. System designers now incorporate network management into fiber architectures, like fiber-to-the-feeder and star-star-bus, as part of the overall system design during the early planning stages. (See the figure below for typical deployment for hub configuration.)

These more complex architectures would require more manpower and time to monitor and manage if maintained by traditional methods. As well, there also are certain cost and labor inefficiencies associated with traditional methods. For example, if a problem is detected in the field, a line technician may be dispatched. However, if the line technician traces the problem back to the headend, a headend technician may need to be called in. In the meantime, the subscribers in the affected service area are experiencing a prolonged period of poor reception — or worse, no reception.

With a state-of-the-art network management system in place, an operator can monitor all parts of the network 24 hours a day, seven days a week, 365 days a year. All parameters can be checked by dialing into the field or dialing into the headend. If a problem is detected, the operator knows exactly what and where the problem is and can dispatch the appropriate personnel with the right equipment. This capability also provides performance tracking to detect potential problems before they can cause a service disruption. Network management, therefore, becomes a necessary element to ensure cost-effective operations.

The main objectives for incorporating network management

Typical deployment hub configuration



Network management software.

are to maintain quality signal delivery and never let the customer perceive an outage — in short, reliability. This is where telcos have the strongest position with customers. The telephone service companies provide an impressive 99.99% reliability rating for both residential and business traffic (not including catastrophic events such as earthquakes) according to the Alliance for Telecommunications Industry Solutions and the Network Reliability Council.

Cable customers are not yet totally convinced that their local cable systems can provide the same level of service all the time. And unlike telephony service, if a cable system experiences an outage, it is literally a very visible problem. If cable companies are going to venture into the arena of two-way communications, such as interactive and telephony services, then the level of reliability must be raised to equal telephony reliability levels as well as customer expectations. Or they risk losing large revenue opportunities.

Providing that level of reliability, however, won't be feasible unless operators first plan and design cable architectures with network management in mind. Then they must integrate network management systems that can support expansion and are compatible with the architectures.

If properly planned, operators should have the ability to detect problems earlier, track equipment performance and conduct timely and cost-effective maintenance. This will translate into less downtime and fewer service calls. It also will enable operators to make the best use of their engineering resources. Best of all, it will increase customer satisfaction.

Network management vs. status monitoring

The common methods of system management aren't keeping up with technology and are often "band-aid" solutions. In some cases, these solutions don't help identify system problems any better than a call from an unhappy subscriber.

What some operators perceive as a form of network management is, in reality, status monitoring. This often consists of: a) equipment in the headend that simply provides "on" and "off" failure indicators, which becomes inadequate as demands and equipment requirements increase; or b) technicians going into the field and taking test points at various intervals on a monthly or bimonthly basis. This procedure would be very costly and impractical if a system had to constantly monitor all the equipment by hand.

These methods often place operators in a position of providing only "demand" maintenance rather than preventive maintenance. In addition, neither method provides any measure of system management or control.

True network management, on the other hand, goes beyond status monitoring by providing both system management and control capabilities. An advanced network management system, for example, should incorporate most of the following capabilities:

- Real-time and remote monitoring of all equipment in the network, including diverse manufacturers' equipment.
- Performance level indication of individual products in the network and including indication if a housing is opened. If there is a catastrophic failure, it would trigger an alarm and provide information indicating location and type of equipment so the operator could take accurate corrective action.
- User-definable monitoring intervals and monitoring functions. An operator should have the ability to monitor multiple functions on an hourly, daily, weekly or monthly basis if required.
- Preventive system analysis that would allow tracking of performance trends. For example, laser power gradually decreases as a system ages. If the fiber-optic power is continually monitored over a period of time, the operator can anticipate the best time to repair or replace. This helps avoid replacing a product before its lifetime is over and before it completely fails, both of which can be expensive propositions.
- A user-friendly and easy to use interface. An operator should be able to receive a snapshot of the entire network in a matter of seconds. And it should be simple enough that it doesn't require an advanced engineering degree to either understand it or operate it.
- The ability to make changes at the headend to overcome some problems in the field. For example, it could enable an operator to initiate a bypass. Or as another example, it might allow the operator to increase the RF output of specific receivers to compensate for a failing amplifier or other piece of equipment for a short period until someone can be dispatched to replace it.
- Ease of installation.

Implementation considerations

As stated earlier, network management needs to be a part of the overall system design and needs to be incorporated in the early planning stages. It is not an aspect that should be considered "off-the-shelf" or a later "add-on."

Operators need to first define how they want to use a network management system and what their expectations are. Then, they need to consider the long-term impact and implications.

Then, operators should define the functions that the network management system needs to perform — all the basics and any others that are unique to the system needs. Do you need to know what the temperature is within certain equipment because the system is located in an area with temperature extremes? Do you need to know when and where tampering is occurring?

Next, operators need to be concerned about equipment compatibility. When selecting field equipment, make certain that the network management system will perform at its optimum in conjunction with it. In many cases, a system uses various types of power supplies, node monitoring devices, amplifiers and so on. It would very difficult to find out halfway through installation that it might require two different independent systems to support the network rather than one.

Evaluate the network management software as shown in the photo on this page. Is it easy to use? Can both a CSR or an en-

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Survivability: How to make your network failure-proof

By Kathy Lynch
Market Manager, Interconnect Systems

And Emmanuel Vella
Product Manager, Broadband Transmission Systems
ANTEC Corp.

Today's cable TV system operators have taken great strides forward in increasing the reliability of their networks, primarily by reducing amplifier cascades. However, as cable TV moves toward high-speed digital networks and the expanded capacity needed to handle emerging interactive services, establishing a "survivable" network will be required if cable systems hope to attract new customers for telephony and other applications.

Survivable networks mean service outages are all but eliminated, offering subscribers nearly 100% service reliability. Diverse fiber paths allow signals to be rerouted around any fiber break or equipment failure seamlessly without alerting subscribers that there was a problem. From competitive marketing and legal liability perspectives alone, a survivable network will be required for an essential "lifeline" service such as telephony.

Cable systems can build "survivability" into their networks through several key steps. First, survivability should be incorporated into the initial fiber design. Digital synchronous optical network (SONET) transmission equipment provides inherent survivability by relying on ring architectures to reroute signals through unaffected portions of the network in the event of a fiber cut or equipment failure. Opportunities to establish or provision diverse fiber paths in the distribution portion of the network also should be evaluated, whether that diversity is built into the network architecture today or in the future.

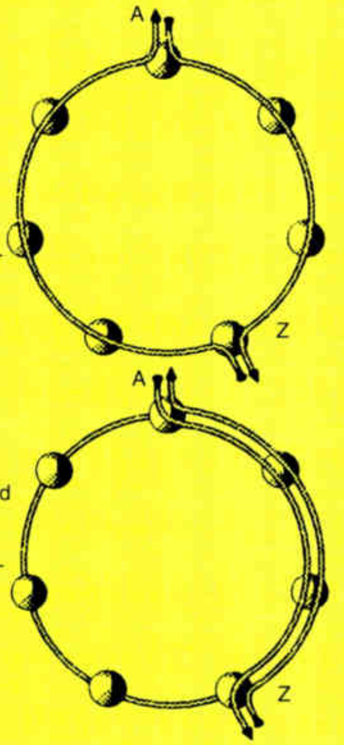
Secondly, redundant components are required to establish the survivable network. SONET equipment provides redundancy for any circuit packs of which failure would impact service. In both SONET and AM applications, headends and regional hubs should be equipped with backup transmitters and other components that can be activated in the event of an equipment failure. Many optical receivers also incorporate RF switching capabilities, allowing technicians to utilize a backup coaxial network in the event of a fiber break or other failure. Optical switching and the use of redundant fibers also enhances the reliability of the broadband plant.

Thirdly, network survivability represents a challenge to network monitoring and management. Network surveillance and remote or centralized network provisioning exist today. However, integrating all of the various operational subsystems remains under development. Ultimately, the larger, integrated umbrella operational support system will manage both the digital SONET and RF platforms, offering technicians an ability to manage the network from a central location.

Figure 1: SONET ring redundancy

Undirectional ring
- Under normal nonfailure conditions, all service traffic is carried in only one direction around the ring.
- For example, if the A->Z direction of a circuit is clockwise, the Z->A direction is also clockwise.

Bidirectional ring
- All service traffic is carried bidirectionally.
- For example, if the A->Z direction of a circuit is clockwise, the Z->A direction is counter clockwise.

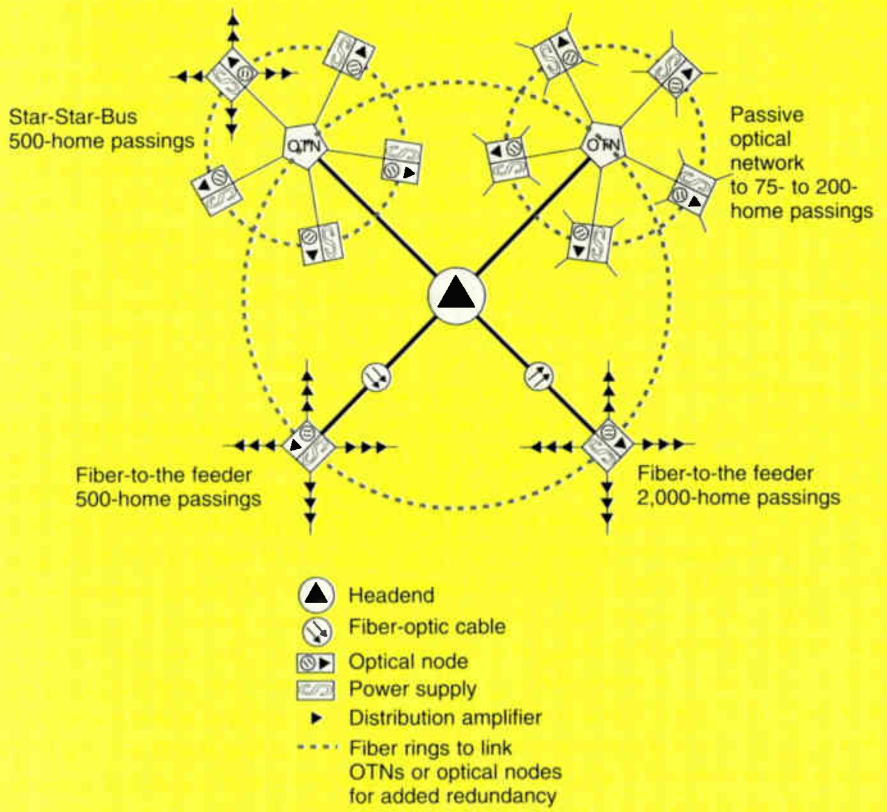


Survivability in the digital network

To evolve today's networks in preparation for new, revenue-generating opportunities, ANTEC's Cable Integrated Services Network (CISN) can provide answers. CISN relies on today's core business — entertainment video — to drive new capital investment. By leveraging the current video business to position the network to handle future interactive telecommunication applications, CISN offers incremental, cost-effective solutions that build on the network foundation already in place. While recent government regulation makes this evolution even more daunting because of reduced cash flow, the urgency to evolve today's networks continues to grow in response to new competitive threats facing the cable industry.

Today, more cable systems are evaluating and implementing digital SONET networks as a means to put a regional backbone digital network in place today. The CISN plan has embraced SONET as a standardized, highly flexible platform that can efficiently deliver video, voice, data and combinations of all three types of traffic. Traffic can be picked up and dropped off at any node within the network, allowing cable systems to take advantage of today's new business opportunities such as alternate access and regional/local advertising insertion. In addition, SONET implementation also provides a major benefit for the core entertainment video business today: economies of scale are significantly improved by consolidating headends. Following SONET installation, one or two master headends collect video information and transmit those signals

Figure 2: Redundancy in the distribution network



to each regional hub site (formerly headends). With two master headends, the system would be able to bring a secondary master site immediately into service should disaster strike at the main regional headend location.

SONET digital transmission offers several important benefits:

• Complete network redundancy for components that directly impact service delivery.

• Ring architectures ensure that the network can survive a fiber break or equipment failure without any impact to services.

• Intelligence. Network elements perform constant status monitoring and have the capability to switch traffic from service fiber to protection fiber to avert service outages.

Redundancy

SONET emerged as a set of standards that specify stringent reliability specifications of equipment manufacturers. Within any SONET-compatible equipment, multiple layers of protection are available. For example, if a transmitter, timing pack or transmission pack fails, SONET equipment automatically switches traffic to the backup component, thereby protecting service delivery. SONET also relies on primary and protection fibers for delivering digital signals to remote regional hubs. Network equipment constantly polls these signals to evaluate signal strength and clarity. Once a certain signal degradation threshold is reached on the service fiber, traffic is switched to the protection fiber.

Ring architectures

Ring architectures are second only to mesh networks in their ability to survive failures. Most current SONET implementations use two different types of ring architectures, both generally accepted by equipment manufacturers and the telecommunications industry.

Path-switched, unidirectional rings mean signals are duplicated at the master headend and fed in both directions around the ring. (See Figure 1 on page 30.) Service circuits typically take the same fiber route around the ring (e.g., clockwise) while protection fibers flow in the opposite direction (e.g. counter-

clockwise). In the event of a fiber cut or equipment failure on the service fiber, service hubs access digital signals from the protection fiber.

Line-switched, bidirectional rings allow fibers to be shared. For example, each fiber between spans carries a total of 48 time slots. Between two hubs, service runs on slots 1 to 24 of a single fiber while protection runs on slots 25 through 48. The separate return path fiber has time slots allocated in the same manner. In the event of a fiber cut or hub failure, the equipment adjacent to the break or failure initiates a "loopback" that alerts neighboring equipment of the problem. Service time slots on one fiber are now carried on the protection portion of the other fiber, thereby averting the break or equipment failure and delivering digital signals to the remote hub without interruption.

Intelligence

SONET-based equipment provides various levels of control. For example, microprocessors mounted on circuit packs monitor the transmission and timing packs and alerts the next level of performance. This second level, "line" control, manages protection switching and can automatically switch traffic from service to protection fiber as required. Line control information is then fed to another "system" level of control that develops status reports, initiates alarms, and lights circuit pack LEDs and equipment control panels accordingly to provide technicians with an easy way to locate faults.

"As part of a strategy for the future, bandwidth planning and fiber provisioning represent fundamental network foundation elements."

Protecting signal delivery to the home

Interactive services will require survivability not only in the digital network but in the residential RF distribution network as well.

The headend and regional hub

For both digital and AM applications, network survivability is enhanced by duplicating equipment at the headend or regional hub. This equipment duplication allows technicians to switch downstream traffic should a laser transmitter failure occur. Or, a single "hot standby" unit could be used to backup multiple transmitters. Choosing the hot standby method, however, depends on how quickly a piece of equipment could be replaced if the spare unit is unavailable.

RF architecture

As part of a strategy for the future, bandwidth planning and fiber provisioning represent fundamental network foundation elements. Planning for a 1 GHz bandpass, with 750 MHz actives and active sub-split return (5 to 41 MHz) is essential. At most, systems should be designed for 500-home nodes with an ability to extend fiber further in the future. As greater network reliability and less distortion to digital signals is required, the network should then be able to migrate to

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a passive coaxial architecture.

Passive architectures aid in establishing a survivable network by eliminating the possibility of service outages because of an amplifier failure. Eliminating all actives significantly reduces the distortion active devices play on digital signals, a prospect that may not be critical today but will be when more services are delivered digitally.

In addition, passive networks are limited only by the transmission, switching and terminal equipment capacity. If, for example, 1 GHz taps and passives are installed, network flexibility increases since the system will be able to provide up to 1 GHz of spectrum within the distribution portion of the network.

For most cable systems, a passive network is too cost-prohibitive to implement today. However, passive networks will ultimately be a key factor in establishing the highest level of service reliability in the distribution network. New revenue opportunities, the need for increasingly reliable services, and the lower costs of fiber and optronics will all help to drive the move toward passive architectures in the future. The important point is that network planners should provision the fiber needed to

"Planning for a 1 GHz bandpass, with 750 MHz actives and active sub-split return (5 to 41 MHz) is essential."

evolve to the passive architecture because this migration path will be crucial to system reliability and capacity in the future.

To position the cable system for a future passive architecture, planners should design the system to ultimately serve 75 to 200 homes. Once those node sizes are established, three to four fibers (one forward, one reverse and one or two backups) should be allocated from node sizes that are cost-effective to implement today. In this way, nodes can be efficiently downsized toward the passive architecture as interactive services such as telephony, require increased network reliability.

Diverse fiber routes

The next step in improving network survivability lies in establishing diverse fiber routes within the distribution network. In ANTEC's Star-Star-Bus-500 or passive optical network (PON) designs, as shown in Figure 2 (page 32), optical transition node (OTN) units act as optical repeater sites deep within the cable plant. These OTNs can be interconnected via fiber, offering the ring protection required to reroute traffic should an equipment failure or fiber break occur.

In addition, optical receiver sites can be interconnected for any installed architecture. In this case, fiber would be routed into each receiver from two different directions. Taking network survivability to this second step does, however, represent a key cost issue. In cases where route diversity is added later into the network in response to increased survivability needs, the additional cost may depend upon decisions made in the initial design. Again, it is critically important to determine how

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USA NATIONWIDE: 800-523-5947 • FAX: 215-675-7543 • WORLDWIDE: 1-215-675-2053 network rings can be established between OTNs or receiver locations when planning the network migration strategy.

Components

Optical equipment should have built-in redundancy features that provide a backup to all primary units. For example, a gateway optical receiver can provide redundant modules for the optical receiver, trunk and bridger modules, power supplies and return lasers. In the event of an equipment failure, the gateway will automatically switch traffic from primary to backup modules, without a significant impact to service. Technicians also can toggle between primary and backup fibers/components for preventive maintenance functions.

Operational support

The third issue regarding network survivability lies in the operational support function of the network. At the highest level, a fully integrated operational support system (OSS) will offer the network surveillance capability needed to monitor both the SONET and RF networks from a either a centralized or remote location.

SONET standards provide for a large amount of this operational support capability. Significant overhead is allocated for use specifically for network management functions. This functionality offers technicians an ability to achieve "visibility" of each component on the SONET network. Today, LAN interconnections are often used to obtain visibility between SONET rings. In this way, a technician can "see" each network component, monitor network performance levels, and pre- or automatically provision signal transmission via the SONET network. The system control level of network operations maintains all network provisioning information even in the event of a power surge or complete power failure.

Recent advances in network surveillance also are bringing more operational support functionality to distribution equipment. The network surveillance system built into a gateway optical receiver can allow technicians to easily switch from primary to backup components/fiber in the event of a network failure — all from the master headend. Another area receiving attention is the development of a multivendor, integrated network management platform that will allow more cohesive operational support in the RF portion of the plant.

In the future, SONET and RF surveillance systems will move toward greater integration and functionality, allowing technicians to constantly poll network components, whether those components are digital or analog devices. Network problems can then be anticipated through diagnosis, based on changes in status measured before full failure of any particular unit occurs. This will offer a more precise understanding of and ability to quickly rectify problems encountered often without the need to travel to a given piece of equipment in the field and, most often, without impacting service.

Like the network migration steps outlined earlier, the OSS will grow in a scalable, evolutionary manner. Advances in and the lower costs of computer technology will likely provide cable TV with an ability to implement its OSSs at much lower costs than the billions of dollars telephone companies have sustained over the past 30 years on its own OSS development. The CISN plan can provide an incremental, cost-effective path toward an OSS solution that will balance more complex network management needs with revenues from new services. It will be these new revenues that will help to drive the migration from today's often proprietary systems to the organizationwide, fully integrated OSS.

In summary

In making any decisions regarding survivability and how it can be implemented into the broadband network, cost-effectiveness must always be weighed against technology options. A cost-cutting measure today will not be cost-effective when it causes unacceptable reliability problems that, for example, don't support telephony services in the future.

Ring architectures, diverse fiber routes, redundant components, and comprehensive operational support are all a part of the highly reliable digital SONET network. However, those same elements will be equally important in the RF distribution network. Telephony will play the most significant role in leading cable systems to establish high survivability in their digital and distribution networks. Public acceptance of an alternative telephony provider will rely on ensuring that cable TV can meet the near 100% reliability requirements the current telephone companies already provide. **CT**

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Triway training: Learning through our sensory style

By Pam Nobles
Senior Staff Engineer/Technical Training
Jones Intercable

Would you like to deliver training programs in half the time, be more productive with less, have a high level of retention among your students, and have more fun in the classroom while avoiding the customary lecture? If you follow the principles of accelerated-learning, you can accomplish this and more.

A fresh look

Perhaps you were promoted into a position where your responsibilities included training the technical staff. Maybe you're a seasoned trainer. Whatever your comfort level with delivering training programs, read on. The purpose of this article is to help you look at the training you do in a fresh way.

Watch small children in the process of learning something new. What do they do? They use all of their senses — taste, smell and touch, as well as hearing and sight.

Then, the child goes to school. She is told, "Sit still, be quiet, don't get out of your seat."

In the typical classroom many of us participated in, the teacher's job was to fill the supposedly empty heads of the students. The teacher's message was "I am the expert, you are the empty vessel."

Over time, the child realizes that in order to succeed, she must learn to conform to this process.

This method of teaching assumes that everyone learns the same way. But this is not the case.

Language in neurolinguistic programming

"I hear ya!"

"I see what you mean!"

You've no doubt heard people use these phrases and perhaps have used them yourself. When we use certain phrases, we illustrate the senses — sight, hearing, taste, touch and smell — we prefer. This language pattern preference provides us with clues as to how we learn.

Neurolinguistic programming (NLP) is a model of human behavior and communication. The basic premise of NLP is that people perceive the world through information that is filtered through their sensory systems.

Learning through our sensory style

There are three main sensory styles that can be used to define the way we learn: visual, auditory, kinesthetic. Most people are visual, with 83% of the population preferring this style. Here's the group most likely to say "I see what you mean." About 11% are auditory learners. This group would most likely prefer talking on the telephone to a face-to-face conversation. The final 7% prefer the remaining senses: taste, touch and smell. This makes up a group known as kinesthetic. You might find this hands-on group relaxing by doing some sort of strenuous physical activity.

Use all senses

All have a preferred style in which they function, communicate and learn. However, we use all our senses to some degree when we are learning. This is why training programs and processes that allow us to use all of our senses ensure we'll learn best, as well as remember what we've learned. In addition, training programs that cover a broad range of senses ensure all learners' preferences are included.

The following illustrates how much information the typical person might retain after three days:

- 10% of what we read (visual).
- 20% of what we hear (auditory).
- 30% of what we see (visual).

• 50% of what we see and hear (visual and auditory).

• 95% of what we see, hear, say, do (visual, auditory and kinesthetic).

Know your audience

By developing training programs that include all the senses, understanding your audience's preference can further ensure a successful training experience. For example, knowing that the technicians in your training class have a propensity toward kinesthetic, you should definitely include abundant hands-on exercises in your class. Even though lecturing is the easiest way to present training, it's not always the best.

Using accelerated learning (AL) principles is one way we can use all of the senses to help our students learn. But AL is more than just that.

Learners become co-developers

The purpose of AL is to provide effective training in a short period of time. David Meier, the director of the Center for Accelerated Learning, says that the instructors, who are really facilitators, should "initiate the learning process and get out of the way." The learners become co-developers and in doing so discover they are responsible for their own learning. Methods employed are interactive and treat learning as a collaborative effort between the teacher and the student.

"Plan for all learning styles by ensuring 'the buffet table of learning' and avoid that lecture."

The basic philosophy employed in the learning environment, as reported in the article "Accelerated Learning Takes Off" (*Training & Development Journal*, January 1989) is that it:

• Be positive and accepting.

• Provide a natural, comfortable, colorful setting.

• Exalt rather than trivialize trainees.

• Help students eliminate or reduce any fears, stresses or learning barriers.

• Be supportive of both the trainer and trainee.

• Provide a multidimensional approach to learning.

• Accommodate different learning styles, speeds and needs.

• Make learning fun rather than serious and overbearing.

• Provide for group-based learning.

• Present material pictorially as well as just verbally.

Sounds good, but will this philosophy work well in teaching adults? Let's explore the answer by considering how this relates to the principles of adult learning.

Learning means a change of one's behavior, attitude and/or knowledge. This involves a reconditioning of one's self. Providing an accepting and supportive environment free of fear and stress is imperative here.

Adults learn by doing. Whatever our sensory preference, we learn and retain information by practicing skills. The multidimensional approach encourages this.

Adults learn only what they want to. There are times when we may not be interested in learning the finer points of a subject, even if it relates to our work. Participating in a training program that makes learning fun, as well as understanding the benefits, helps promote interest.

Learning is largely an emotional process. This begins with exalting rather than trivializing trainees. (How much can you learn if you are flustered or upset?) Ensuring the correct room temperature, a comfortable environment and snacks (if appropriate) all add to the students' comfort, creating agreeable emotions. If the course is more than one day long, knowing that both students and facilitator leave each night without that worn-out lecture feeling creates positive emotions and expectations for beginning the next day. The use of colors and music also can produce moods and emotions.

Learning depends on not getting the answers too soon. Students learn best when they are able to discover for themselves. Group-based learning and discussions allow this.

Each person learns in his or her own way. In AL, there are countless ways to do this. From accommodating different learning styles, speeds and needs to presenting material pictorially as well as verbally, AL is virtually "a learner's buffet of choices."

AL can be divided into four main components: preparation, presentation, practice and performance. I will briefly highlight each one. Note that all suggestions point to a successful training session.

Preparation

Before you begin your planning ask: "How would I teach this to a child?"

Preparation is where most of your work is. This process will take at least as much time, and perhaps even more, than preparing for a lecture.

Plan how you will set the environment for a positive learning experience. Write out the course objectives and what the students will learn. Prepare the benefits to the learners. An example presented in the class I attended involved having students associate with success right at the front of class by playing "pomp and circumstance" when students arrived. You can give out certificates at the beginning of class to show the confidence you have that all your students will succeed. Also keep in mind that your goal is to make the training stress-free and enjoyable for you as well as your students.

If appropriate, develop a theme such as a safari or treasure hunt to complement your course. Perhaps a cruise into the "superhighway" would fit.

Prepare a "learner prep kit." When I attended a seminar on AL my learner prep kit consisted of materials we needed for the class such as colored markers and a pictorial outline of the course (to be colored in as the class unfolded). Included was an acorn, a curious item in a training class. We used the acorn as a metaphor for the class and how it related to us in the class. For example: An acorn has a hard shell and the shell must be cracked for life to begin. Then that life needs to be nurtured so it can grow. This set the stage for my class' success. We all have within us the ability to be creative and incorporate AL techniques into our own training classes — it just needs to be let out and nurtured.

Plan the room arrangement to accommodate your activities. Do you need round tables or one long one? Avoid the classroom style for lack of something better to do. Also note that the room arrangement should be free from distractions. Avoid the break room! →

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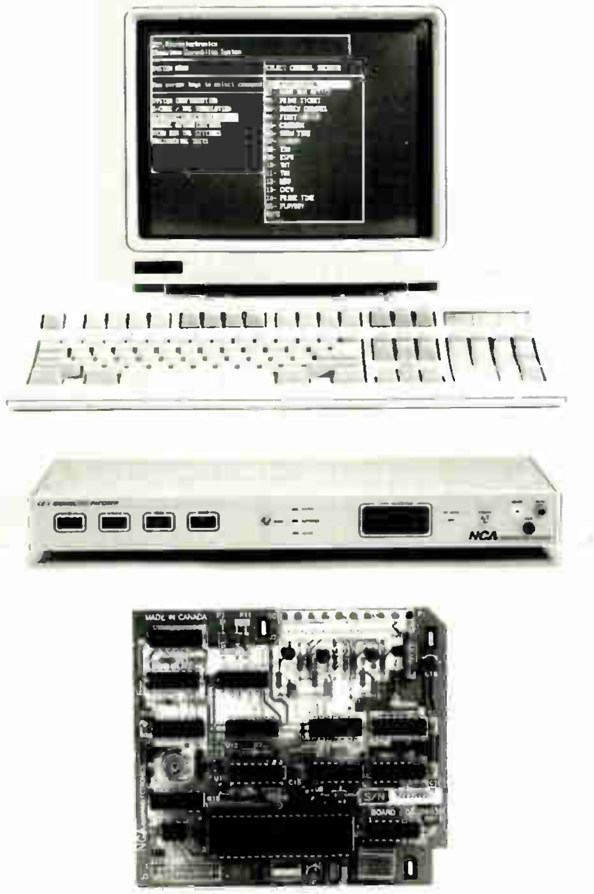

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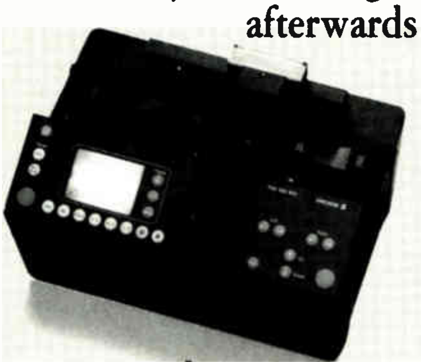

Layout any opening activities. Ice breakers are useful to help introduce the students if they don't already know each other or to help a group of business associates learn something more personal about their co-workers.

Consider the effects music may have on your topic. Music speaks to the whole person and creates or changes moods. It can be very effective when used in context.

Develop any supporting materials you'll need, such as flip charts or slides. Colors affect people in different ways, and like music, helps to create moods. Blue, for example, is the "old standard" (that's why so many slides are created with blue backgrounds). Green promotes discussion. Black and white is good for delivery of financial data.

Keep this in mind. We have so much information already bombarding our lives every day! How do we navigate through all this data? Make it light!

Presentation

David Meier says, "Keep the threat low, the energy high and trust the leaner and the learning process."

This is where you create the learning environment and begin to awaken the minds of your learners. Give your students a relationship to the topic of study. For example, if you are providing instruction on voltage detectors, ask them to provide you with an explanation of why it is important to use the voltage detector properly.

Provide the learning objectives at the beginning of class. Define learner benefits or "what's in it for me?"

Be positive! How much do you think your students would learn if you started your class with "I don't think this voltage detector training is really necessary but the Occupational Safety and Health Administration says we need to do it"? Provide positive suggestions so the learners know they will be successful. To the students it says, "You're important."

Let your students set the rules. Encourage mistakes and questions.

You may want to give your students a pretest. Studies show that giving a test before the class helps the students learn the material better. Have them work as teams on the pretest.

Training is presented in many different ways through multimedia and multisensory inputs. This includes computer-based training and interactive laser videodisc training, but it's not just computers.

Additional multisensory inputs in-

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clude learning projects, learning games, collaborative learning activities, questioning and self-discovery exercises, as well as discussion. These are all forms of "action learning." As you found out earlier, the whole body, not just the mind, is an instrument for learning. Arrange your training so that the activities are alternately active and passive for variety and a change of pace.

Act out the technology your students are learning about. Have the students become the technology. Put the technology on a big sheet of paper on the floor and walk on it. Who said you have to do all the work? Remember, the students are the experts (even if they don't know it yet.) Have students teach their peers. Get your students involved in the learning!

Practice

Now that your students have the theory, make it real. Reinforce the learning by giving your students the opportunity to hone their skills.

There are almost countless activities to do this. A few ideas include peer tutoring, team-based games, board games, self-study and role playing. Action learning here is key.

At this point you can almost sit back and watch the learning happen. Previously, fear of participation in such activities could make many a student build up a sweat. But since so much attention was given up front to being positive and accepting, providing a comfortable setting and exalting the students, you've already reduced many fears of participation.

Performance

Get your students ready for the job. Did they really get it? Bring in real-life situations to work on. Students teaching other students is very effective. Do a performance measurement. The learners come up with the instrument of evaluation. Ask your group to take five minutes to review how something could be done better. Students can perform a self-assessment or mastery demonstrations, depending on the course. Provide follow-up activities.

Does it work? Folks at Bell Atlantic's C&P Telephone Co., which serves Maryland, Virginia, West Virginia and Washington, DC, think so. In the article "Accelerated Learning Takes Off," mentioned before, Mary Jane Gill (managing director of training and education services for Bell Atlantic) and David Meier reported the following: "The training department converted two courses to the accelerated learning format. As a result, the costs of one course was reduced by 42% and the other by 57%. In addition, the satisfaction of students and trainers greatly improved, as did their job performance."

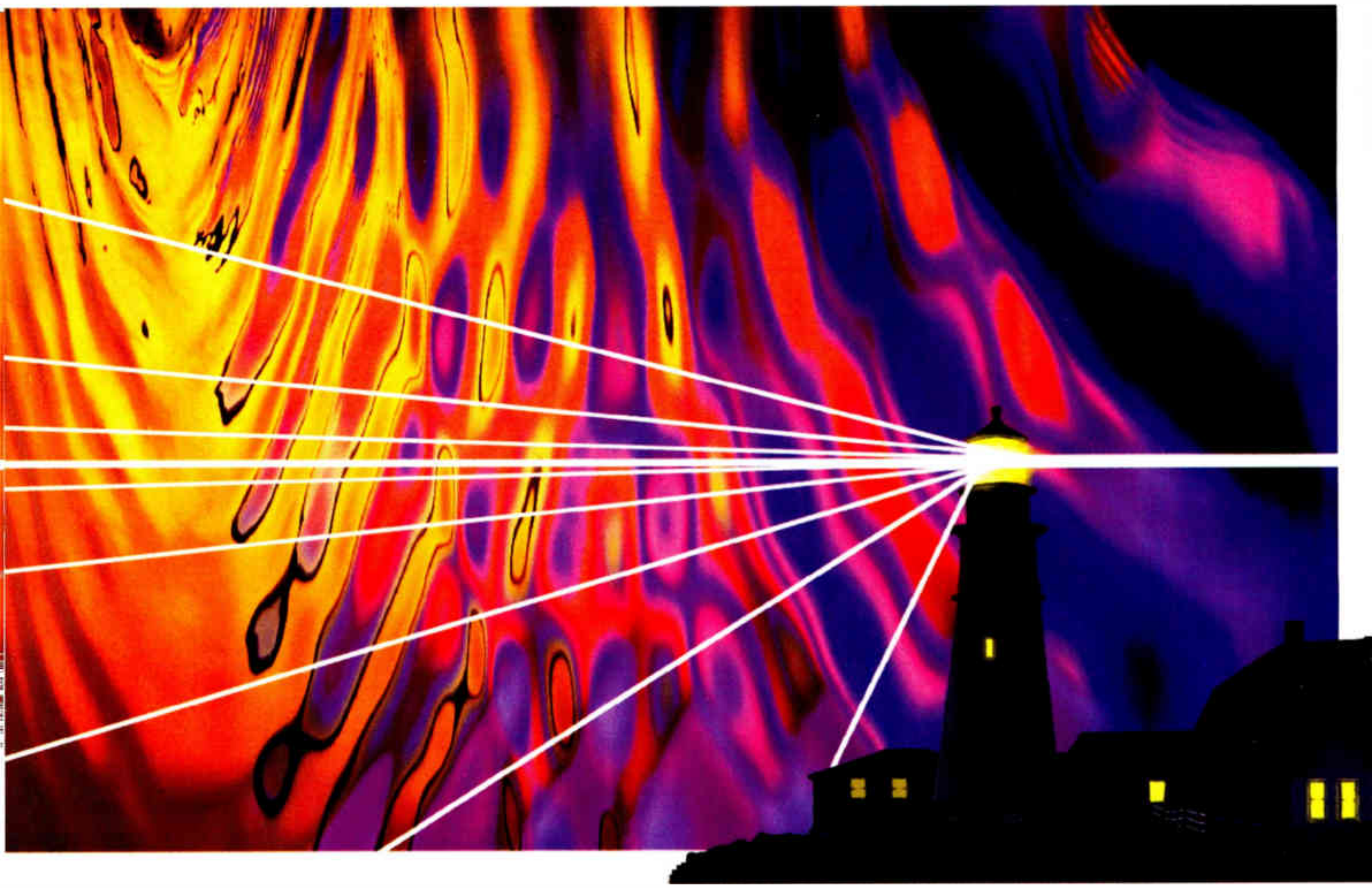
The article goes on to provide details of their achievements. It seems that Bell Atlantic has discovered a powerful tool in meeting today's challenges to do more with less.

Summary

What can we do to prepare our associates for our telecommunications future? Change is inevitable and we need to embrace it.

You can teach any kind of process with AL. Plan for all learning styles by ensuring "the buffet table of learning" and avoid that lecture. **CT**

The author would like to thank the Center for Accelerated Learning for assisting with this fresh look at training. If you'd like more information on accelerated learning, contact the Center for Accelerated Learning at (414) 248-7070.



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Video testing step by step — Part 1

The new Federal Communications Commission-required "video tests" are just a year away. Remember that systems subject to the new rules are required to pass and document the tests by July 1, 1995. This article is one approach to fulfilling the testing requirements. Part 1 covers FCC reporting requirements and baseband video basics. Following installments will detail each of the FCC-required tests, plus offer information on a few tests that may benefit picture quality and system troubleshooting.

By Jack Webb
Product Manager, Sencore

For the purposes of this article we will assume that basic instruments, such as a waveform monitor/vectorscope combination, video test signal generator and calibrated or precision demodulator are available. Their uses will be covered in context with common test procedures employed to evaluate system performance in any CATV system, including day-to-day operations, FCC proof-of-performance testing and troubleshooting.

It will become apparent that certain features of these instruments will be extremely useful in the testing process, especially to prevent interference with system operation and to minimize interpretation and calculations. Many broadcast-type instruments will fill the requirements, but care should be exercised in purchasing instrumentation designed for broadcast use to be sure that it also meets the specific needs of cable testing. Those who must purchase instrumentation should expect new products to be introduced in the near future that are designed for the cable application and are more reasonably priced and less complex since they are not burdened with features designed for broadcast applications. For simplicity, the combination waveform monitor and vectorscope will be referred to as a video signal analyzer.

The quality of the color and luminance signals for each channel can be affected by almost any single component in the CATV system; this is why the FCC requires testing from satellite receiver through to the converter for many tests. Many factors can affect the performance of these components. I will attempt to review the most common system configurations and point out the most common pitfalls.

Figure 1: TV channel

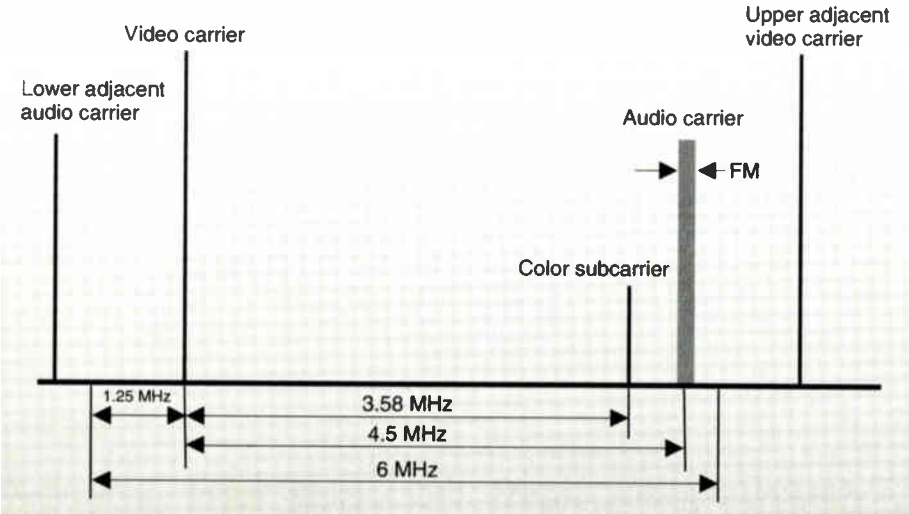
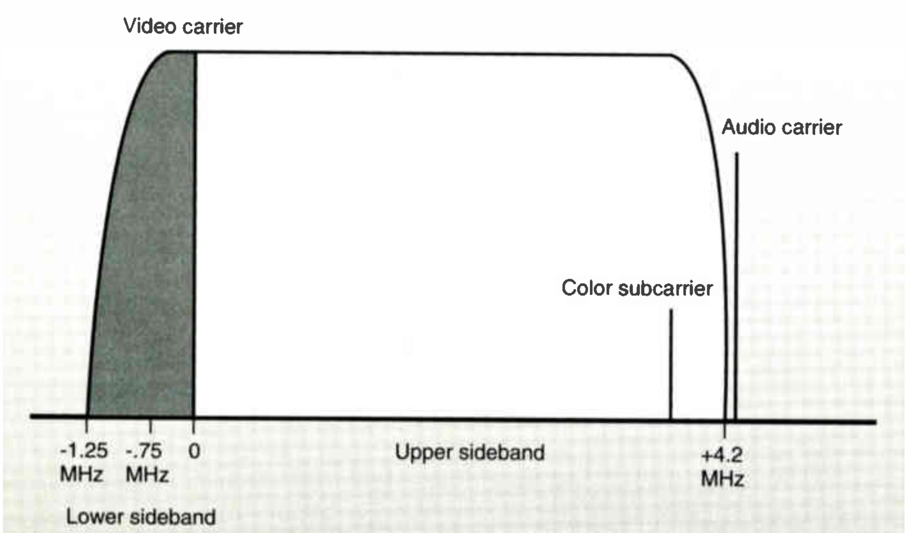


Figure 2: Vestigal modulation



FCC reporting requirements

The "color tests" become effective June 30, 1995. As of June 30, systems subject to FCC reporting must have on file passing reports. Although included here, the in-channel frequency response tests must be made in conjunction with the other semiannual FCC reports. The "color tests" and any repair or adjustment must take place prior to that date. The same rules that apply to the other FCC tests for the required number of channels tested, apply to the color tests as well. The number of channels that must be tested are listed by system bandwidth utilization in Table 1 on page 50.

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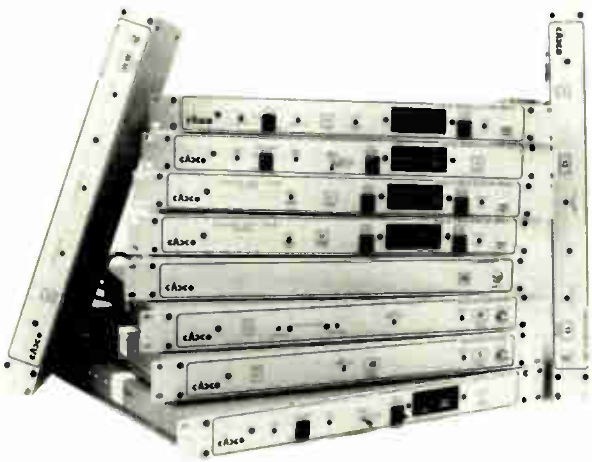

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Figure 3: FCC video/sync waveform for color transmission

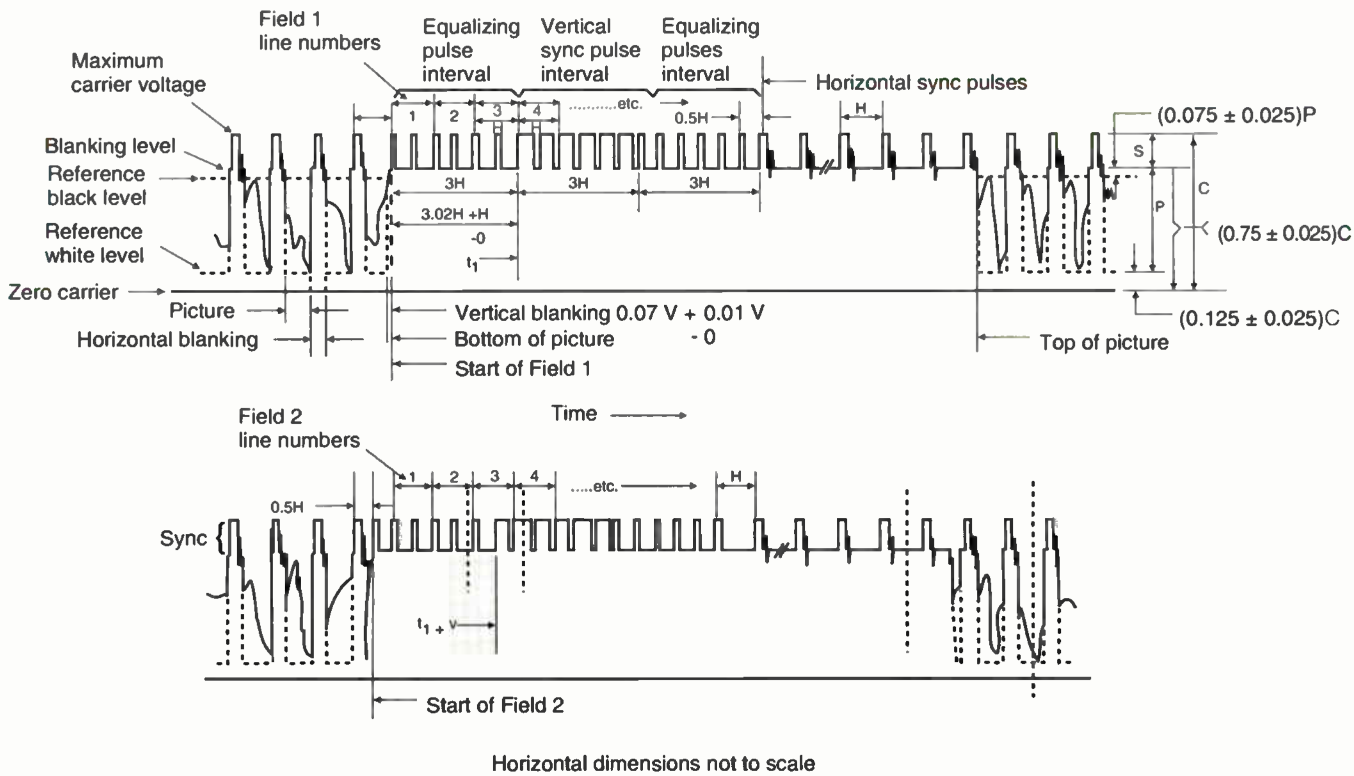

Table 1: Number of channels to test vs. bandwidth used

Number of channels to be tested	Bandwidth used (MHz)
4	Min. up to 101
5	101-216
6	217-300
7	301-400
8	401-500
9	501-600
10	601-700
11	701-800
12	801-900
13	901-1,000

+1 channel for each 100 MHz or portion thereof

required to report only a few channels, the system is responsible for all of the NTSC channels carried by the system at all times. Good engineering practice would indicate that all channels should be tested. In selecting channels to be reported to the FCC, channels representative of those used in the system must be chosen. Choose one channel of each signal processing technique used in your headend. The other test channels should be chosen based on the distribution of signal processing type. This means that you should choose channels for testing that are generated by every process in the headend. If a few processors are used, at least one processor channel should be tested, even if most channels are generated from satellite receivers/modulators.

Baseband basics

This section reviews the basic TV signal components and the common system components, their effect on the signals and some helpful hints for measuring the common baseband video signal quality.

- *The TV channel.* The standard TV channel consists of two RF carriers; the video carrier and the audio carrier. Figure 1 (page 48) shows the carrier frequency allocations within the 6 MHz channel. The audio carrier is frequency modulated and is placed 4.5 MHz above the video carrier frequency. The monoaural carrier frequency deviation is ±25 kHz and is typically operated 13 to 17 dB below the video carrier level to reduce system loading and avoid interference with the upper adjacent video signal. The video carrier is 1.25 MHz above the channel lower boundary and is vestigal sideband amplitude modulated with the luminance information up to ≈4.2 MHz. Color information is modulated on a 3.58 MHz subcarrier.
- *Video modulated carrier.* The video carrier is type M negative AM vestigal sideband. That is, all of the upper sideband and a small part, or vestige, of the lower sideband is transmitted as shown in Figure 2 on page 48. Vestigal sideband modulation creates an inequality in the frequency response of the modulated signal if a simple detector is used to demodulate the signal. The inequality of this type of modulation, when detected, is compensated by the IF filter's shape in the receiver and is a "mirror image" of the vestigal frequency response. The video baseband modulating signal ranges from near DC to 4.2 MHz and includes both the luminance and color information.
- *The video signal.* The composite video signal contains picture luminance (brightness) information, color saturation and hue information, and the sync signals required to recreate the picture line by line and frame by frame. Figure 3 illustrates the composite signal used in the NTSC system.
- *The luminance signal.* The baseband luminance signal is the portion of the video signal between 0 and 100 IRE (714 mV in a 1 V signal), which represents the picture brightness infor-

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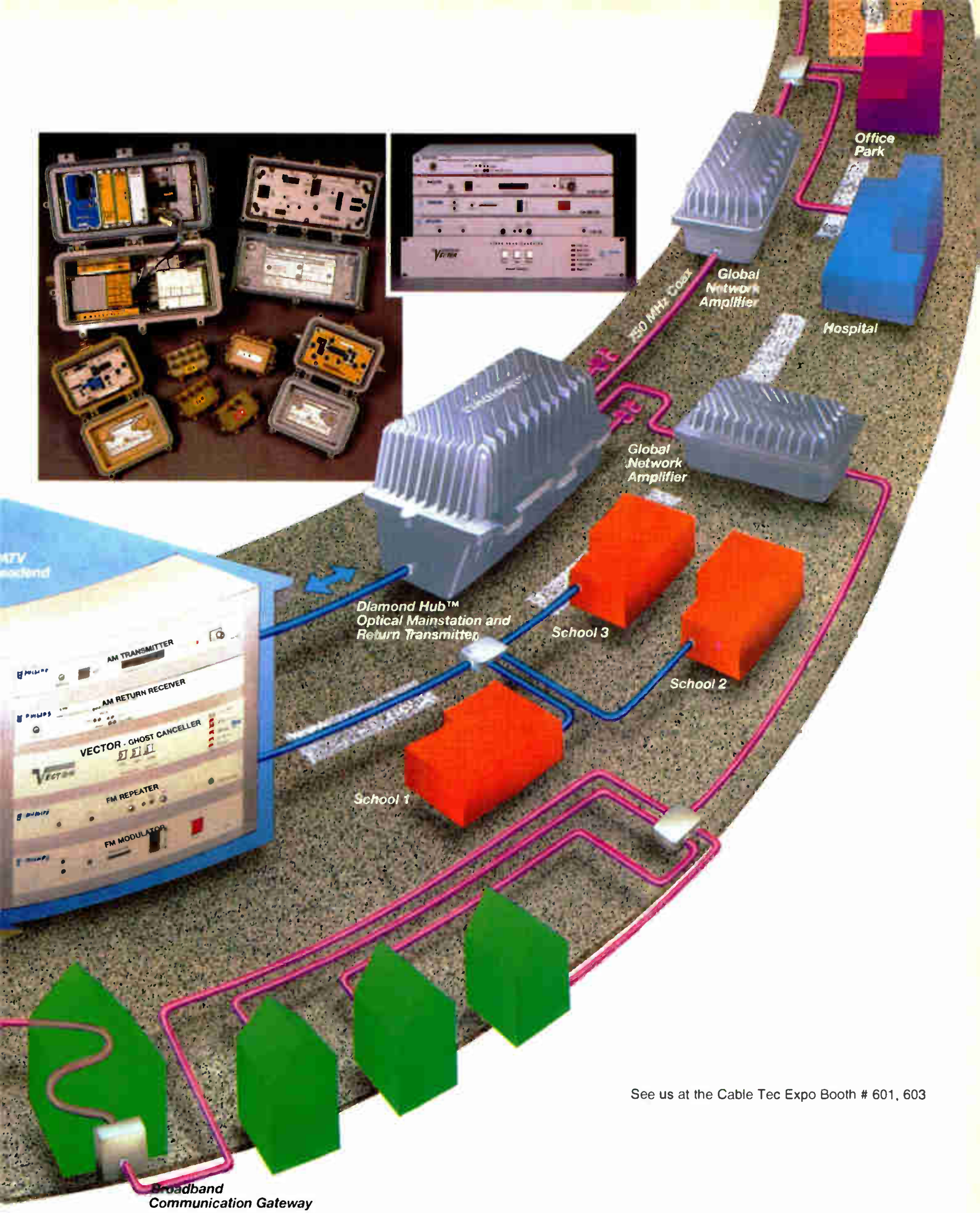

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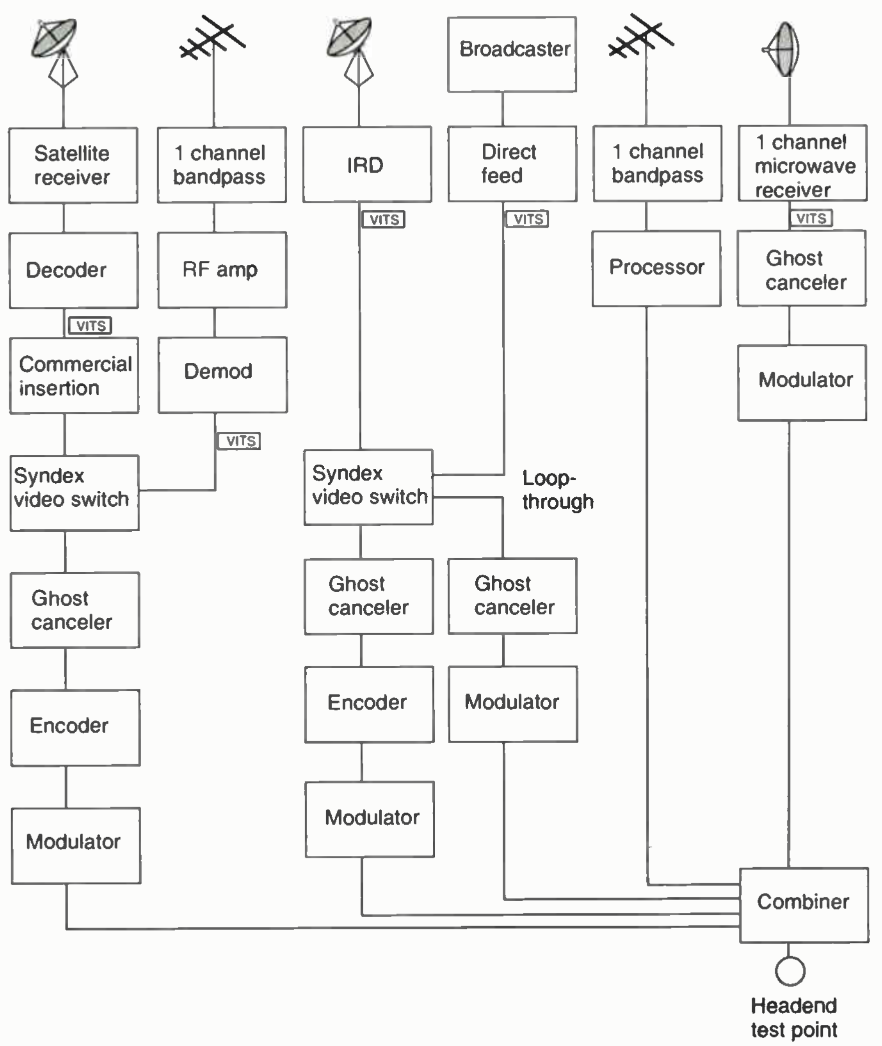
Figure 4: Typical system headend



mation as each horizontal line is scanned across the picture tube. The luminance signal is often referred to as the Y signal and in a color system, is actually made up of the brightness signals from each of the separate color signals summed together. Due to the sensitivity of the human eye the signals are not added equally, but as 59% green, 30% red and 11% blue. This "added" signal is equivalent to the former black and white luminance signal. The luminance portion of one line of video is highlighted in Figure 3 (page 50).

• *The chrominance signal.* The chrominance signal consists of two components, the B-Y or I signal and the R-Y or Q signal. While the Y or luminance signal discussed previously supplies the brightness information, the amplitude of the chrominance signal supplies the color saturation information and the phase of the chrominance signal supplies the hue information. Obviously, phase or amplitude distortions of the chrominance signal affects the color reproduction in the TV receiver.

The chroma signals modulate a 3.58 MHz carrier using quadrature amplitude modulation producing chroma sideband signals. The 3.58 MHz carrier itself is suppressed to prevent interference with the luminance signals, but a small sample or burst (≈8 to 10 cycles) of the 3.58 MHz signal is placed on the back porch of the horizontal sync to be used by the TV receiver as a reference for demodulation of the I and Q signals. The burst

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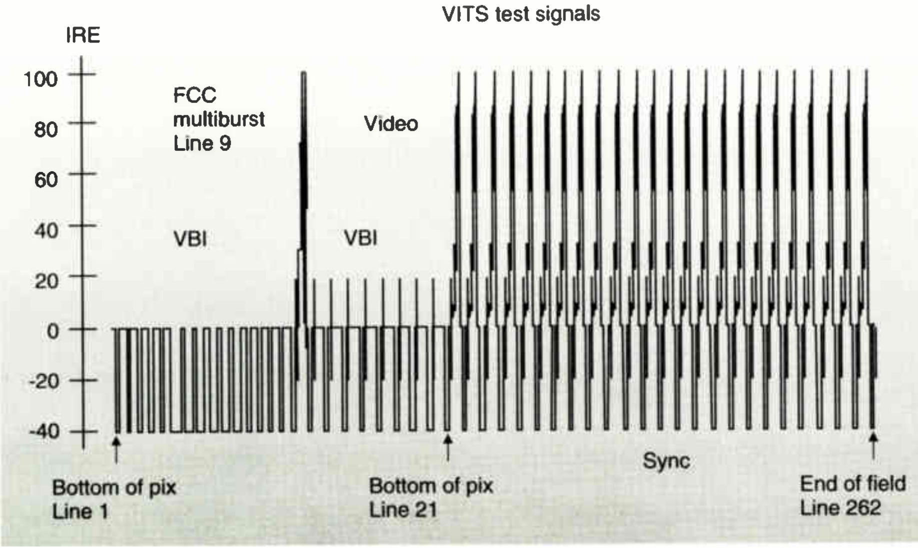
Figure 5: VITS



signal is shown in the composite video signal illustrated in Figure 3 (page 50).

• *The video bandwidth.* As previously stated, the luminance signal includes frequencies ranging from near DC to 4.2 MHz and color signals slightly above and below 3.58 MHz. Therefore all equipment that processes the composite video signal must have a sufficient bandwidth to faithfully reproduce all of the signals from near DC to 4.2 MHz without amplitude or phase distortion. High frequency roll off will reduce the clarity and fine definition of the picture.

• *Transporting video.* While not as high a frequency as the RF signals used on the distribution system, composite video signals must be considered RF and great care taken in handling the interconnection between various components in the headend or studio. Proper grounding, shielding and impedance matching are very important, just as they are to the RF signals.

• *Cables and connectors.* Grounding and shielding of the video signals and processing equipment is very important. As more video processing — in the form of commercial insertion, syndex switching and local origination — is commonly in use, the video path becomes longer and longer between satellite receiver or demodulator and the modulator. As these video paths become more complex, the importance of shielding the signal from other signals and noise becomes more and more important.

We know from our system work that an interference signal 50 dB down from the desired signal causes visible picture distortion. High-quality coaxial cable and carefully installed connectors will minimize ingress of undesired signal in the baseband video signal paths. Grounding also is important, since ground loops between equipment can

See us at the Cable Tec Expo Booth # 511, 513 exist even though they are connected by the shield of the coaxial cable. Just 10 millivolts developed across a ground between the video processing equipment and the modulator can generate 1% hum in the picture.

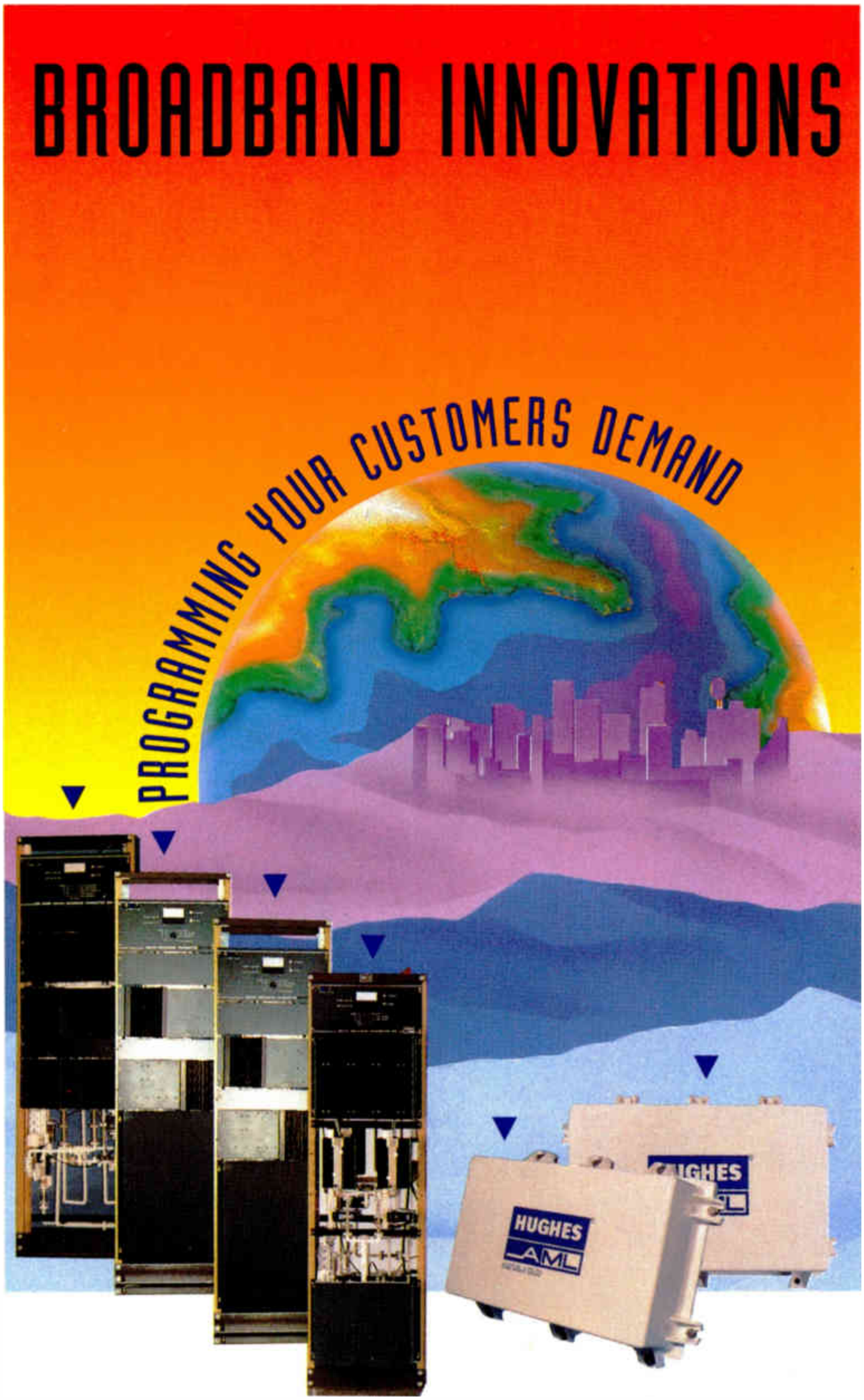
Equipment ground straps and strapping between equipment racks will reduce the possibility of hum generated in the baseband video signal processing system. Clamping circuits or DC restorers found in some equipment inputs effectively eliminate minor ground loop problems. Refer to the headend equipment operation manual for the specific equipment capabilities. It should be noted that many waveform monitors and vectorscopes have a built-in DC restore, which will prevent the user from seeing hum problems.

- *Impedance.* As with the distribution system, proper impedance matching must be maintained throughout the video path. All video equipment should be terminated in 75 ohms and be interconnected using 75 ohm cables and connectors. This is not as simple as it immediately appears. Some equipment is fixed with 75 ohm internal impedance, while other equipment has a switchable 75 ohm terminator, some will have loop-through connectors requiring an external terminator, or the equipment may be high impedance with no provision for termination. This can become confusing, but is very important.

"The quality of the color and luminance signals for each channel can be affected by almost any single component in the CATV system; this is why the FCC requires testing from satellite receiver through to the converter for many tests."

Naturally, in complex configurations two terminators are as bad as none. Check each piece of equipment or the operator's manual carefully. Without proper termination, the signal level will be too high, if unterminated, and too low if double terminated. This can severely affect the video signal-to-noise ratio (S/N) and the percent modulation, thus affecting many other elements of picture quality. This will require special care when adding test signal generators and measurement devices to the video path.

Generators are typically loop-through devices requiring the path to be interrupted. Some new generators, however, include a low-cost insertion routing device that may be left permanently installed in the video path for future use without service interruption. Measurement devices are either high impedance or switchable from high impedance to 75 ohms. High impedance devices may be connected to the video path without affecting operation. Before connecting any device, be sure it is in the high impedance mode. If a 75 ohm impedance is connected to a video path that is already properly terminated in 75 ohms, the signal level will be reduced substantially. This may reduce the percent modulation, decrease the S/N ratio and cause the operator to reset the percent modulation to a level that will result in severe overmodulation when the measurement device is re-



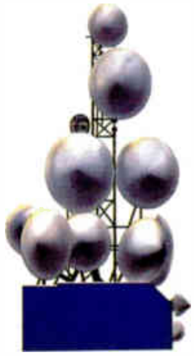


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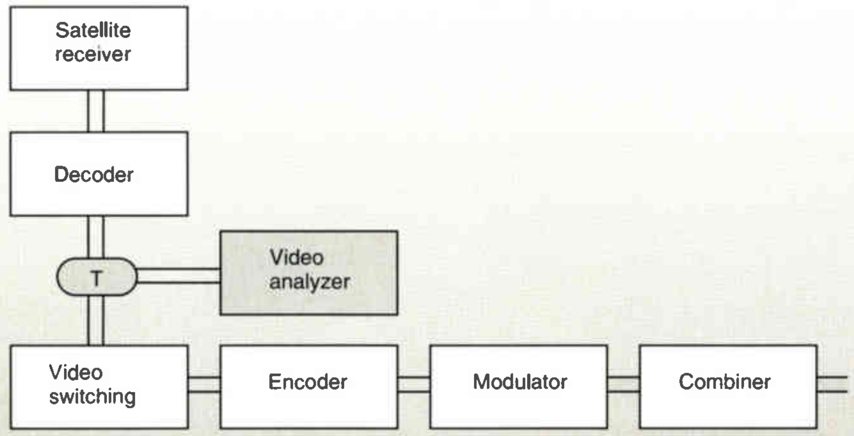
Figure 6: Establishing a reference



moved. This also can lead to severe differential gain and phase distortion.

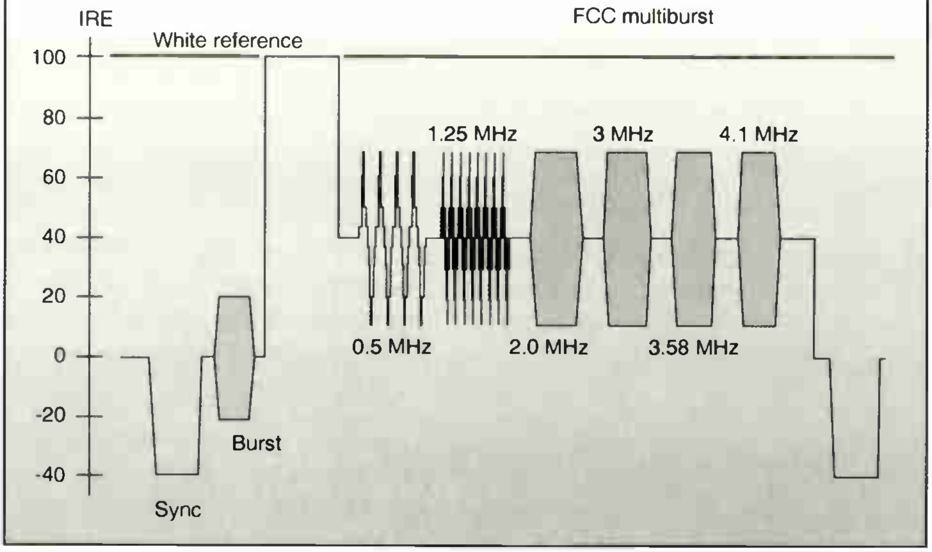
• *Typical system configuration*. Figure 4 (page 54) illustrates a portion of a typical headend. Note the various video paths that are used in different programming situations. When testing such systems, the operator should test each of the possible paths to be sure that each video source provides the required 1 V of video with acceptable noise and distortion performance. Each device in series with the video path also should be tested in all modes of operation. This includes video switches, encoders, decoders, etc.

• *VITS testing*. VITS stands for vertical interval test signals, but is often used to describe insertion of test signals and making measurements of those test signals in the vertical blanking interval (VBI). The VBI is the portion of the signal that produces the black edge at the top and bottom of the screen, in addition to blanking the beam during the time required to move the beam from the bottom back to the top of the screen. Since these lines are not viewed or a part of the active picture, additional information can be added to these lines without affecting the picture or TV receiver operation. Closed caption signals, VITS, VIRs and data signals are often added to the video signal in the VBI.

As well, many test signals, such as the FCC composite, FCC multiburst, modulated ramp, etc., can be added to the VBI and used for testing the quality of the video signal without interference with normal operation. A frame of the video signal contains two fields, the even and odd fields are interlaced to prevent flicker in the reproduction of the picture. The illustration in Figure 5 (page 56) shows one field of video with the VBI containing VITS in addition to all of the other normal video components.

Waveform monitors and vectorscopes must have a line-select feature, which permits the operator to select a single line in either field for display in order to use the VITS test signals. VITS generators also require normal sync to properly insert the test signals,

Figure 7: FCC multiburst



thus insertion can not be done on scrambled video (at least after the scrambling process).

• *Satellite receivers.* The video output of the satellite receiver is the reference point set by the FCC. From this point onward through the system the operator is responsible for most of the performance tests. Problems can occur ahead of this point — in the receiver, in the LNB, in the dish alignment or other associated hardware — that could result in poor picture quality even if the system were meeting all of the other performance specifications. This point of reference was chosen due to the difficulty and cost of the necessary instrumentation to test the performance of the microwave satellite receiving equipment. It also should be noted that the reliability and quality of modern satellite receiving equipment is generally very good.

In many cases the quality of the incoming satellite signals can be evaluated using a VITS test signal that the programmer or uplink facility has inserted for their test purposes. Using the line-select feature on the CATV video signal analyzer allows the operator to search the VBI for these test signals. The FCC composite signal will commonly be found between Lines 11 and 20.

In measuring the output of your satellite receiver, remember that you will be measuring the total noise and distortion of the programmer's video processing, distribution, uplink and satellite transponder. You should expect the performance to be roughly: 50 dB S/N, <2° differential phase distortion, <3% differential gain, < ±0.5 dB frequency response. This represents fairly good performance and is the main reason that commercial satellite receiving equipment is more expensive than typical home TVRO equipment. This performance, while good, would

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still be added to your system measurements if the programmer's VITS signals are used for testing without separate measurement at the satellite receiver output and subtraction from the total system measurements.

Be sure to measure and record the raw data for each "burst packet" when measuring frequency response, differential gain; and the phase or sign of each measurement when measuring differential phase and chroma-to-luma delay, for each packet or phase vector. Measurements are greatly simplified when local test signals are injected using a VITS insertion generator.

If the satellite receiver includes a decoder, it is called an IRD (integrated receiver/decoder). No special provision need be made for the integrated decoder, since the VITS test signal used for measurement during the VBI is unaffected by common scrambling and descrambling techniques. All types of video analyzers have difficulty in maintaining synchronous lock in the line-select mode when viewing scrambled signals. Operate the decoder in the normal mode, providing descrambled video output for measurement.

• *Scrambling decoder*. In systems that use a separate decoder, the output of the decoder may be measured just as the output of an IRD. Decoder performance is not easily measured since VITS test signal insertion is not possible on already scrambled signals. VITS signals can only be inserted in standard NTSC video. VITS generators require normal sync to properly insert the test signals.

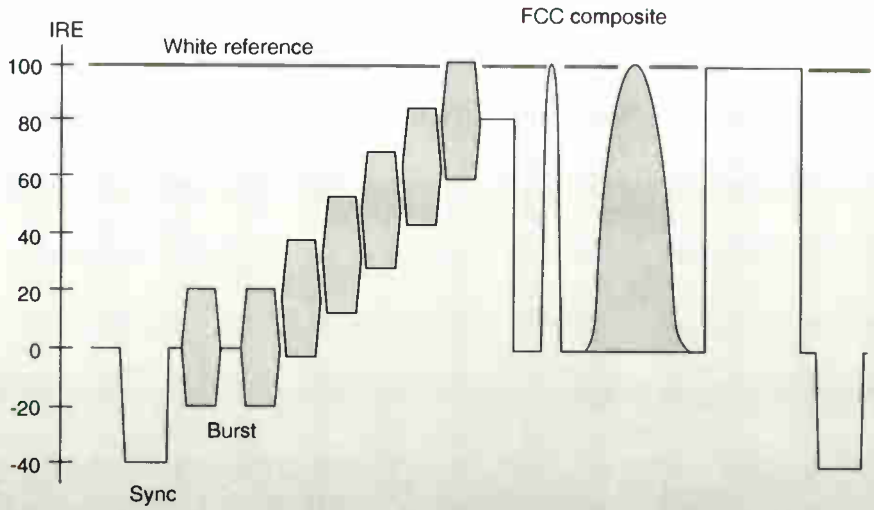
• *Commercial insertion*. Commercial insertion equipment is typically in series with the video path. The signal may be routed through a video switching circuit when commercial insertion is not in operation or the signal may be sent through a buffered unity gain amplifier. In the insertion mode more complex circuitry comes into play. If possible, testing should be performed on the video insertion equipment. When possible, test signals should be inserted at the commercial video source and measured at the combiner output test point.

• *Video switching*. Video switching is a complex subject since no two systems are alike. Here we will just say that each source should be properly set for 1 V, with the proper termination and quality cabling; each path should be tested in all modes of operation from end to end. Syndex switching is generally fairly straightforward, however, insert the VITS test signals at each video source and measure the performance at the output of the channel's modulator or headend test point, with each source, to be sure that both sources and their respective video paths are within specification.

• *Scrambling encoder*. When testing the system end-to-end the encoder will be included in the video path. Demodulators and measurement devices will not sync to the scrambled signal and therefore, not provide proper measurements. For the video signal analyzer to sync to the video input signal and allow use of the line-select function to measure VITS test signals in the VBI, turn off the encoder scrambling or use a characterized demodulator with decoding capability.

• *Modulators*. The modulator is one of the most likely sources of video distortion. Overmodulation will cause severe differential gain and differential phase distortions and

Figure 8: FCC composite



make accurate chroma-to-luma delay measurements impossible. When testing the modulator or making system end-to-end tests, a demodulator must be used. The demodulator is another device likely to create performance problems, thus a precision demodulator or a calibrated demodulator must be used. Remember that if a calibrated demodulator is to be used, the individual measurements of each modulated packet of the multiburst and each amplitude and phase measurement of the burst packets in the modulated stair step test signal must be used in the final calculations.

- *Signal processors*. Signal processors represent a special challenge. Because the input to the processor is RF, VITS insertion is difficult. If the programmer supplies an FCC composite test signal in the VBI, it can be used with fairly good confidence since most broadcast performance specifications are well inside the performance that could be achieved by demodulating the incoming RF signal, adding the test signal and remodulating the signal for injection into the processor. (*Editor's note: Multipath or other problems can render the broadcaster's VITS unusable.*)

If no VITS test signal is provided by the programmer, the best approach is to temporarily take the channel out of service or temporarily replace the processor to maintain service. With the processor out of service use a characterized modulator with the test signals as the video source to produce the required processor RF input. This test setup can be characterized simply by tuning the precision demodulator to the modulator output and noting each of the individual measurements of gain and phase of each modulated packet

Table 2: Data generated when measuring frequency response using FCC multiburst test signal

	Satellite receiver	Combiner	Actual Delta	dB Delta
Packet A	63 IRE	68 IRE	+5 IRE	+0.66 dB
Packet B	62 IRE	60 IRE	-2 IRE	-0.28 dB
Packet C	62 IRE	65 IRE	+3 IRE	+0.41 dB
Packet D	55 IRE	59 IRE	+4 IRE	+0.61 dB
Packet E	49 IRE	42 IRE	-7 IRE	-1.34 dB

of the multiburst and modulated stair step test signals, being sure to keep the sign of each correct.

- *Interdiction systems.* Any interdiction system operating at the headend will have to be turned off during all of the measurements taken after the signals are combined for distribution. The interfering carrier would prevent the CATV video analyzer from locking on the proper line and also would interfere with the desired measurements since the interfering signal occupies the same frequency as the video information we are attempting to measure. Be sure to turn off any pre-emphasis circuitry that may be part of the interfering carrier encoder.

- *Traps and filters.* Traps or filters used in the headend to eliminate undesired signals — such as TI, strong off-air channels, FM signals, etc. — may cause phase distortions or chroma-to-luma delay problems. Consult the trap or filter specification sheet vs. actual performance to be sure that your filters are acceptable for the application. Without more sophisticated instruments it is impossible to test individual RF and microwave components for phase and group delay distortions.

- *Relative measurements.* VITS signals injected by the programmer and measured at the satellite receiver output can be used to measure the noise and distortion of any component in the delivery system by making reference measurements that can be subtracted from the overall system performance. Frequency response, differential gain and differential phase reference measurements require individual manual measurement so that the true results are obtained when the reference measurement is subtracted from the total measurement. A typical instrument configuration is illustrated in Figure 6 (page 60).

When measuring the frequency response of a channel using the FCC multiburst signals, samples typically called "packets" are individually compared for amplitude. Each frequency packet should be measured and its peak-to-peak amplitude noted. This must be done because the system frequency response will likely have a different signature than the point where the reference is taken. Thus, the worst case in each system will not occur at the same packet or frequency. In fact, a low gain response may occur at the reference point while an excess gain situation may occur in the system under test. For example, if the reference is 0.5 dB low at the 2 MHz packet and measures 2.0 dB high when the total system is measured, the system response is actually 2.5 dB and does not meet the requirements.

When measuring the frequency response using the FCC multiburst test signal the data shown in Table 2 should be generated. In this table, dB Delta is calculated by:

20log(Combiner level/Sat. rec. level) =

20log(68/63) = +0.66 dB

The "actual Delta" calculations must be used in measuring the in-channel frequency response (FR) of the system between the satellite receiver and the combiner. Note that if the raw combiner reading were used the flatness would be:

FR = 1/2 x 20log(68/42) = ±2.1 dB

since 68 IRE is the largest packet and 42 IRE is the lowest packet. The ±2.1 dB is not the system frequency response, but the total of the system and the uplink and downlink. If the reference at the satellite receiver is used, then the maximum positive and

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negative deviation for each step, from reference to the test point, must be used to calculate the frequency response.

FR = 1/2 x [20log(68/63) - 20log(42/49)]

= ±1.0 dB

or

FR = 1/2 x [Positive error (dB) - Negative error (dB)]

Similarly, when measuring differential gain each packet, at its individual luminance level, must be measured and individually compared to the total system response. Differential phase similarly must be measured at each luminance level and compared to the total, being sure to keep track of the sign of the vectors when subtracting the reference.

When measuring the chroma-to-luma delay, the subtraction of the reference can done with the actual measured delay, paying attention to the sign of each since both leading and lagging situations may occur at any point in the system.

This is not intended to be a complete guide to video testing, only some key basics. Much more information is available on video system operation and troubleshooting. Consult the SCTE or NCTA recommended practices for further information or training. It is always a good practice to become familiar with the equipment in your headend and to keep the operation manual for each piece of equipment used in the headend handy for reference.

- *Test signals.* The FCC multiburst and FCC composite are the recommended test signals for making all of the cable TV FCC baseband video measurements. Complete testing can be accomplished by inserting both of these signals in a channel's VBI. Newer CATV VITS generators are available that insert two signals simultaneously on user-selected lines. The FCC multiburst is shown in Figure 7 (page 62). The FCC composite is shown in Figure 8 on page 68. (Each test signal will reviewed in a later installment on each of the FCC required tests.)

"You should note that while you are required to report only a few channels, the system is responsible for all of the NTSC channels carried by the system at all times."

The FCC multiburst is used to measure the frequency response of video equipment. It may be used full field or as a VITS. The FCC multiburst contains: normal sync, a 40 IRE pp burst signal, a white reference level that reaches 100 IRE and six equal amplitude (60 IRE) "packets" of video at six incremental frequencies. The frequencies may vary slightly from one generator to another, but typically will be: 0.5 MHz, 1.25 MHz, 2.0 MHz, 3.58 MHz and 4.1 MHz. Measuring the relative changes of each of these packets, as the signal is processed through the system, will result in the frequency response characteristic of the system.

The FCC composite signal shown in Figure 8 (page 68) is used to measure differential gain, differential phase, chroma-to-luma delay and other tests described in a future installment of this article. The FCC composite signal contains: normal sync; a 40 IRE pp burst signal; six stair steps, each ≈16 IRE, modulated with 40 IRE of burst; a 100 IRE amplitude 2T luminance pulse; a 100 IRE 12.5T sine-squared pulse modulated with burst; and a 100 IRE white reference pulse. The amplitude of the burst signals in the stair step can be compared for differential gain measurements. The phase of each step can be compared to measure differential phase. The 2T pulse can be used to detect gain/frequency distortions and group delay. The 12.5T modulated sine-squared pulse may be used to measure chroma-to-luma delay and gain distortions. The white reference bar may be used to measure line time, gain/frequency distortions and group delay. **CT**

Author's note: The information contained in this article is considered to be accurate, but does not represent a legal recommendation or complete interpretation of the FCC rules. A copy of the FCC rules Part 76.605 can be obtained from the NCTA along with additional information and recommendations on filing the FCC reports. SCTE is also a good resource of further information and instruction on performing the required tests.

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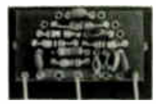

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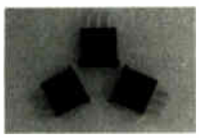

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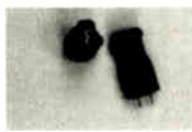

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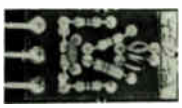

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Reader Service Number 68

Methodologies for multiple conditional access technologies in digital delivery systems

The following is adapted from "CCTA Technical Papers '94" with permission of the Canadian Cable Television Association.

By Tony Wechselberger
Executive Vice President

And George Parkanyi
Technical Marketing Consultant
TV/COM International

The quest for "open architecture" digital video compression (DVC) systems has led to many efforts toward putting standards (either formal or defacto) into practice. Most noteworthy are the organized efforts of Advanced Broadcasting Systems of Canada (ABSOC), the Digital Video Broadcast (DVB) group in Europe, and the National Renewable Security Standards Committee (NRSSC) in the United States, who have each united various interest groups to study, define and adopt comprehensive guidelines for digital compression delivery in their respective markets.

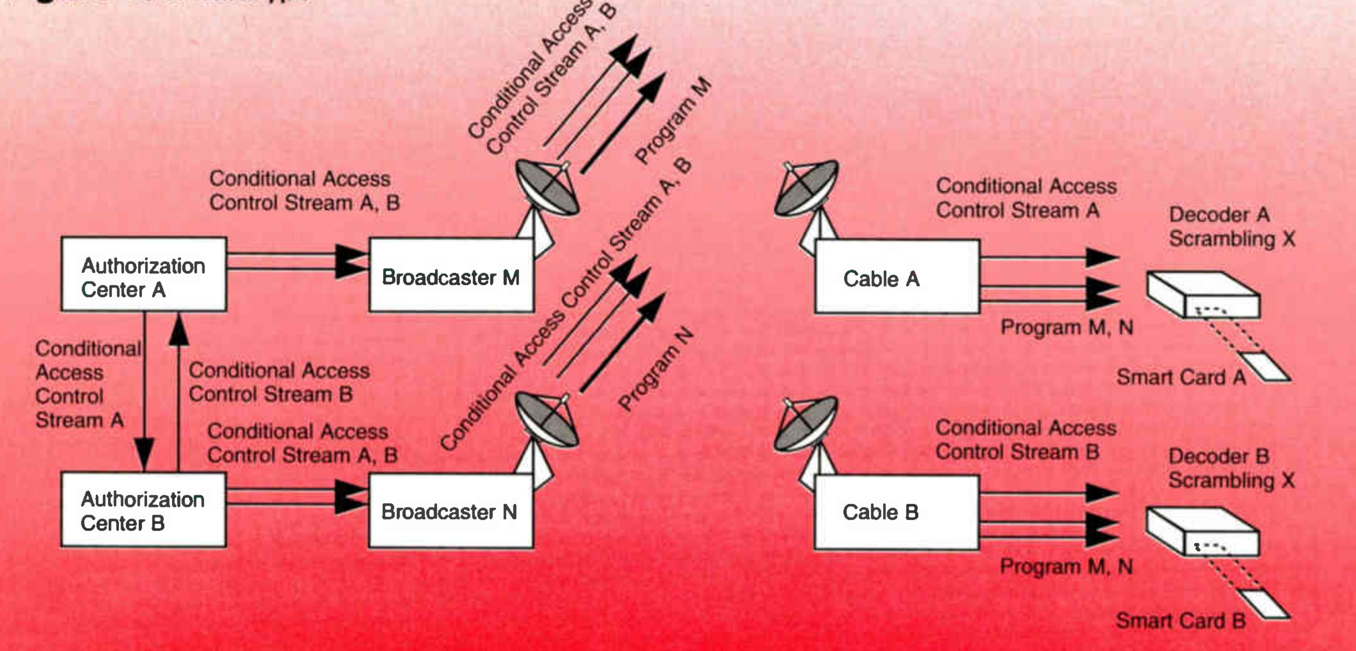
One of the most challenging areas continues to be conditional access, where "standardization" and "security" have traditionally been considered contradictory pursuits. But conditional access is multifaceted, having various functions that perform at different levels to realize a harmonious overlay to the distribution system. At some of these technical levels, opportunities exist to standardize certain functions so that multiple conditional access capabilities can be employed on the same system.

This article will look at the multiple conditional access problem, describing various approaches and trade-offs surrounding system design and set-top requirements.

As DVC development continues, the pressure is mounting for transmission standards and interoperability. There is a strong impetus for maintaining flexible, simple commercial and consumer decoders while minimizing the cost. Multiple compression, conditional access and encryption systems are emerging. Consequently, there lies the threat of programming being segmented such that cable operators are faced with dealing with more than one type of decoder or one vendor or group emerging to become the defacto standard and dominating a given market. Neither of these conditions is desirable and the marketplace does not want this.

Through MPEG-2, the International Organization for Standardization (ISO) has created a standard for compression and transport (programming distribution) functions. The Digital Video Broadcast group in Europe has gone further and agreed on standardized transmission functions. Conditional access and encryption, if also standardized to a certain level, could allow one

Figure 1: SimulCrypt



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"generic" decoder to give the subscriber access to programming controlled by multiple authorization centers that have fundamentally different conditional access system architectures. Proprietary functions would be in an insertible smart card or detachable module.

Standardizing authorization and encryption is like mating a lion with an elephant, with any progress accompanied by a great deal of roaring and trumpeting. There are strong opposing camps. One wants to standardize, while the other insists that standardization by its nature compromises security.

Within the standardization camp itself, two preferred end-to-end technical alternatives are emerging — each with its own following. Another alternative addresses more the decoupling of satellite and cable delivery systems, each with its own conditional access. The discussion to follow gives the benefit of doubt to the standardizers. On the methods and the issues — you be the judge.

Current developments

The evolution of digital video compression overall is moving along but still faces significant issues. MPEG-2 is mostly accepted, but where control over authorization is concerned, the interplay between broadcasters, cable companies, satellite operators, telephone companies and regulators to date has mostly resulted in agreements to disagree. Therefore, there is mounting pressure on system vendors to provide the technical flexibility to accommodate multiple conditional access systems.

ABSOC in Canada has approached the DVC and conditional access vendors, encouraging action in this area. There has been some success, with certain compression manufacturers and conditional access service providers talking and exchanging implementation concepts. To date, at least one dual conditional access scheme involving a compression vendor and an independent authorization system vendor has been deemed technically feasible and has been jointly bid in this marketplace. Getting the compression manufacturers together has been more colorful. But not to worry, we can be bludgeoned.

In the United States, the Electronics Industry Association and the National Cable Television Association have formed the NRSSC to explore providing a conditional access standard for consumer electronics. The NRSSC is looking at a degree of standardization that pushes the limits of smart card technology in terms of memory and processing power. One of the options they are looking at is to put the complete conditional access subsystem, including descrambling, in a wholly contained, replaceable module.

In Europe, the Digital Video Broadcast group has mandated the Conditional Access Specialists Group (CASG) with evaluating the two multiple conditional access schemes described later, among others. There has already been some progress, with the CASG agreeing to accept its Crypto Experts Group's recommendation for a common scrambling algorithm once technical evaluations have been completed.

Definitions

At this point it may be useful to define some of the terms.

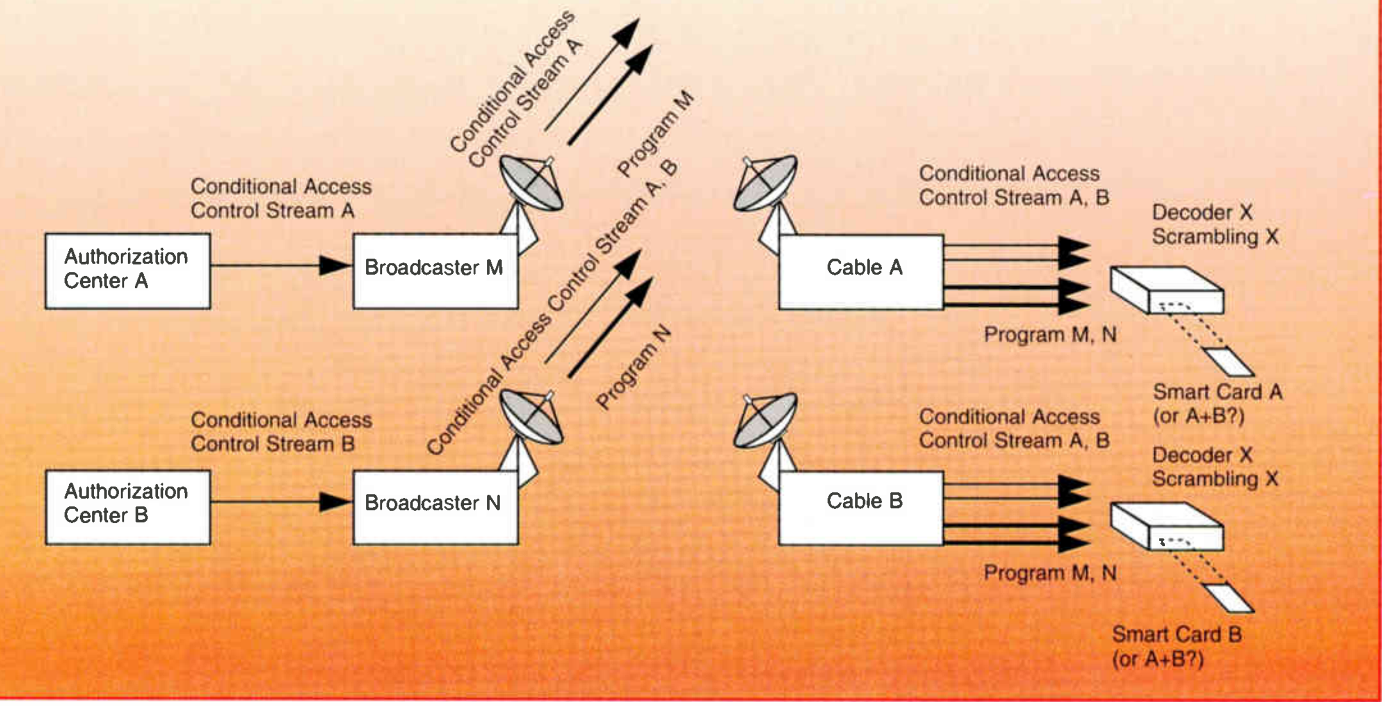
"Conditional access" is defined to mean the process of authorizing a user to receive programming, either by ongoing subscription or by single event.

"Scrambling" is the process of rendering program content unrecognizable/unusable with a special encryption algorithm.

"Encryption" is defined generally to mean the protection of control information (ECM/EMM) used in conjunction with the scrambled programming — allowing it to be received by the authorized user.

"Program" in this discussion simply means a TV program, as in your basic hockey game. Helmeted, pay-cyberspace adventures over the digital

Figure 2: Standard interface

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superhighway? Um, maybe after the playoffs.

The typical participants in the conditional access system are the consumer, the cable operator or satellite broadcaster that distributes the programming, the authorization center that implements the consumer's entitlement to the programming, and the subscriber business system (SBS) that manages the customer data bases and provides billing services.

Objectives

Standardization implies a multivendor, multioperator environment. The objectives of having vendors and operators standardize are:

1) Satellite broadcasters can buy from multiple hardware vendors and need only uplink their programming once.

2) Cable operators can buy from multiple hardware vendors while accessing digital programming from any programmer.

3) Consumer choice is driven by user features and not by an underlying architecture.

Consumers especially cannot be expected to give up any of the features and flexibility that they have today, other than unauthorized access to programming and possibly program copy restrictions.

Required conditions

To meet the previous objectives, agreement must be reached in the following areas:

1) Full transmission, transport and decompression interoperability of one or more vendor's hardware in the domain of decoders being served.

2) A common scrambling algorithm, its key size and synchronization method.

3) The location of scrambling (program stream, packetized elementary stream or transport stream).

4) Standardization of certain areas left open in MPEG-2 relating to the transport/conditional access interface.

5) Conditional access system IDs.

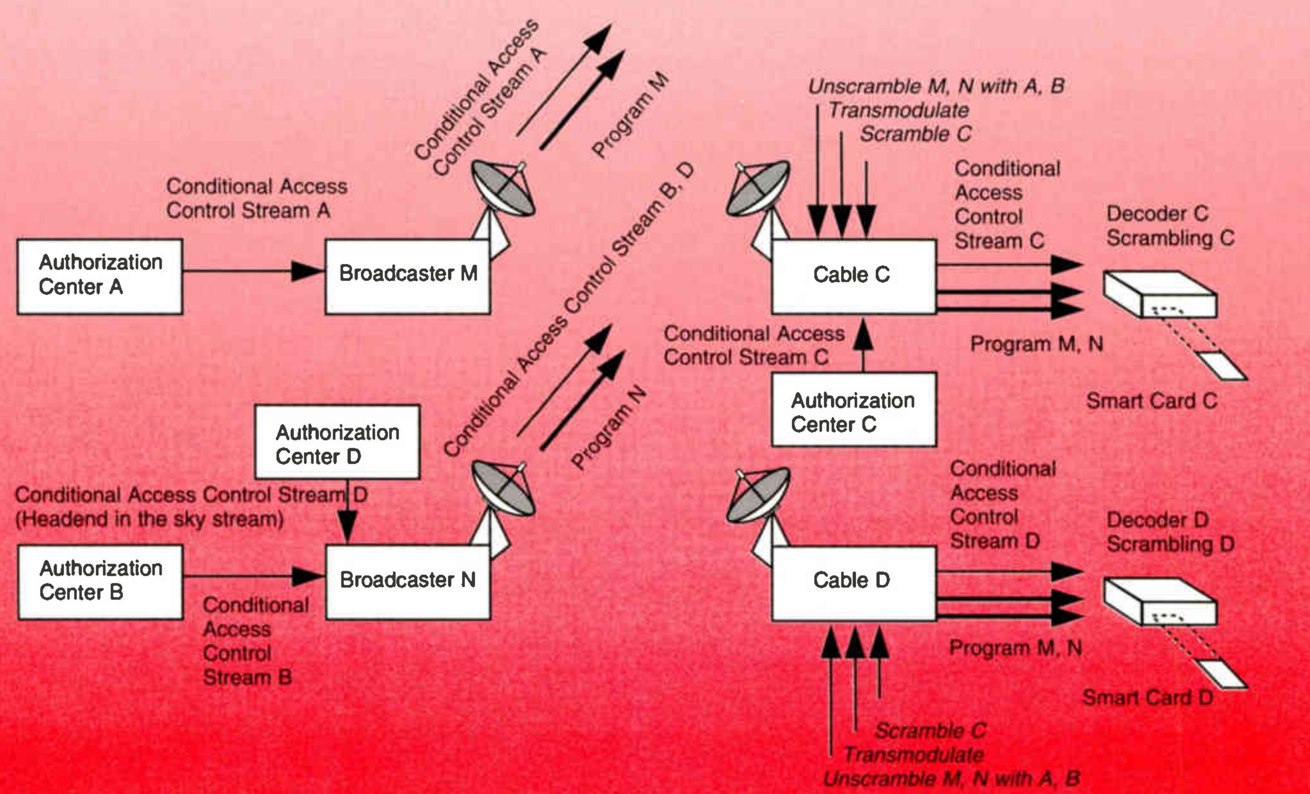
Transport and decompression interoperability involves either a single-vendor domain that is by default interoperable or a domain of vendor equipment that has been made interoperable by cooperation. If multiple vendor equipment cannot decompress the same program, then the satellite broadcaster (or cable operator) is forced to broadcast the programming more than once to reach all decoders.

A common (hardware) scrambling algorithm is required for all conditional access standardization schemes, except where conditional access and descrambling are both implemented completely in removable or multiple modules. With a common algorithm, all equipment can descramble the same program, and programs can be passed from one distributor to another without descrambling and rescrambling. Multiple scrambling algorithms are more complicated and expensive to implement, especially in the same decoders. The algorithm, the key size, the synchronization of key loading and the latching process need to be agreed on.

Under MPEG-2, scrambling is allowed at either the program stream, transport or packetized elementary stream levels. Scrambling has to be handled uniformly at each level.

The precise method of injecting and retrieving conditional access streams from the MPEG-2 transport is anticipated, provided for but not defined within MPEG — thus it must be specified. Continuing the accepted architectural conditional access processes developed for contemporary analog sys-

Figure 3: Decoupled satellite and cable interface



"Standardizing authorization and encryption is like mating a lion with an elephant, with any progress accompanied by a great deal of roaring and trumpeting."

tems, there are two types of conditional access related messages in MPEG-2:

- Entitlement management message (EMM) — subscriber specific.
- Entitlement control message (ECM) — program specific.

The EMM is used to authorize a subscriber to receive specific programming. The ECM is a associated with the actual programming that contains program-specific information and the keys to descramble it. The method for mapping EMM and ECM streams to a common program in the MPEG-2 tables needs to be defined, as well as agreement reached on the private data in the MPEG-2 network information table.

There also will have to be a common way of identifying conditional access systems so that they are recognized by the host DVC system.

Methods

In Europe, the Digital Video Broadcast Conditional Access Specialists Group (DVB/CASG) has been tasked by the DVB Conditional Group to evaluate and comment on two front-running end-to-end approaches, while here, satellite broadcasters and cable companies are looking at ways to interface different compression and conditional access systems at the cable headend. This leads to three configurations:

- "SimulCrypt"
- Standard interface
- Decoupled satellite and cable delivery

The first two are end-to-end approaches that have been put forward by members of the European DVB. The last is a possible technical solution to reconcile the business objectives of satellite broadcasters and cable companies.

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Europe, proposes to "attach" multiple conditional access EMM/ECM streams to program multiplexes, such that one broadcast can be delivered to multiple decoder populations, each of which can have its own proprietary conditional access system. Each service provider managing a population provides his ECM/EMM control stream within the multiplex. At the cable headend, only the applicable stream is allowed through to the consumer decoders. (See Figure 1 on page 74.)

The service provider having the uplink must allow the other service provider(s) access to the multiplex, either through his own conditional access system or over a separate data stream included in the multiplex.

SimulCrypt has the advantage that a cable company only has to deal with one conditional access system, and one smart card offering. This will make the consumer decoder less expensive because it is allowed to be less flexible with the proprietary design. Because of a reduced scope in required standardization, manufacturers should be able to get their products to market more quickly.

One disadvantage is that the consumer might be held hostage to the ability of service providers to agree on access. Allocating the cost of the access also could cause problems and delays and potentially competitive advantage to some service providers. How strong will cooperation be if the parties also are competing aggressively in the consumer decoder market? Since consumers generally don't have the choice of which cable company to deal with, this may be more of an issue with multiple satellite direct-to-home (DTH) operators, where the consumer could have a fair degree of choice.

Another disadvantage is the added complexity for the broadcaster, who has to manage and synchronize multiple conditional access systems. The extra streams also consume physical inputs and (albeit marginal) usable bandwidth.

Even with SimulCrypt, it may still not be wise to put proprietary conditional access functions in the decoder itself in case the system is compromised.

The piracy implications are interesting. At first glance you might think that the diversity fragments the pirates' "market," making it financially less attractive. However, too much choice could actually compromise security, since pirates can target a number of different systems. They need only break one to get access to the whole market. Therefore, SimulCrypt may not be desirable in a cable "pass-through" mode unless the other control streams are filtered out. For this reason, multiple satellite DTH services using this scheme may be more vulnerable.

And what if the conditional access and scrambling is too good? Well, that gets the spy people excited. National security types hate getting stumped by off-the-shelf products and can render a hardware vendor "bureaucratically challenged" when it comes to getting an export permit. So the rule of thumb is that the common scrambling algorithm must be secure enough to fend off pirates but vulnerable enough so that your local spy agency is guaranteed free TV for life.

The standard interface concept proposes to make the system's conditional access functions and the decoder generic and place the remaining proprietary element(s) in a smart card or detachable module. Some or all of the conditional access, scrambling and en-

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1190 South Lapeer Rd., P.O. Box 628, Oxford, MI 48371 (810) 969-0010 Fax: (810) 969-0377 cryption functions may be in the replaceable module. (See Figure 2 on page 78.)

Because all but the actual ECM and EMM data are being standardized, the access control message delivery mechanism and access control message filtering must be made uniform. With this implementation, the consumer buys one decoder and obtains one smart card from Service Provider A, and possibly another card from Service Provider B. The biggest challenge is in drawing the functional dividing line between the decoder and the smart card functions.

The advantage of this method is that it is easier on the broadcaster, since only one conditional access system is required. Access to any decoder could be as simple as issuing a smart card. The generic design also gives the cable operator and the satellite DTH consumer multiple choices for decoders. In the long run, the standardized elements will be produced in large enough volumes to provide a cost benefit.

There also are disadvantages. The added flexibility may lead to increased decoder costs in the short term. The standardization may affect the freedom of manufacturers to develop differentiating user features, and it may take longer to bring the products to market since the standards have to be formulated and negotiated.

The ultimate objective is to put both scrambling and conditional access in a proprietary replaceable module. The advantage is the freedom to implement any conditional access and scrambling system without modifying the decoder. This becomes even more significant when DVC functions are built into digital TV sets and other consumer electronics devices. It can be argued that the proprietary element in a smart card is more disposable than a $2,000 TV set. The disadvantage of fully replaceable security is the incremental cost and the process of standardizing the removable module interface.

The replaceable module also raises the issue of how many smart cards the consumer has to deal with. It is a step backward for viewers to have to get up and swap smart cards when they want to see a different program. To prevent this, the decoders may have to support multiple smart card slots or service providers may have to share the smart card, requiring a more expensive type. Both of these solutions add to the decoder's cost.

Decoupled satellite and cable delivery implies that the compression and conditional access systems are different for satellite broadcast and for cable distribution. It allows the cable operator to take control at the headend with his own proprietary scrambling and conditional access implementation.

In Figure 3 on page 80, two broadcasters are transmitting to two cable companies. Everyone has their own conditional access system. Each cable operator receives both broadcaster's programs, and unscrambles and decrypts both. The MPEG-2 transports (M&N) are passed on to the cable operator's digital cable system, where they are rescrambled with a new algorithm and controlled with a new conditional access stream. The decoders, in addition to the smart cards, can be proprietary.

This implementation offers a compromise that allows freedom to broadcasters and cable operators to provide their own compression and conditional access system. It works best in an environment where the cable companies

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P.O. Box 39 Claremont, NC 28610-0039 (800) 729-3737 have mostly adopted one vendor's proprietary technology for digital cable distribution and the broadcasters have adopted a different vendor for satellite distribution. It adds extra cost at the cable headend, mainly because of having to unscramble and rescramble.

Figure 3 page 80 shows local insertion of the Conditional Access Stream C at Cable Headend C. Cable Operator D is using a headend in the sky (HITS) approach instead. Control Stream D is delivered as a separate data stream included in the satellite broadcasts. This data is then extracted from the broadcast multiplex and passed to the cable conditional access system terminal at each of Cable Operator D's headends and synchronized with the programming.

"Single vendor proprietary systems? We don't think so. The commitment is strong in all major markets to avoid this as standards setting organizations around the world tackle the issue head on."

Summary

Because of variances in market requirements and the potential benefit of added security, it is desirable to allow multiple conditional access schemes to co-exist and operate in the same DVC systems. There are many ways to accomplish this and one approach may work well in one market but not another.

"SimulCrypt" may get products to market more quickly with the advantages of proprietary systems but complicates the satellite transmission and leaves questions on how to fairly coordinate access at the uplink. The standardized interface may take longer to develop and may cost more but should be well worth the extra work and effort. It promises a truly generic decoder that offers more market choice and leaves the cost of a security compromise in the replaceable security module.

If necessary, the digital satellite DVC systems can be decoupled from digital cable systems, allowing satellite broadcasters and cable operators to independently optimize their networks and businesses. The price is the extra cost of having to unscramble and rescramble programming at the cable headend but it is feasible and a possible option for the North American marketplace if further standardization conditional access cannot be achieved here in the short term.

Single vendor proprietary systems? We don't think so. The commitment is strong in all major markets to avoid this as standards setting organizations around the world tackle the issue head on. The first step is to get the compression and transport functions of DVC systems truly interoperable — then the conditional access, starting with common scrambling algorithms for specified major markets, and/or a standard interface for proprietary conditional access and scrambling that is wholly contained in replaceable modules. **CT**

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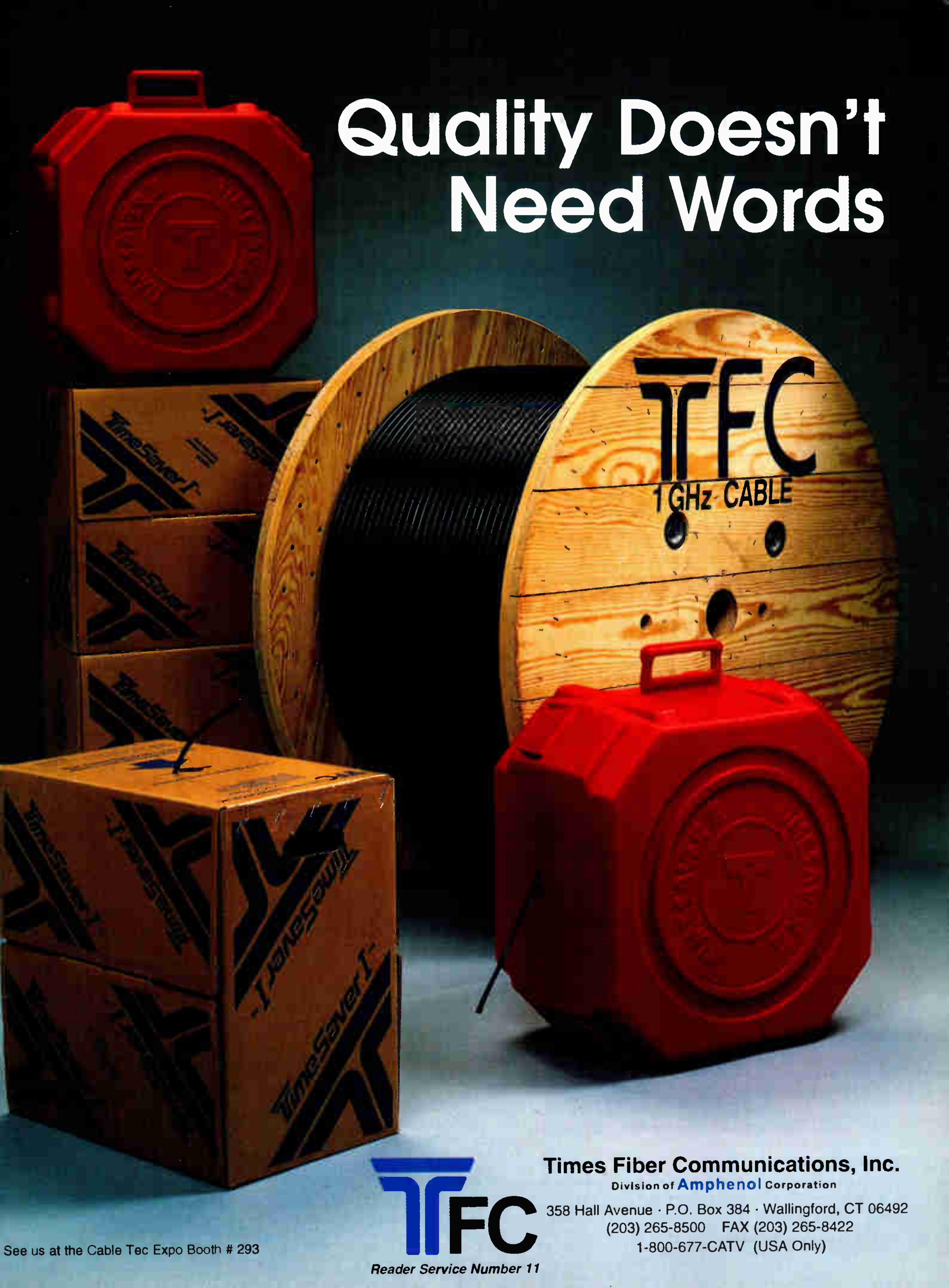
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Developments in addressable control and signal security

By Mitchell Olfman
President and CEO
Electroline Equipment Inc.

Cable operators in the United States now face a conditional access environment that is extremely challenging, in part because of the transition to digital video and multimedia services. Also, cable operators face new requirements in the signal transparency area, required by the Cable Act of 1992. Moreover, recent rate reductions of 17% in the basic cable area, ordered by the Federal Communications Commission, are fostering a business incentive to create new tiers. That means a greater need for addressable control.

Also, the creation of what amounts to a "regulated" class of cable TV services is spurring the search for new lines of business to offset revenue losses in the now-regulated basic cable service areas. In most cases, that translates into a need for more complex and expensive access control equipment. Complicating matters, there is a possibility that proposed information superhighway enabling legislation will, as a byproduct, lead to creation of an "open" encryption standard. As a result, cable industry technicians face a series of decisions involving complexity and cost unmatched in recent history.

Figure 1: Telephone multilevel conditional access

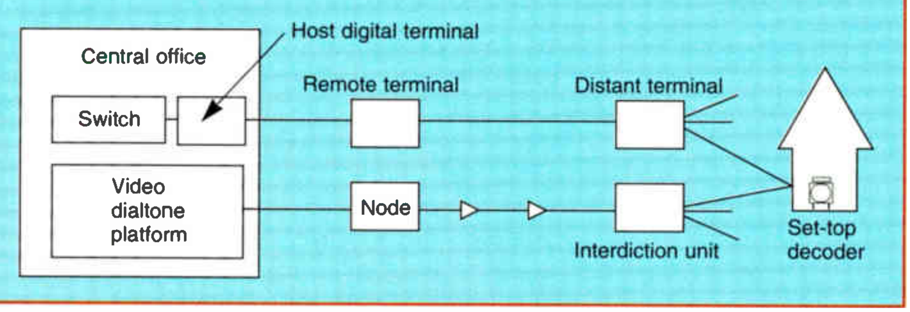
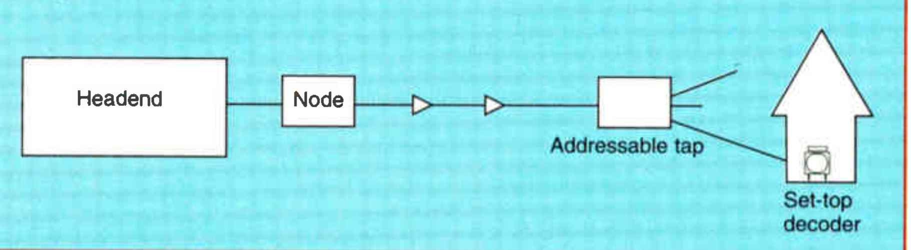


Figure 2: Cable multilevel conditional access



Strategic challenges

At a strategic level, the U.S. cable industry is in the midst of a transition to delivery of digital video and interactive multimedia services. At a minimum, decoding of compressed video material will require decompression circuitry, in addition to the standard addressable control functions performed by an analog set-top decoder. Also, there will be the need for an electronic program guide.

At higher levels of complexity, required for access to advanced home shopping and information services, home terminals may need microprocessors and memory equivalent to a powerful desktop personal computer based on the Intel 386 or 486 processor. Some multimedia proponents believe more powerful units will be required, powered by reduced instruction set computing (RISC) processors such as the IBM-Motorola-Apple Computer PowerPC and the Digital Equipment Corp. "Alpha" processor.

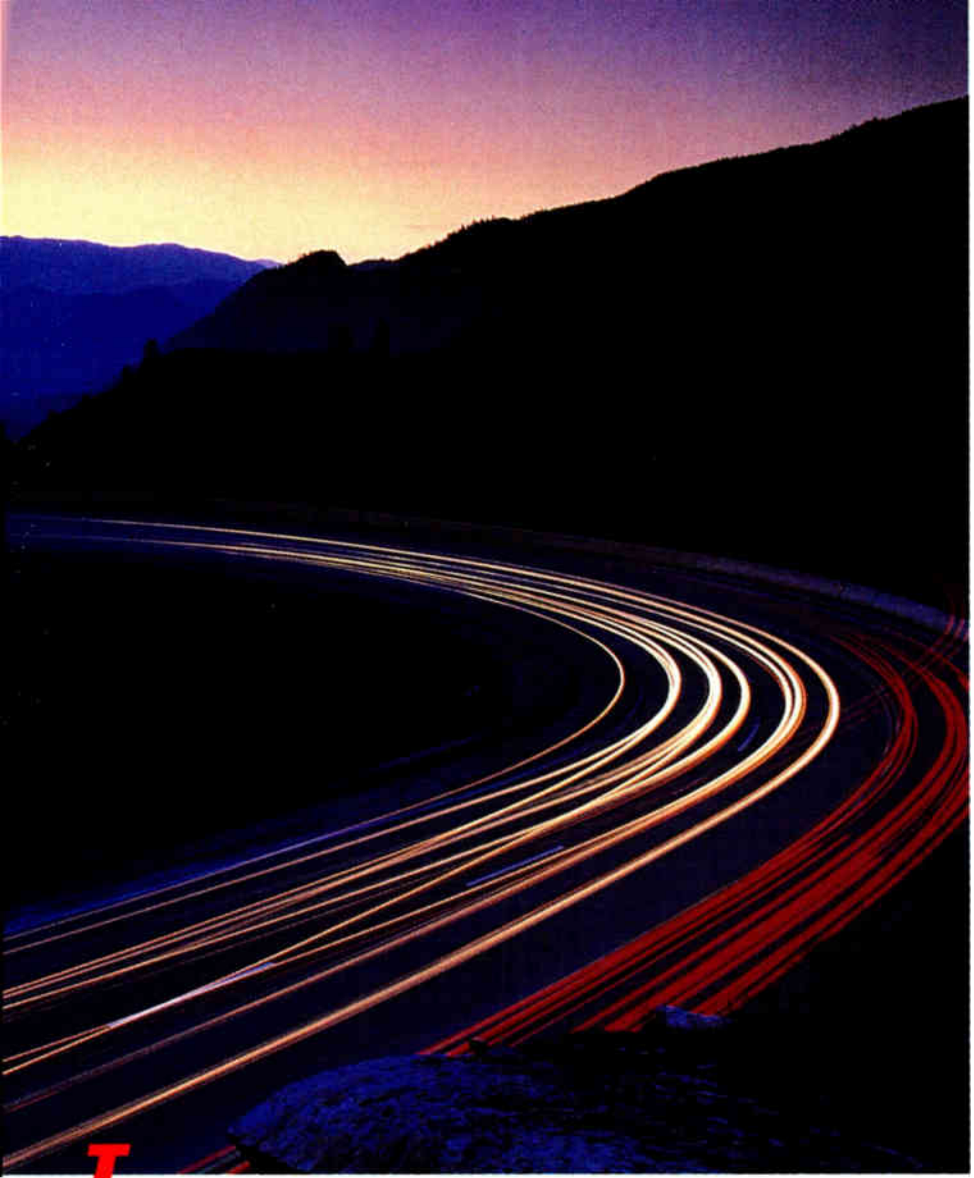
It remains an unresolved issue whether home terminals must have asynchronous transfer mode (ATM) capability, or whether ATM send and receive capability remains at the headend. But there is fairly widespread agreement that cable operators will need full two-way capability and interconnections to a wider telecommunications network that does transmit digital information in ATM format, over networks based on synchronous optical network (SONET) protocols.

In addition to controlling access to entertainment video, conditional access systems of the future may have to accommodate multimedia information services including downloaded video games, home shopping, infotainment services, distance learning, interactive gaming, local and long distance telephony, video telephone, high-speed data communications, energy management and monitoring, and digital audio.

Regulatory changes

On a more prosaic level, U.S. cable operators will be coping with new rules in the consumer electronics compatibility area, which were set to be issued by the FCC this spring. Those rules, developed as a direct outgrowth of the Cable Act of 1992, require that operators make available to their customers decoders with RF bypass circuitry, addressable decoders featuring built-in VCR timers, universal remotes, as well as dual-tuner decoders.

As a longer-term matter, cable and TV manufacturer interests will need to craft a new definition of what a "cable-compatible" or "cable-ready" TV set is. Among other things, such sets will need 1 GHz tuners, better tuner shielding and a new type of decoder interface. And though many would question the wisdom of such a move, based on the speed with which digital technology



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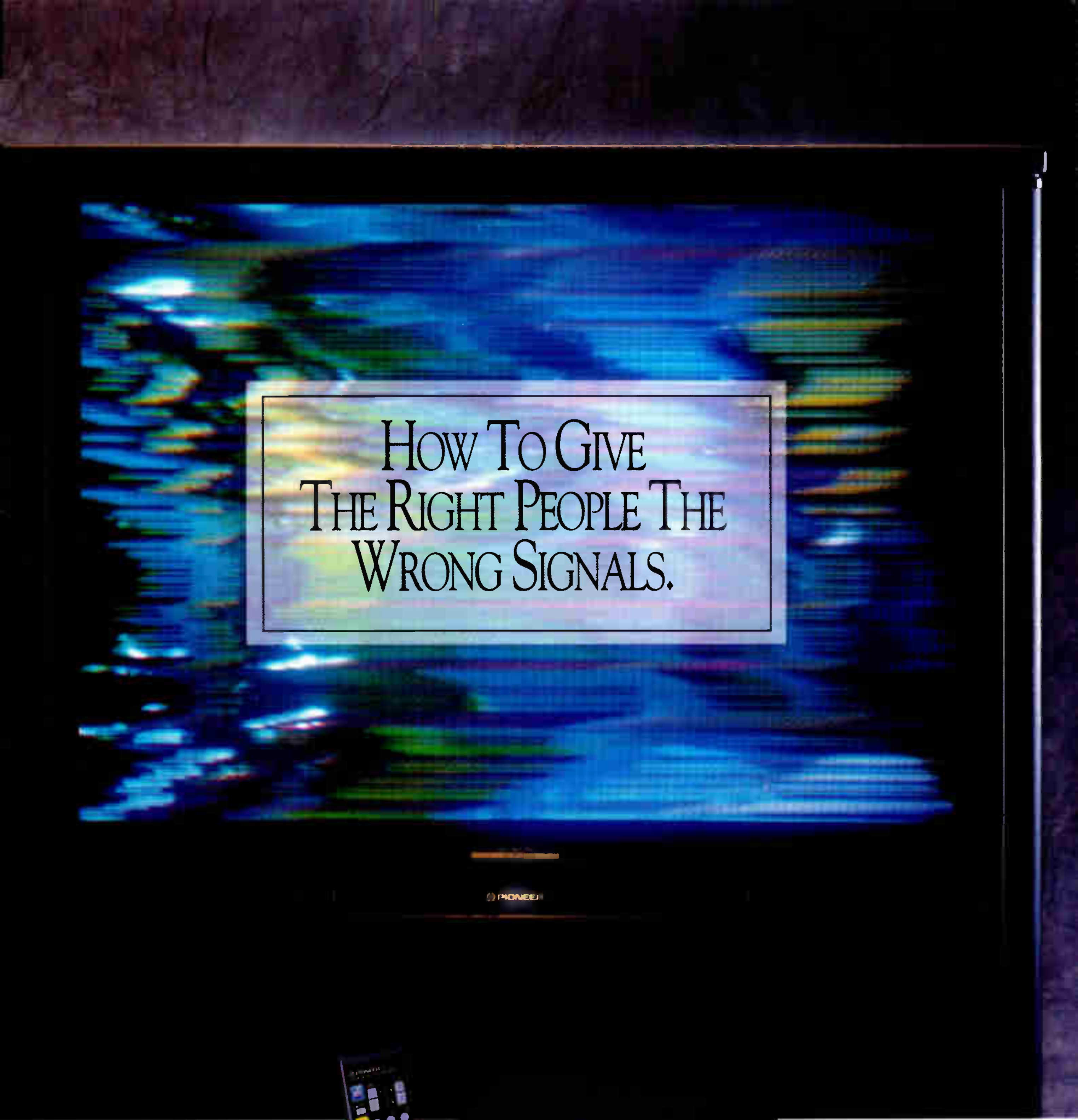
See us at the Cable Tec Expo Booth # 431, 433, 435 now is advancing, the FCC is supposed to create a standard for digital TV tuners and transmission specifications this year. By 1995, signal decompression and security interfaces also would be developed.

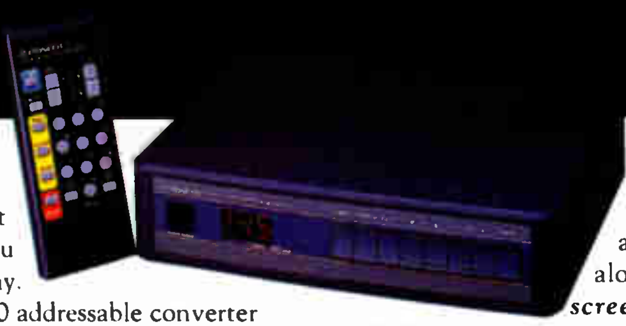
The actual language of the rules was not available as this article was written. However, the underlying principles, developed by a committee called the Cable/Consumer Compatibility Advisory Group, including representatives from both the cable TV and consumer electronics industries, include a recognition that no acceptable method yet exists for transmitting all cable programming "in the clear." Furthermore, the committee agreed that multiple signal scrambling and encryption standards are an essential part of delivering cable TV signals, though consumer electronics interests initially had called for a single mandated encryption standard.

At the same time, the industry must fend off attacks by the video rental industry, which has argued (successfully in several cases) that so much signal theft occurs in the cable environment that the release window for significant pay-per-view (PPV) movies should be lengthened, in favor of the video retailer channel. Though cable interests dispute the methodology used to develop the argument about laxity of cable-provided security, it nevertheless remains imperative if cable is to prosper in a PPV environment that signal security efforts be heightened.

So, in addition to maximum-feasible flexibility, cable conditional access efforts must provide adequate signal security. Though in yesterday's business climate it might have seemed less crucial to prevent signal theft, in today's tough business environment with competition growing, basic rates capped and PPV release windows going into reverse, signal theft can't be tolerated. That will be increasingly the case as high-value new services, ranging from Internet access to video-on-demand, home shopping and interactive video games are provided to customers.

What it all means is that operators now require conditional access systems of great flexibility, incorporating both broadband and channel-by-channel control, while the evolution path to digital services is preserved. Though the initial focus will be on video entertainment, conditional access to a wide variety of communications services probably will follow. →





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Conditional access: Medium-term

Over the medium term (a period of time lasting five years or more) cable TV conditional access will require hybrid analog/digital signal control, the ability to tier analog services as well as control a menu of digitally compressed video offerings. That suggests the utility of a multilevel approach, in which the ability to secure a channel, a tier and a drop are significant.

Some major local telephone companies, for example, will deploy a multistage conditional access approach using both addressable interdiction and set-top decoder technologies. (See Figure 1 on page 90.) Though most U.S. cable operators will resist taking that approach, the layered security system is not conceptually much different from the cable operator practice of combining traps and/or addressable taps and set-top decoders to secure a variety of services. (See Figure 2 on page 90.) Required as part of the video dialtone regulatory framework to transport video from a number of providers, Bell operating companies face channel-by-channel signal control needs that cable operators do not face.

At a minimum, cable operators will be investing in upgraded addressable set-top boxes, initially to support delivery of mass PPV movie services. Those terminals also will provide the traditional descrambling functions for premium channels and support the traditional channel mapping and parental control functions as well. In many cases, upgraded electronic program guides and support for digital audio also will be bundled into the package. Given the strong legislative push for transparency of cable service to TV sets and VCRs, there will be a continued need for delivery and control of analog signals in as friendly a manner as possible.

Conditional access in a digital world

Longer term, over a decade or two, cable operators will move to an interactive, multimedia environment featuring delivery of a mix of signals including switched, digital services, a broadcast menu of digitally compressed signals, as well as analog signals. In that environment, many operators will be using high performance home terminals that will resemble personal computers more than today's set-top decoders. Though traditional cable TV services will still be part of the mix, advanced terminals will enable sophisticated, two-way communications with remotely located information sources.

The digitally compressed broadcast PPV services will be augmented, if not replaced, by full video-on-demand terminals that give a customer full control of a video stream, including the pause, still frame and rewind functionality consumers expect when using a VCR. Just as important, those terminals will support a variety of transaction services, most likely anchored by home shopping, interactive direct marketing services and interactive information services.

In the new switched digital environment, conditional access will begin to resemble more closely the sort of security now provided by telephone and computer networks. In that world, the network switching infrastructure and management information systems will play a larger role in controlling customer access to various services and establishing a price for what will amount to computer "sessions," if there is a charge above and beyond a flat subscription fee.

(Continued on page 146)

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Microwave antennas: Collinear paths and interference

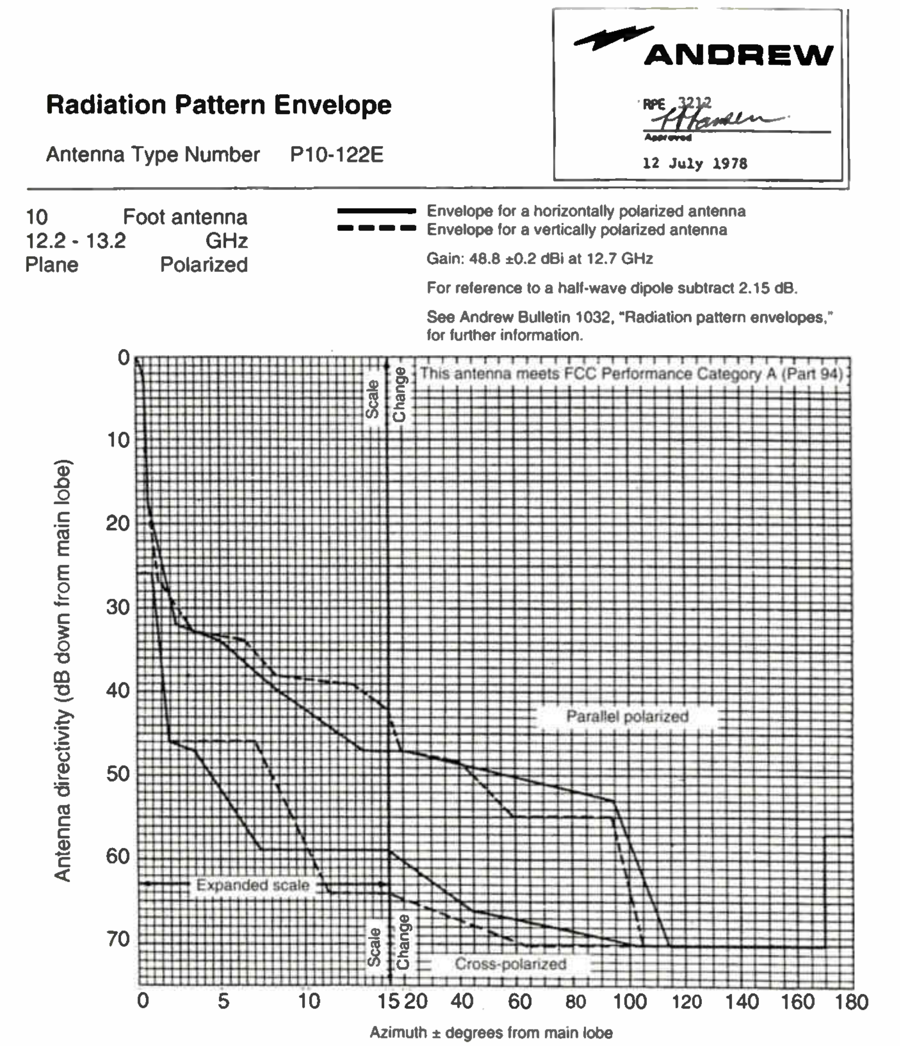
By Dane Walker
Senior Systems Specialist
Hughes Aircraft Co.

In these days of the information superhighway, two-way fiber and coax systems we sometimes forget about microwave and what it can do. It was once said that information is power. Today we in the cable industry can still provide more information to the home than any other service. A 40-channel system to 10,000 homes is a lot of information power and it's there now just for turning on a TV set.

So what does this have to do with microwave and microwave antennas? Some years back we needed to link three buildings to send data and video. The fact that there was almost a straight line from the main building to the other two made it possible to use a collinear path — one transmitter to two receivers with one transmit antenna. The numbers looked easy to get but what was required?

One can think of this type of path as a standard TV transmitter sending out a signal in 360° to your home TV antenna except in this case the beam is not 360°. It's in the order of 0.6° to the 3 dB points. The more you get off bore sight the more signal you will lose. To lose 20 dB or so all you have to do is get to the first side lobe and that is about the same off of bore sight as the half power points of the antenna.

Figure 1: Andrew P10-122E 10-foot antenna pattern



Things to remember about antennas

Gain goes up as the beamwidth goes down. When we use parabolic dishes of a fixed size it also can be said if the dish diameter (D) is increased the gain goes up, or if the frequency (F) goes up so does the gain. →

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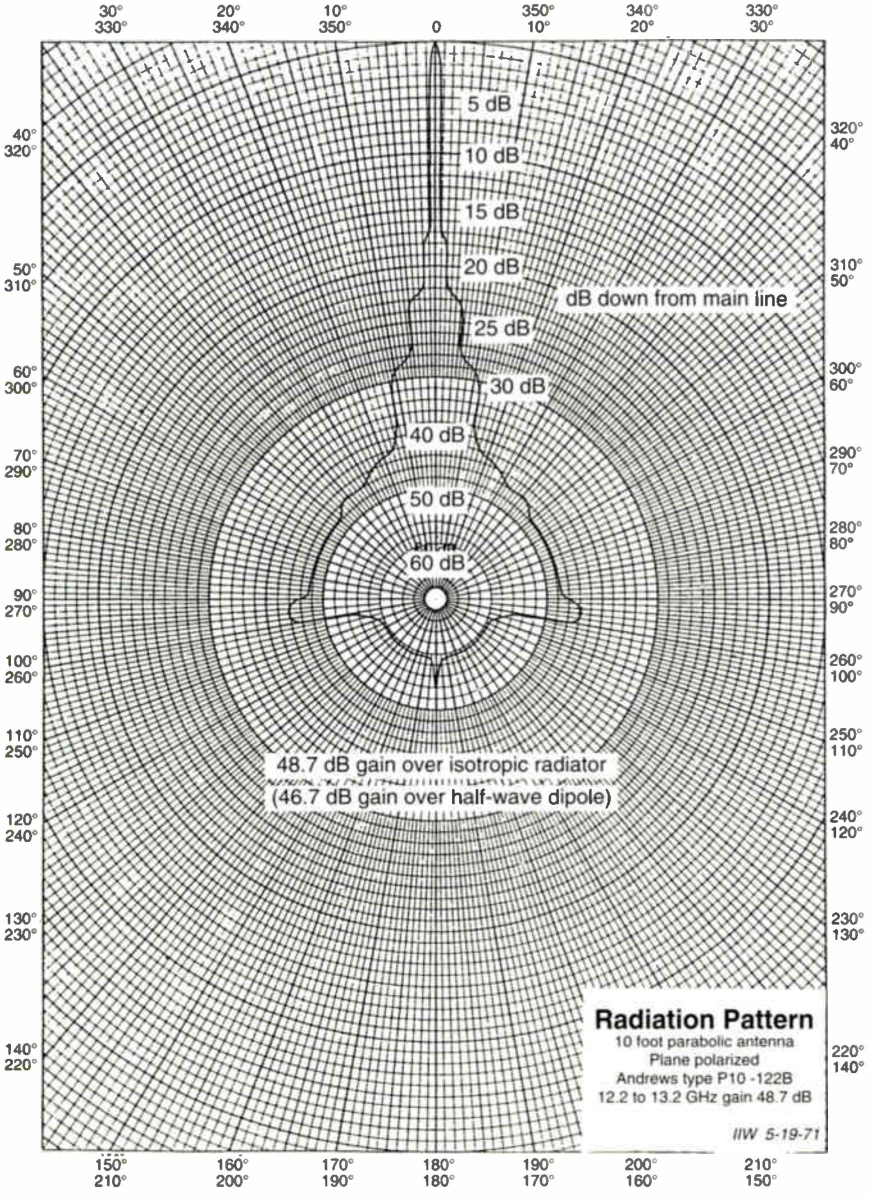
Figure 2: Andrew P10-122B 10-foot antenna polar plot



"Know the pattern of the antennas you are using. Make sure the proper feed and feed guys are used with each antenna. Don't mix manufacturers."

The formula used for the gain of a dish is:

20logF (in GHz) + 20logD (in feet) + 7.5

This is based on a 55% efficient parabola. I find this is very close to the test numbers published by Andrew Corp. In some cases a 10-foot antenna will show one gain from one manufacturer and something else from another. I have found that it is not because one has more gain, but that some manufacturers use the mid-frequency gain and others use the highest frequency gain. Don't be fooled.

Side lobes on the other hand will be different depending on the type of antenna (e.g., high performance, standard or horn). The best place to find this information is from the manufacturer. All manufacturers should be able to supply you with the patterns for their antennas. All you need is the model number. This same information is useful when looking at interference from other sites. In fact, the math for a collinear path is just the same as if we were looking at a carrier-to-interference (C/I) study.

Understanding the antenna pattern

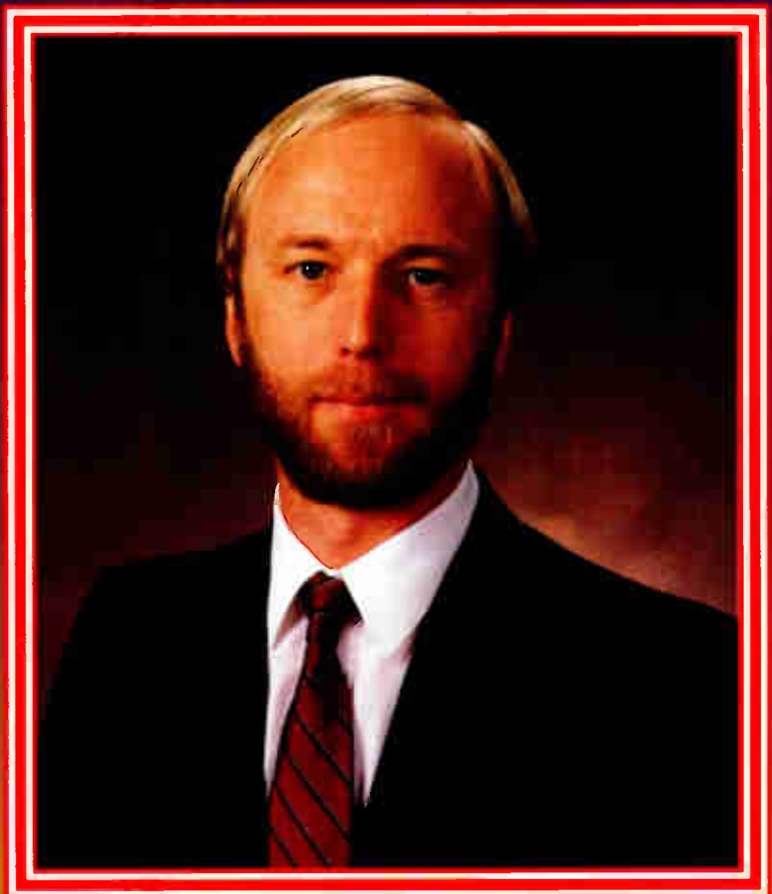
If you look at Figures 1 through 3 you see the patterns for Andrew Corp.'s P10-122E 10-foot, P10-122B 10-foot and P6-122D 6-foot antennas. All are 12.2-13.2 GHz. The gains are all given at the frequency of 12.7 GHz. This is about 0.2 GHz below the center frequency and in fact at the low end of the CARS band (12.7-13.2 GHz). The gains are 48.8 dBi (for both the P10-122E and P10-122B) and 45.1 dBi for the P6-122D. The first side lobes are from 18 to 22 dB down at 0.3° (for both the P10 models), and 0.45° for the P6 off bore sight and the 3 dB power points at 0.6° (for the P10s), and 0.9° for the P6.

The antenna showing the greatest isolation is the 10-footer and that is 70 dB down from about 115° to 175° right or left of the main lobe. The gain at this point is -21.2 dB. So what do the numbers tell us? All antennas have sharp main lobes. In most cases, looking just by the adjustments it would be hard to tell a 4-foot from a 10-foot antenna. The fact the signal is so concentrated makes it so someone not in line with the path would have a have a hard time stealing signal that is usable. More about this later.

Let's look at what happens as the signal travels from the transmitter. The signal spreads and in fact illuminates an area of space. The fact is a 4-foot dish illuminates more area than a 10-footer. After a signal travels 10 miles (52,800 feet) from a 10-foot dish, the beam is about 552 feet wide to the 3 dB points. From a 4-foot dish it is about 1,290 feet wide. This tells us that if we had two different sites inside the 3 dB points the system would work and only require one transmit antenna.

This type of system also works in reverse. Let's say we had a number

Recipient of Communications Technology's 1994 Service in Technology Award



Dan Pike

Vice President of Science and Technology — Prime Cable

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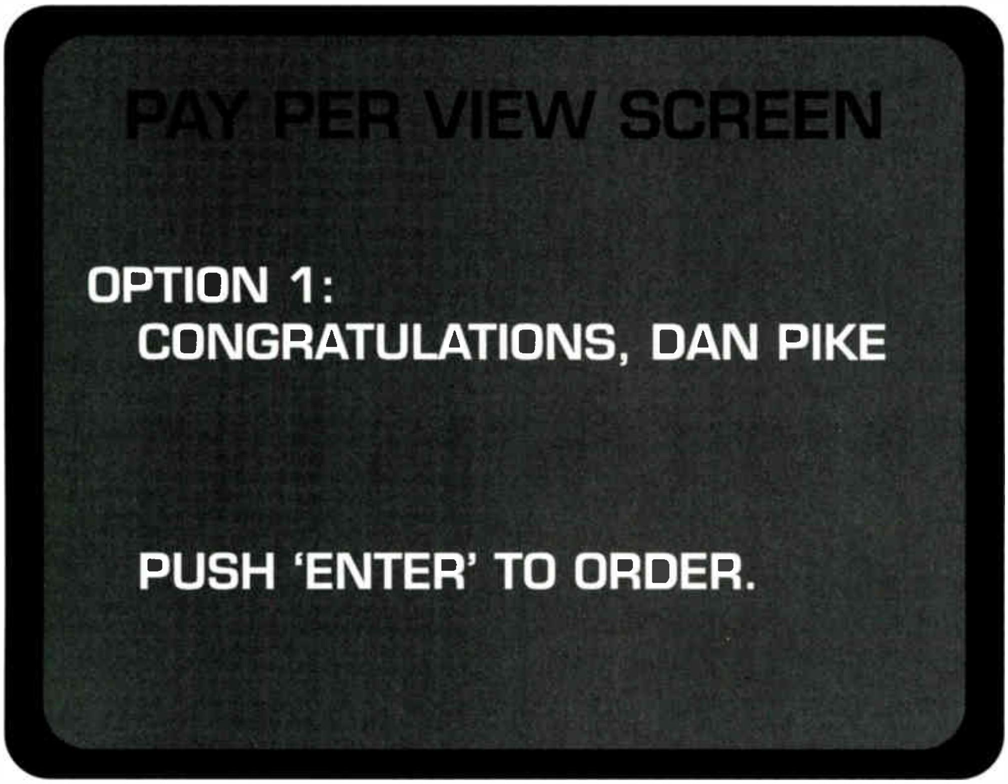

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1994 Service in Technology Award Recipient

Communications Technology is proud to present Dan Pike, vice president of science and technology at Prime Cable, with this year's Service in Technology Award.

Pike's interest in electronics was fueled by the hands-on experience of living on a ranch in west Texas. It was his job to maintain the generator that provided a few hours of power to the household each evening. In addition, he helped maintain a line from the ranch to town that enabled his family to have use of a phone. When the line was in need of repair because of strong winds or accidents, he did his part to help restore communications.

"Dan is often a stabilizer in times of chaos, helping to develop rational solutions to problems. He has always been a leader in getting the most out of his systems. His analytical style has led to many system improvements and innovative techniques."

— Geoff Roman, General Instrument Corp.

A natural curiosity

This was more often easier said than done. He recalls, "Actually this was the experience that helped me learn how to climb poles. There were times when I would stand on the back of my horse or pickup truck to do the repairs!"

He had a natural curiosity for all things electric. While in high school, he worked both part-time and during summer vacations as a lineman for an electrical contractor who built electrified oil fields. He maintained this interest through college by working part-time and spending vacations working the bench on consumer electronics as well as on two-way radio. He earned both a BS and MS degree from Oklahoma State University.

Pike began his career in the cable industry in 1973 with encouragement from the dean at Oklahoma State who thought that cable "offered a wide range of challenges in communications." From 1973 until 1977, he was a project engineer for LVO Cable, which later became United Cable. That company was planning a move to Denver and because he believed that "Tulsa was already two blankets too cold" he opted to go to Texas where he joined Communications Properties Inc. He held both engineering and engineering management positions with that company through its acquisition by Times Mirror until 1981. At that time he rejoined his CPI colleagues at Prime Cable as director of engineering. In 1983 he was appointed vice president of engineering.

"Dan Pike is one of the quietest and brightest people I know. I've learned the importance of listening to Dan. Almost without exception, I take away a new piece of knowledge or a better insight from each discussion. I am sometimes amused at the number of 'important' people in the cable technical community who haven't learned this yet. They are missing a great opportunity."

— Walt Ciciora, Ph.D., Cable TV Industry Consultant

"I am pleased that Dan is receiving the Service in Technology Award. If anyone deserves the award, it should be Dan. His work at characterizing cable plant is important for the industry, especially with coming digital technology. Dan is a personal friend and one of the reasons that working in cable is rewarding. Besides, he tells the best lawyer jokes I've ever heard."

— Vito Brugliera, Zenith Electronics Corp.

He is presently vice president of science and technology for Prime Cable in Austin, TX.

A commitment to education

Pike's interest in disseminating information on technology and management for industry personnel is evidenced in eight papers he authored, including two works he co-authored that were published In the National Cable Television Association annual transcripts.

Additionally, Pike authored one paper on engineering management for an American Management Association Communication publication.

He comments, "The writing is an outcome of areas of interest to me. If I thought It would be of benefit to the industry, I would seek to publish it."

A popular speaker at industry conferences and trade events, including the 1992 NATOA annual conference, he also was the recipient of the NCTA Vanguard Award for Science and Technology in 1991. He also guest lectures on the college circuit, most recently speaking on telecommunications to MBA students at St. Edward's University in Austin, and at the University of Dallas.

Pike's volunteerism is a tribute to his concern for the training and education of industry personnel. He is a member of CableLabs board of directors and the advisory board of *Communications Technology* magazine. His committee work includes positions on the Technical Advisory Committee for CableLabs and the Engineering Committee for NCTA. He also is on the subcommittees for high definition TV (HDTV), ad-hoc on Federal Communications Commission technical standards and ad-hoc on consumer interface. In addition, he is an IEEE senior member and a member of the Society of Motion Picture and Television Engineers.

A senior member of the Society of Cable Television Engineers, Pike joined the organization at the start of his career and has contributed a great deal to the Society. As part of its Engineering Committee, he participates in the Curriculum Subcommittee for the SCTE Broadband Communications Technician/Engineer (BCT/E) Certification Program's Category VII, "Engineering Management and Professionalism." In addition, he is on the Senior Member Subcommittee, was program co-chairman for Cable-Tec Expo 1992, and served on the Program Committee for both the 1993 and 1994 Conferences on Emerging Technology.

Pike says, "The value of SCTE is that it is a complete forum for the exchange of ideas, information and training for members who work in the technical side of the industry."

Although one might think that his involvement in the industry leaves little time for leisure, Dan's hobbies include water skiing, snow skiing and hunting.

"Dan's an incisive thinker who backs up his positions with lots of theory and practice. It's our industry's gain to have Dan. If he could ride a little better, he'd be a 'full-time' cowboy."

— Ted Hartson, Post-Newsweek Cable

Prime Cable prepares for cable's technical future

Dan Pike, 1994 Service in Technology Award winner, works for a company with its vision firmly focused on cable TV's technological horizon — Prime Cable.

In 1979 Times Mirror bought Communications Properties Inc. (CPI), the eighth largest cable TV operator in the United States, from an investor group that included CPI co-founder Robert Hughes. Convinced cable was entering an era of even greater growth, Hughes and his team formed Prime Cable. Today, Prime is one of the most successful communications management companies and multiple system operators in history.

Always looking forward

Cable began life vulnerable on many fronts: uncertain demand, restrictive regulation, limited programming and capital, competing technology. Today, a $20-billion-a-year industry, it has proven resilient in the face of change and is now a leader in redirecting a much larger communications field.

Company visionaries have seen the future at Prime. Video, voice and data are forming an almost limitless communications world. It has solidified its position in cable and moved into related technologies where the company has prospered. Prime's expectations for consumers, the company and those associated are rooted in experience.

In its infancy, cable wasn't a sure bet. The principals in Prime accepted the risk because they sensed a cultural phenomenon in the making. As it materialized, the company's work ethic took over. From the outset cable was regarded as a service. Customers came first. Taking care of them, Prime felt, would take care of business. And so it has, which is why Prime has always met or surpassed its investment goals. This performance isn't lost on markets, employees or investors.

On one level, Prime Cable is a diversely skilled, long-associated group whose know-how in finance, management and communications technology is as good as it gets, and whose mutual respect inspires creative thinking. On another level, company personnel take performance and reputation personally and operate flexibly, openly, allowing smart people to move quickly, deal situationally and to make things happen.

Smart technology

The technologies it is involved with are ones that make sense. Cable came first. Historically, Prime has purchased cable systems in which it saw an opportunity to deliver better service and pictures, priced and packaged to fit the marketplace. In doing so, it increased basic subscribers, reduced churn, added premium subscriptions and expanded systems past more homes. That creates value and Prime has done it in every cable system its operated, from Atlanta to Alaska.

In recent years, the company has ventured into hotel pay-per-view, video retail, cellular phones and the telephone bypass business. What Prime Cable does best is create value in communications businesses. Given the rate at which technology barriers are falling, it sees a lot more value out there to create.

Coaxial cable's broadband capacity lifted limits on transmission years ago. The combination of cable, fiber optics and digital compression reduces limits even more dramatically. Sending billions of bits of data in seconds means more channels (up from 50+ to 150+ with hundreds more on the horizon). Suddenly, the economics work for the most targeted audiences.

Prime and others in cable are well positioned to capitalize. Cable passes 90% of U.S. homes. By interfacing Prime's broadband plant and fiber optics, it can quickly and economically upgrade transmission capacity with little disruption to existing service.

Simultaneously, industries are experiencing an unprecedented level of integration through technology. The corporate model for success is collaboration, as computer makers, telephone companies, cable programmers, and TV networks joint venture with cable operators. Prime's association with a regional Bell company typifies cable's catalyst role.

The outcome is a seamless infrastructure of computer, television, telephone and electronic data systems that delivers a full range of communications technology virtually on demand.

Today's newest adult generation grew up with technology, inheriting a kind of "techno-birthright." Unlike cable's early days, when educating and convincing were prerequisites to the sale, demand no longer has to be created. The message is clear. Now the emphasis can be on delivering the goods — something Prime excels in.

Prime introduced multiplexing successfully in Chicago and Las Vegas and is now testing digital audio. It typically owns addressable systems, putting the company in the forefront with pay-per-view. On the horizon it will be adding improved hardware such as for high definition TV (HDTV) and multimedia.

Telecommunications has changed more in a decade than in the last century. Car phones, faxes, personal communications networks (PCNs) linking callers directly, and systems bringing long-distance carriers to major users are reshaping the industry. Prime is taking small bites with the potential for big rewards. It installed a phone system in its 32-story office building headquarters. Early application for PCN licenses puts the company in this breakthrough field, as well.

Convergence: Challenges in transaction management

By Ed Means
Telecom Industry Marketing Manager
U.S. Computer Services

As the information superhighway approaches and voice, video and data merge, what new challenges in transaction management will MIS executives at cable and telco companies encounter?

Cable companies

As cable companies move toward convergence, they must adapt their technical capabilities to accommodate telephony. In the past, cable companies' customer management systems focused primarily on subscription systems, where customers sign up for a specified service for a specified period of time. The tracking and recording of charges (and therefore customer billing) had been fairly straightforward with relatively few transactions originating from each customer. Today, these systems have advanced to management and billing for transaction-oriented events like pay-per-view (PPV) and near-video-on-demand (NVOD) services. These systems, with open architectures and standards-based designs, have placed cable transaction management systems in a strong position as cable and telephony markets converge.

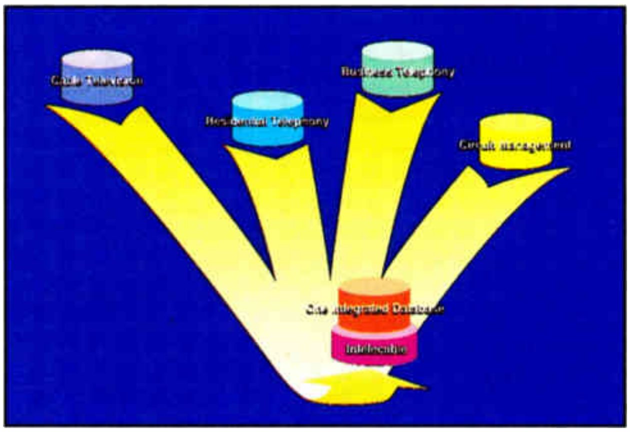
However, while cable PPV is an event-centered system, the specifics of each event usually are identified and specified in advance: the date and time of the event, the length of the event and the rate customers will be charged for viewing it. Very little is unknown about the event, and cable companies have the information they need for billing before the event begins. While the number of transactions originating from each subscriber is still relatively low, PPV and NVOD opportunities are expanding, and current technology provides a microcosm of what is needed for a cable/telco environment.

Before cable companies begin to offer telephony and other convergent services they must be sure to have the systems in place that can handle a transaction-intensive environment. These systems must be based on open systems design principles and fully relational data bases.

Telephony

Telephone companies have traditionally viewed cable subscriber management as fairly simple — a notion based on early cable system development. With cable's recent growth, its systems have employed modern technologies and architectures. Telephone companies must keep in mind all the functions that today's cable transaction management systems provide.

Intelcable



Cable transaction management systems provide many of the same customer service and billing functions the telephone systems do and have added capabilities to deliver customized marketing programs. Whereas telcos hold an advantage in transaction-based experience, cable companies hold an advantage with their open, flexible systems that can be used as competitive marketing weapons. Telcos will have to adopt these capabilities before they can successfully offer cable services to the public.

Real-time rating and discounting

There are many challenges that will be common to all service providers as we move toward convergence. As cable companies and telcos begin to provide the more advanced services that interactive broadband allows, they will have to face the subject of real-time rating and discounting of transactions. Telcos have some valuable experience here, because telephone calls are currently rated in real time. Cable systems have been honing their services in this area through current PPV and NVOD service management.

Convergent services, however, will require more intricate and sophisticated discounting plans. Factors such as the time of day and day of week a service is used, bandwidth used, the party with which a customer is interacting (such as frequently contacted friends, family and institutions), cross-service discounts and length of service all may need to be taken into consideration, with multiple discounts being applied on top of one another.

As an example of the challenges that telcos and cable companies will face together with interactive broadband services, let's look at video-on-demand (VOD). Once widely available, VOD will have virtually the same functionality as a videocassette recorder. With VOD, not only will viewers be able to start a selection whenever they wish, they will have the ability to pause, rewind and fast forward the selection as well. Each of these actions will carry billing consequences and every transaction will certainly have to be recorded, stored and retrieved if accurate billing is to be done.

As an example of the intricacies that may arise, let's say that viewers will be able to order discounted movies if the selection includes commercials. If the viewers "cheat" and fast-forward through the commercials included with that selection, will the price they are charged be affected? Will there be a system for "catching" viewers who don't comply with discount rules? Further, if a viewer pauses a selection for a half-hour while he runs out to pick up dinner and therefore increases the length of access time for the selection, will extra charges be applied?

There are many services that broadband will allow cable and telcos to provide their customers — services with options we have yet to imagine. The trans-

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action management systems for the convergence market must therefore be extremely flexible and adaptable. They must be able to be altered, added to and expanded to enable providers to bill for the services they offer.

Third-party vendor involvement

Third-party vendor involvement is another challenge that cable and telco MIS executives will have to face in the convergence market. As the number of services that are available to customers proliferate, there will be more — and more varied — suppliers. Customers will order services at times that are most convenient to them.

These services will come from a variety of suppliers. One man may want to do his banking from home at 5:30 a.m. before leaving for work. A woman may want to view a program on tax laws at 11:30 p.m. before going to sleep. A child may want to play an interactive video game and order a pizza for dinner.

The intervals during which these services are ordered may be nearly impossible to predict. It will therefore be quite difficult to preplan third-party billing. A system for handling this situation will need to be developed.

"As we move toward convergence, perhaps the best method of facing the challenges that will arise is developing alliances."

As interactive broadband services are introduced, the arrangements necessary between network operators and third-party service vendors will become more complicated. It will be quite a challenge for cable and telco executives to negotiate these agreements. It is crucial, however, that these arrangements be made before services are offered. In order for providers to survive and continue developing products for the public, they must be able to bill and be paid for their part in providing services.

Bandwidth

In addition to the challenges of real-time rating and discounting and third-party vendor involvement for interactive broadband services, there also is the question of bandwidth. How much bandwidth will customers use for each different type of service? Long-distance phone calls will use a certain amount of bandwidth. VOD will use a different amount of bandwidth. Interactive video games may use varying amounts of bandwidth during a single play, depending on the stage of the game the consumer is in. This may add a whole new dimension to the rating process.

Solutions

Cable companies and telcos are beginning to work with one another to bring the best characteristics of their respective systems together to meld the transaction management systems needed for convergence. This approach most certainly will deliver the fastest solutions. In the past six months, a tremendous amount of learning and advancement in the understanding of these issues has surfaced in conferences, magazine articles and seminars. All now routinely address these challenges. →

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Many cable and telephone companies have been researching systems that will be able to handle more advanced services. They realize they have to get on the information highway if they want to survive in the world of convergence. Service providers also are seeing the wisdom in working together toward finding solutions.

Much work remains to be done, however, to solve the challenges convergence will bring. Many recent test projects and experiments have focused solely on the types of services that providers will be able to offer and the hardware that will be necessary to get them to the consumers. While both factors are important, little consideration has been given to how the service providers will be paid for their products and collect the funds necessary to stay in business. This is one issue that must not be overlooked.

Fully relational data bases

The fully relational data base is vital in meeting the challenges of convergence. Because all the new transactional information will have to be retrievable in a myriad of unforeseen ways, fully relational data bases will be crucial in the convergence market of the future. Not only will service providers need to keep detailed records of each customer's transactions for billing purposes, they also may want to retrieve the records to support marketing decisions.

Being able to inquire which customers responded to which types of services will allow service providers to make better decisions on service offerings and marketing plans. Flat file data bases will not be adequate to support the new services made available by convergence. Relational data bases and the ability to do ad-hoc query reporting will be crucial to the success and survival of service providers. Many transaction management systems used today by cable companies make use of relational data bases to transform information into an asset.

As we move toward convergence, no one knows how many services will be available for providers to offer their customers. A great advantage to utilizing a fully relational data base is the ease with which a service provider can add new service offerings. Accommodating additional, unpredictable new services is as easy as plugging them into the existing data base. No time-consuming and costly system redesigning is necessary.

As service providers begin to look at additional service offerings, the ability to use fully relational data bases to merge multiple data bases into a single information source will emerge as a valuable asset. Cable TV, residential telephony, business telephony and as-yet-unnamed service customers can be serviced simultaneously with immediate access to complete account information. Systems that employ the "service group" concept and fully relational data bases — and therefore enable service providers to view subscriber data bases independently from the services a subscriber may receive — will become prominent. Service groups also enable providers to address all customer needs from one application. Service groups integrate the data base by linking related information while allowing separate data input screens, billing formats, collection processes and report options to be established for each service.

Object-oriented technology

Object-oriented technology is another tool that will be useful in meeting convergence transaction management chal-


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lenges. For support systems, object-oriented technology may help make the development of these systems less expensive.

Other technologies that will be key tools are graphic user interfaces for terminals, open systems standards, client-server technology and general real-time processing technology.

Lessons from integrated services

To date, there is no single solution to all of the previous challenges. We can look, however, to the lessons learned by cable and telephone companies in the United Kingdom that are already providing integrated services. While they have not yet discussed interactive broadband services, the U.K. integrated providers supply residential telephony, business telephony and cable services to their customers. The fact that they are operating as integrated entities and have transaction management and billing systems to handle transactions on a unified and integrated basis provides valuable experience.

To develop the necessary transaction management systems, these businesses realized the need to partner with companies that are experts in transaction management. The result of one such partnership is Intelecable (see accompanying figure) , the world's first fully functioning transaction management system designed specifically to support converged telephony and cable operations.

In 1992, Britain's Birmingham Cable Ltd. (BCL), the world's largest cable/telephony company, entered into a unique customer/vendor relationship. Supported by major investors such as Comcast, BCL pioneered a working relationship to create one system to support both its cable and telephony business. BCL chose CableData, which offered cable subscriber management systems expertise, open systems architecture and relational data base technologies, as a working partner in the software system development.

With BCL serving as a live-in lab and working in open vendor/vendor relationships with companies such as Mercury, Northern Telecom and CableTime, CableData delivered a system that integrated four separate data bases — cable, residential telephony, business telephony and circuit management — into a single data base. The system provides circuit assignment and provisioning capabilities as well as separate data input screens, billing formats, collections paths and financial reporting options for each service.

Intelecable went live in the summer of 1993. It now supports BCL's 49,000 cable subscribers, 35,000 business and residential phone lines and 250,000 calls daily. Its structure gives BCL the capacity to support projected growth that includes 375,000 cable

"Service providers should keep an open mind about forming working relationships with other companies whose products and services will complement their own in the convergence marketplace."

customers and 465,000 homes passed by 1997.

Costs

While it is impossible to quote what the solutions to transaction management challenges will cost telcos and cable companies, a major expense in creating a successful system will be integrating data bases with the myriad of service offerings that will develop.

While cable companies have some advantage with their open systems designs, they will have to face the costs of developing applications that are telephony-specific. In addition to the costs of developing applications that are cable-specific, telephone companies face the additional concern of redesigning their entire systems. While telcos already have transaction-intensive subscriber management and billing systems in place, many of these systems are old and it will be difficult and expensive to integrate them with interactive broadband.

The lowest-cost solution for all service providers is to partner with companies who can provide an integrated system design. Since the design of the systems has already been done, the only costs involved may be porting these open platform transaction management systems to the service provider, and making those adaptations necessary to support the additional service offerings convergence will allow.

Sources of information

Answers to the challenges that will face cable and telco MIS executives as we move toward convergence cannot be found in textbooks. Every day new services are imagined and new challenges arise. For example, the thinking behind the network architecture of broadband systems has changed radically during the last year. No textbook would have been able to keep up with it. Cable and telco executives can best stay informed of developments by being active in industry groups, attending conferences on the topic and reading industry publications and technical papers.

Conclusion

As we move toward convergence, perhaps the best method of facing the challenges that will arise is developing alliances. Service providers should keep an open mind about forming working relationships with other companies whose products and services will complement their own in the convergence marketplace, like the situation described earlier at BCL. **CT**

Powering stability and loading in a modern communications network

By Don Sorenson
Senior Project Engineer, Alpha Technologies
And Tom Osterman
President, Comm/net Systems Inc.

Cable TV, stimulated by the advancement of fiber optics and digital compression technology, is rapidly evolving into a "total communications network" offering a wide range of services never before available. One area in particular that is receiving a great deal of attention is the use of telephony over a broadband network. Both existing cable TV plant (upgraded to carry telephone service) and new broadband systems (constructed by the telephone companies) will demand reliability and performance.

One of the most important and fundamental components of any communications network is power. Reliability is absolutely vital to networks deploying telephone and digital services via broadband. An interruption in power may adversely affect communications and potentially destroy critical data such as dropping telephone calls in progress.

Network designers face important powering decisions, including the selection of a reliable uninterruptible power supply (UPS). This article addresses several powering issues including power supply characteristics for active devices, the influence of coaxial loop resistance, and other potential powering details that could potentially affect system stability. In addition, several measures are discussed to moderate or eliminate these detrimental effects.

Amplifier power supplies

The increased deployment of switchmode power supplies (SMPS) in cable TV network actives has resulted in unanticipated loading and powering stability problems in longer feeder and trunk designs. Previously successful network designs, which

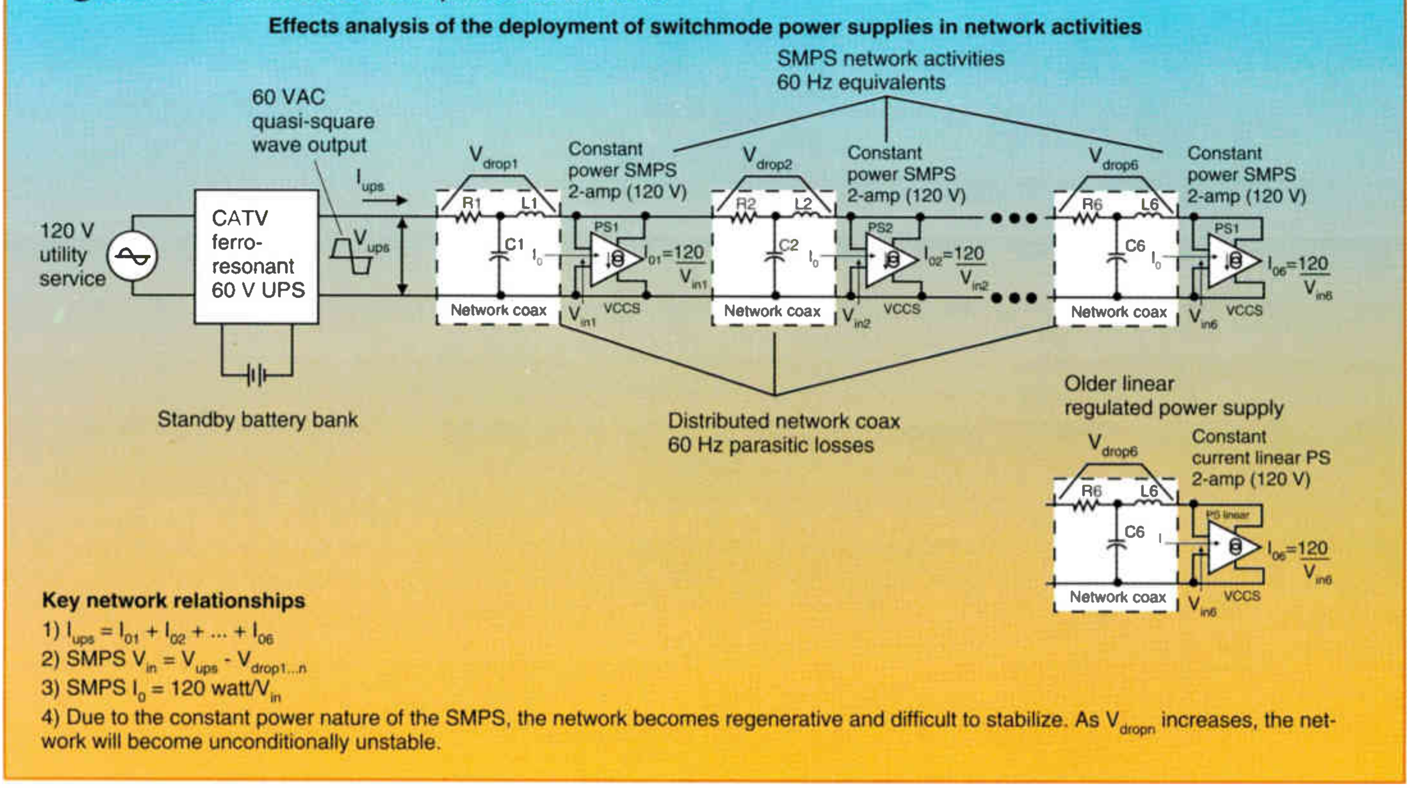
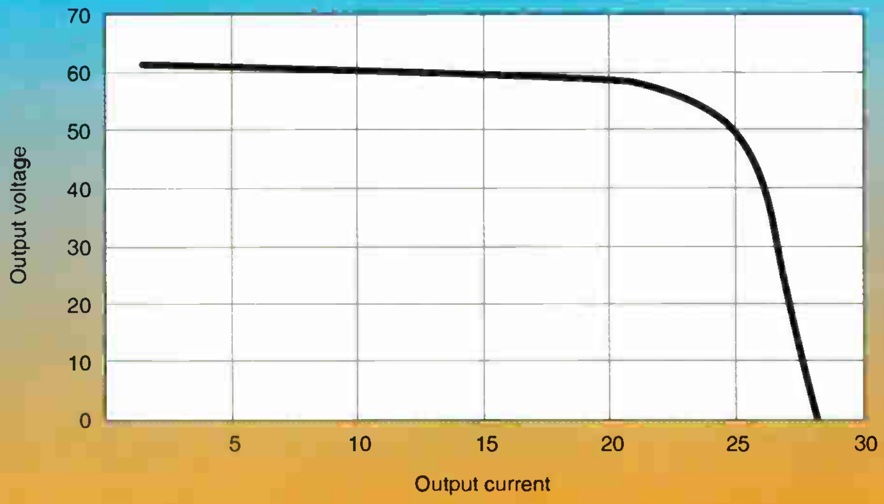


Figure 1: CATV network simplified schematic

Figure 2: 15-amp CATV ferro UPS fold-back characteristics



Comment: This graph illustrates the fold-back characteristics of a common 15-amp cable TV ferro UPS. The UPS can sustain an output current beyond its nameplate rating without substantial reduction in its output voltage. However, as the RMS output current exceeds 21 amps the output begins to fold and by 26 amps the voltage of the UPS collapses.

deployed older active devices, are now potentially unstable at power-up or during transitions or disturbances in the electric utility grid.

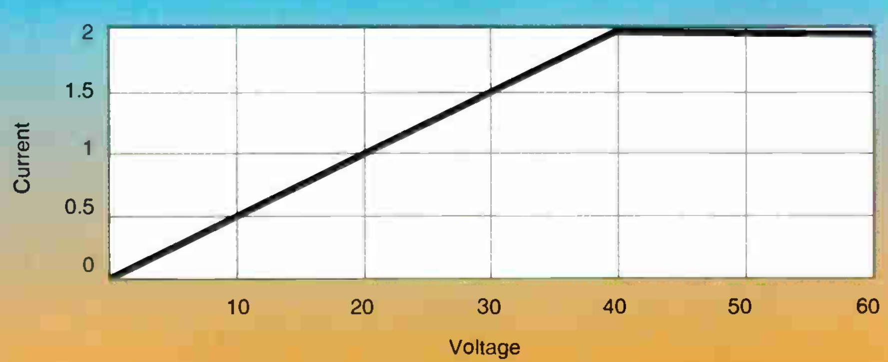
In an effort to improve efficiency, the cable TV amplifier manufacturers began to utilize advanced power switching techniques. This allowed the power supply to efficiently convert 60 VAC power to DC, which could then be used to power its internal circuitry. Prior to the switch-mode power supply, earlier designs utilized linear regulator techniques that performed the same function. However, efficiency was usually 20-30% lower. The advanced SMPS design allowed the cable TV network designer to take advantage of several cost reducing benefits:

- The deployment of additional actives per 60 VAC power source.
- Potential power supply downsizing within the network.
- Increased network energy savings.
- Reduced size, weight and cost of amplifier power supplies.

Cable TV network powering

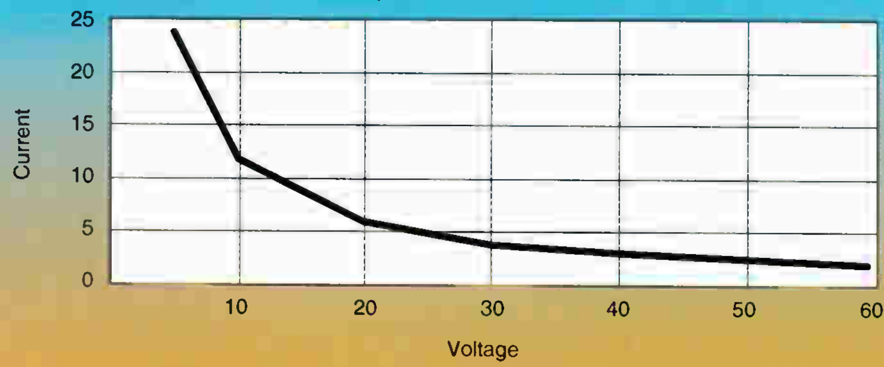
A typical cable TV feeder or trunk is composed of several thousand feet of coaxial cable segmented by a series of amplifiers. The amplifiers are, in turn, powered via 60 VAC inserted on the coaxial cable. Figure 1 illustrates a "worst-case" powering condition: an end-fed network. In

Figure 3: Linear power supply (constant current load)



Comment: Once the power supply's input voltage reaches a nominal low line level, in this case 40 VAC, the load current becomes constant. The curve is an idealized representation of a 2-amp 60 VAC power supply.

Figure 4: SMPS constant power load

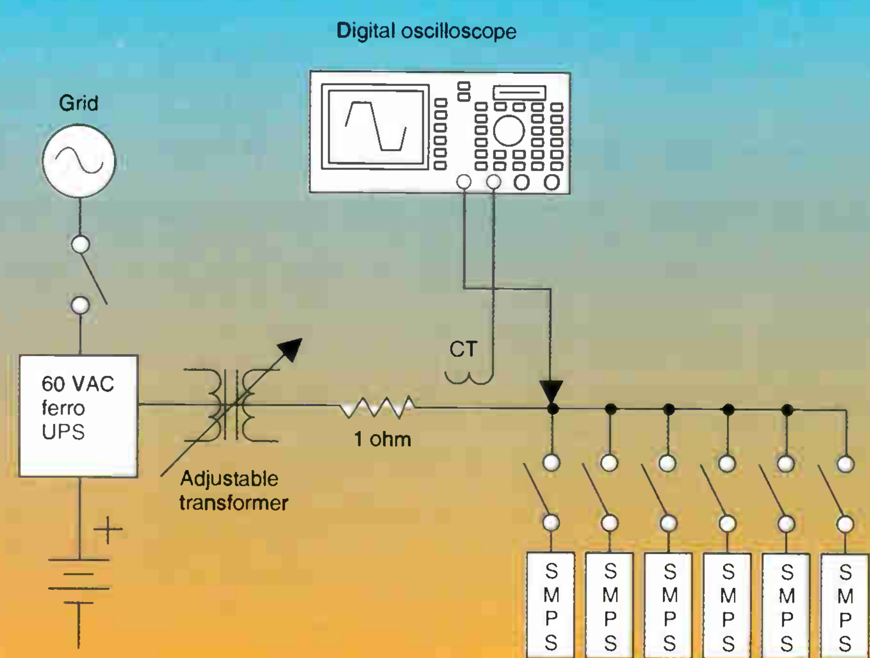


Comment: In case of a constant power supply load the input current increases rapidly and the input voltage falls. The curve is an idealized representation of a 2-amp 60 VAC power supply.

many cases, the 60 VAC source is located elsewhere in the system. Even though this configuration helps moderate the effects of coax loop resistance on actives, the basics are valid for all power insertion locations.

Ferroresonant 60 VAC power supplies, nonstandby, standby or UPS, are most commonly utilized to power cable TV equipment. The power supplies convert and condition power from the electrical power grid before supplying it to the amplifiers and other active devices in the network. Some of the key features of the 60 VAC power supply are its "quasi-square wave" output, plus excellent isolation, regulation and current limiting characteristics. These greatly increase the quality and reliability of the power provided to the coax feeder and prevents potential damage to active and passive devices in the event of a network fault condition. Figure 2 (page 113) represents the voltage/current characteristics of a typical 15 amp ferroresonant power supply. As the network load increases beyond the output rating of the power supply, the fault current is lim-

Figure 5: Stability test fixture



1) Power supplies are switchmode.
2) Network resistance simulated with 1 ohm series resistance.

Special section

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SCTE's 25th: You ain't seen nothin' yet!

By William W. Riker
President, Society of Cable Television Engineers

This year the Society of Cable Television Engineers celebrates the 25th anniversary of its creation by a group of industry engineers at a meeting in San Francisco. Although the 79 charter members can better relate activities of the Society during its early days (see profile of charter member Rex Porter in the March issue of the SCTE newsletter, *Interval*), my personal recollections of SCTE begin in 1977, the year I went to work for Suburban Cablevision in northern New Jersey. My new boss was Bob Bilodeau, who was serving as SCTE president at the time. Naturally, many of Bob's staff joined the Society and at my first meeting, I helped erect a transportable downlink for the members in attendance to witness satellite-delivered signals for the very first time.

In the early 1980s as National Cable Television Association's director of engineering under Wendell Bailey, I acted as liaison between the NCTA and SCTE. In that capacity, I sat in on several Society board of directors meetings as the organization was going through some major restructuring. This resulted in my becoming involved in many Society committee activities, which ultimately led to my being appointed executive vice president of the organization.

Bill Riker addresses attendees at the SCTE's annual Cable-Tec Expo.

"I have seen the membership grow from 2,500 to almost 12,000, the number of chapters expand from 3 to 73 and the reputation of the Society evolve to become the technical training organization for the industry."

Since joining the SCTE staff in 1984, I have seen the membership grow from 2,500 to almost 12,000, the number of chapters expand from 3 to 73 and the reputation of the Society evolve to become the technical training organization for the industry. This phenomenally rapid expansion can be largely credited to the leadership of the board of directors, the dedication of the national headquarters staff and the devotion of the over 600 chapter and meeting group officers who have brought much-needed technical training opportunities to the local level.

As we celebrate the Society's 25th anniversary at Cable-Tec Expo '94 in St. Louis, I would like to publicly thank all those responsible for all their hard work in making the Society what it is today. But, we are far from finished. As the cable TV industry evolves into the telecommunications industry, the Society faces yet another challenge. That is to train our existing membership in these new technologies as well as educate technicians and engineers from related industries about the business that has been so good to us. Therefore, I ask the membership to continue its support of the Society so that we can make this organization a key player in today's converging marketplace. Even though the Society is one quarter of a century old, I strongly believe that "you ain't seen nothin' yet!"

The history behind the SCTE

The Society of Cable Television Engineers, which celebrates its 25th anniversary this year, had its roots in an editorial that appeared in the November 1968 edition of *Cablecasting* magazine. Charles Tepfer wrote of the lack of recognition awarded cable system engineers. William Karnes of National Trans-Video wrote a letter in response to this piece stating that system engineers should be acknowledged for their valuable contribution to the young and growing cable TV industry. This suggestion drew resounding support from others in the industry, resulting in *Cablecasting*'s publication of an application for membership in the newly named Society of Cable Television Engineers.

The first board

Words became action on June 22, 1969, as the fledgling Society held its first general meeting in conjunction with the National Cable Television Association convention (held, ironically, in the San Francisco Hilton Hotel, site of SCTE's Cable-Tec Expo '88). Seventy-nine people, today recognized as charter members of the Society, were in attendance. Elections for officers were held at this meeting, which also saw the presentation of the temporary bylaws that would evolve into the national bylaws observed by the Society. Eleven regions also were identified for the purpose of establishing local chapters.

It was at this first meeting that Ronald Cotten of Concord TV Cable suggested that the Society incorporate as a nonprofit association. This incorporation also would extend to the regional chapters. The group elected as temporary officers Ronald Cotten (president), William Karnes (vice president) and Charles Tepfer (secretary/ treasurer). Karnes moved that a temporary board of directors be constituted of the three officers and the regional chairmen until a permanent board could be elected by the membership.

Chapters emerge

Organization of local chapters began in 1970, but were delayed by problems with correspondence, dues and miscommunication. It is interesting to note that SCTE was perceived by some as having the hidden purpose of unionizing all technical personnel in the industry. There also was concern voiced in the industry that there were no standards established for admission to the Society. These concerns ultimately led to the establishment of the Society's entrance requirements.

Bill Karnes remained president in 1971, with Austin Coryell serving as vice president. The Society once again met in conjunction with the NCTA show, this time in Washington, DC, in July of that year. Approximately 110 members were in attendance, but the Society's total membership was over 500 at this point. The development of a certification program remained an important concern to the membership, which grew to 675 in 1972.

The rush is on for the Expo '92 show floor. Expo attendees keeps going up as does Society membership.

Gaining prestige

SCTE had gained additional prestige in the industry by 1973, the year in which it was invited to participate in the NCTA's presentation of achievement awards. That year's new officers included Bob Bilodeau (president), Steven Dourdoufis (eastern vice president), Robert Cowart (western vice president) and Charles Tepfer (secretary/treasurer). Bilodeau guided a national membership drive aimed at more experienced CATV personnel.

The society has celebrated many successes through the years. Here at Cable-Tec Expo '93 in Orlando, FL, fireworks wrap up another successful confab.

LRC Electronics became the first sustaining (corporate) member of the Society in 1974. Sustaining membership has since served as a means of allowing individual organizations to show their support of the Society through annual financial contributions.

1974 also saw a surge in interest in the Society. Membership was nearing the 1,000 mark, and local chapters were revitalized while new chapters were organized. SCTE changed its bylaws to establish senior and student members as new grades of membership. SCTE also incorporated in 1974, officially becoming the Society of Cable Television Engineers Inc.

Expanding activities

First published in March 1975, the Society's monthly newsletter, *Interval*, gave SCTE new visibility in the industry while publicizing its activities on a timely basis. 1975 also was the year in which the SCTE Member of the Year Award was officially introduced to recognize individuals who had made a significant contribution to the Society. Steven Doudourfis was honored for his efforts in 1974, but James Collins became the first

INTERVAL

Volume 18, Number 2 March 1994

The Monthly Membership Newsletter of the Society of Cable Television Engineers

1994 Emerging Technologies Conference Draws Record Attendance

Nine hundred and fifty people were in attendance when SCTE held its 1994 "Conference on Emerging Technologies" Jan. 4-6 at the Pointe Hilton Resort on South Mountain in Phoenix, AZ. This figure represents a 25% increase over last year's attendance and the largest group to convene since the conference was first held in 1988.

Once again, this year's attendees had the opportunity to participate in the preconference tutorials that were held prior to the event. "We received a great response from the telephone industry at this year's conference," stated SCTE President Bill Riker, "so the tutorials were held to acquaint people with telephony and digital terminology."

Missing from this year's program were the table top exhibits. Although established to give members the opportunity to get hands-on experience with new equipment, Riker said, "We started to feel having exhibits along with the conference was competing with our annual convention, Cable-Tec Expo." →

A record number of attendees registered for the 1994 Conference on Emerging Technologies, held Jan. 4-6 in Phoenix, AZ.

Conference program chairman Ted Hartson leads the panel discussion on competing technologies for Session D, "Who Are These Guys?"

SCTE

"Training, Certification, Standards"

"Interval," the Society's monthly newsletter, has been published since 1975.

formal recipient of the award in 1975.

SCTE held its first National Engineering Conference in 1976.

In 1977, the Society opened its first full-time office in Washington, DC, and hired its first paid staff. (SCTE had been all volunteer until this time.)

1978 saw the publication of the first *SCTE Membership Directory*, which was distributed to the Society's 1,000 active members.

The Society fell upon hard times during the early 1980s and few records exist. However, picking up from 1983, the chronicle continues.

The Expo

The Society's first Cable-Tec Expo was held May 6-8, 1983, in Dallas. This annual training and CATV hardware conference has subsequently been held in such diverse and exciting locations as Nashville, TN (1984), Washington, DC (1985), Phoenix, AZ (1986), Orlando, FL (1987) and San Francisco (1988). SCTE returned to Orlando for the 1989 and 1993 Expos and Nashville in 1990. Reno, NV (site of Expo '91), and San Antonio, TX (location of Expo '92), also proved to be popular locations for the conference.

More programs

The Satellite Tele-Seminar Program series was created in 1984 to provide technical training videotapes to cable systems across the country. System operators are encouraged to downlink and record these programs for their present and future training needs.

In 1985, the Broadband Communications Technician/Engineer (BCT/E) Certification Program was introduced at Cable-Tec Expo with 90 attendees becoming the first BCT/E candidates. Since its introduction, over 3,000 candidates have enrolled and sat for a total of over 8,000 individual exams.

"It is this dedication in the professional development of the industry technical personnel that has enabled the Society to make such tremendous advances."

The Technical Tuition Assistance Program was created in 1985 by the board of directors. This SCTE scholarship program has provided educational opportunities to 81 of its members by awarding them tuition assistance for NCTI correspondence courses. In 1988, the program awarded tuition assistance for university courses to deserving members for the first time.

In 1986, the number of local SCTE chapters and meeting groups reached 30, doubling the total from one year before. These groups continue to hold low-cost, high-quality technical training seminars across the country, bringing educational opportunities to industry personnel at all levels. As of this writing, SCTE has 67 chapters and six meeting groups for a total of 73 local groups.

1987 marked the first time in the Society's history that it has owned its own office space. The new national headquarters building, located in Exton, PA, officially opened in January with a joyous grand opening celebration. The purchase of the property was made possible in part by generous contributions to the Society's new building fund.

Another SCTE milestone, the full certification of the first BCT/E participant to successfully complete the program, Ron Hranac of Coaxial International, occurred in 1987. Hranac was certified at the program's Technician level. Les Read of Sammons Communications, who completed the program later that year, was the first person to be fully certified at the Engineer level.

The Society's membership figures provide a chronicle of its growth. Although SCTE experienced strong growth from 1977 to 1979, recent years really tell the story. The Society has effectively tripled in size since 1984, when the year-

(Continued on page B20)

Phillips Business Information

and

Communications Technology

magazine,

the offical journal of the

SCTE,

are proud of this alliance

and wish to congratulate the

SCTE

for 25 years of leadership

and dedicated service

to the

cable television industry

SCTE committees: How they serve the membership

The day-to-day operation and administration of SCTE and its various activities is guided and monitored by five committees reporting to the SCTE board of directors. These committees are called board committees and consist of a Training Committee, an Engineering Committee, an Operations Committee, a Planning Committee and a Finance Committee. These committees have five members. The majority of any committee are members of the SCTE board of directors, but nonboard members also can be members of the committee. Board members normally serve on no more than two board committees.

Training Committee

The Training Committee is responsible for the Broadband Communications Technician/Engineer (BCT/E) Program and all other matters related to technical training. Any committees, subcommittees and their working groups or task forces necessary for training report to the Training Committee.

Engineering Committee

The Engineering Committee is responsible for all standards and recommended practices activity of the Society. Any committees, subcommittees and their working groups or task forces necessary for standards and practices report to the Engineering Committee.

Operations Committee

The Operations Committee is responsible for the day-to-day operations of the Society. This committee works closely with and coordinates with the SCTE professional staff. The SCTE president is a member of this committee. Any committees, subcommittees and their working groups or task forces necessary for operations report to the Operations Committee.

Planning Committee

The Planning Committee is responsible for planning the direction and focus of the Society. The committee and its subcommittees are responsible for gathering information and ideas that guides the Society toward becoming the best possible broadband engineering professional society. Any committees, subcommittees and their working groups or task forces necessary for planning report to the Planning Committee.

Finance Committee

The Finance Committee is responsible for the financial health of the Society. It works with the SCTE staff and independent auditors to ensure that the SCTE financial situation is sound. An annual budget and project budgets are produced and submitted to the board. The SCTE treasurer is the chairman of this committee. Any committees, subcommittees and their working groups or task forces necessary for fiscal reasons report to the Finance Committee.

Executive Committee

The Executive Committee may act on behalf of the Society in any matter when the board of directors is not in session. All Executive Committee recommendations must be approved by the full board. The Executive Committee has the treasurer's accounts audited at least once each calendar year by an accountant/auditor and reports the results of the audit to the board of directors.

Focus on education: Certification programs and scholarships

The Broadband Communications Technician/Engineer (BCT/E) Professional Designation Certification program was officially introduced in March 1985 at SCTE's Cable-Tec Expo in Washington, DC, following nearly two years of development. SCTE chapters and meeting groups across the country have been administering the BCT/E examinations to area technicians and engineers since the program's inception, enabling it to continue to grow in recognition and enrollment. James McKinney, Federal Communications Commission mass media bureau chief, applauded the certification program as a means of recognizing the demonstration of technical knowledge, serving as a substitute for the canceled FCC First Class License examinations and assisting in personnel evaluations by management.

Following are abridged study outlines.

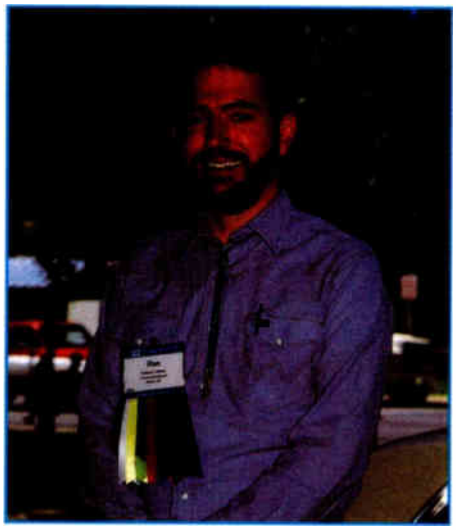
Category I — Signal Processing Centers
- I: Physical Design and Maintenance
- II: Antenna Types and Theory
- III: Headend Equipment
- IV: Maintenance
- V: Miscellaneous

Category II — Video and Audio Signals and Systems
- I: Baseband Video
- II: Baseband Audio
- III: Production Equipment
- IV: Tests and Measurements
- V: Digital in Video and Audio Systems

Category III — Transportation Systems
- I: General Considerations
- II: Microwave Systems
- III: Coaxial Supertrunk
- IV: Fiber Optics
- V: Satellite Transmission

Category IV — Distribution Systems
- I: Calculations
- II: System Design Engineering
- III: Distribution Components
- IV: Construction Techniques
- V: System Proof and Testing

Category V — Data Networking and Architecture
- I: Data Transmission Terminology
- II: Transmission Basics
- IV: System Design Implementation & Testing



Ron Hranac, shown here in 1992, was the first SCTE member to be fully certified at the BCT/E Technician level back in 1987.

Category VI — Terminal Devices
- I: Installation Practices
- II: Consumer Equipment Interface
- III: Set-Top Devices
- IV: Program Security Methods
- V: Pay-Per-View Systems
- VI: Regulatory
- VII: Performance Testing

Category VII — Engineering Management and Professionalism

No program outline or bibliography is supplied for this category. However, review courses for Category VII have been produced on videotape. The examination questions for this category are a series of case studies. In each case study, a short description of a situation is given. Candidates are requested to respond to the case study with an essay. While the length of the essay is relatively unimportant, the examination committee is most interested in the thought processes used by each candidate to fully explain the expected courses of action.

"Deserving applicants have been awarded tuition assistance to pursue correspondence courses from NCTI from the inception of the program, and in 1988 the first grant for a college course was awarded."

Certifying installer/techs

The goals of the Installer Certification Program are to establish minimum skill requirements for installers and installer/technicians in the cable TV industry. Once they have mastered the elements of the program and successfully completed the required examinations given by the Society of Cable Television Engineers, the Society will award them a certificate indicating their competence in this area.

Local SCTE chapters and meeting groups, under the guidance and direction of SCTE national headquarters, conduct the training and examination of all candidates. Installer training workshops and certification examinations also may be given by any national SCTE director, members of the national SCTE staff or other individual designated by the Installer Certification and Administration Subcommittee.

Installer membership in the Society entitles the individual to all the discounts afforded SCTE members at conferences, meetings and seminars, as well as discounted prices on all SCTE products, publications, materials and videotapes sold by the Society. Installer membership does not include voting privileges, holding an SCTE office at national or local chapter and meeting group levels, insurance coverage or any other Active membership benefits that require an expenditure of Society funds. A special membership card is issued for Installer members of the Society.

The certification program consists of training conducted by local chapters and meeting groups using the *Installer Certification Manual* as the basis for classroom training as well as "hands-on" training in proper drop cable preparation, fitting installation and signal level meter reading.

Upon completion of the training program, a 50-question, closed-book written examination provided by SCTE national headquarters is administered to the candidates. Chapter and meeting group presidents are authorized to proctor this examination. Other local chapter or meeting group members also may receive approval

Congratulations
to the
SCTE
for 25 years
of leadership
and dedicated service.
On behalf of,
Electroline and its staff.

Mitchell Olfman,
President and C.E.O.

to act as proctor following application to national headquarters. Prerequisite requirements for proctors include national membership and a statement of ability from the chapter or meeting group.

In addition to the written examination, two practical examinations are conducted. The areas covered under the practical examinations are:

1) Proper drop cable fitting preparation and installation.

2) Signal level meter reading.

Each of the practical examinations, when successfully completed, is recognized with a special seal that is to be attached to the certificate. Proctors for the practical examinations also must be approved by national headquarters.

Installer Certification by the Society is valid for a period of three years.

SCTE scholarships

The SCTE Technical Scholarship Program, with the goal of providing tuition assistance for technical training courses to industry personnel who show great potential for advancement, received its impetus from Rex Porter's personal donation of $2,500 in 1986. The National Cable Television Institute (NCTI) agreed to match Porter's grant, enabling SCTE to award $5,000 in technical tuition assistance. Deserving applicants have been awarded tuition assistance to pursue correspondence courses from NCTI from the inception of the program, and in 1988 the first grant for a college course was awarded. The broadening of the program's scope to include technical school and other industry-related courses means an unprecedented number of scholarship recipients can advance their knowledge and careers.

Though originally conceived as a one-year program, donations from industry corporations and individuals and the continuance of NCTI's fund-matching agreement have allowed the program to continue. 1992 and '93 again proved the generosity of our industry, with contributions from Adelphia, CT Publications Corp., Contec, Corning, Harron, Jones Intercable, Lyn-Lad Trucks Equipment, NewChannels, the New York State Cable Commission, and individuals James Kuhns and Albert Richards, as well as NCTI's fund-matching. In addition, SCTE has been honored by being selected by the New York State Cable Commission to oversee the financial investment of its Ken Foster Memorial Scholarship Fund.

SCTE chapters and meeting groups

The development of local chapters has grown to be one of the Society's most successful "grass roots" programs, which is evidenced by the national board's recent elevation of yet another meeting group to official chapter status within the organization. The Pocono Mountain Chapter becomes the newest training arm of the Society, which now comprises 73 chapters and meeting groups (chapters under development) operating under the auspices of SCTE. This translates to the Society's presenting over 300 local technical training meetings each year for the benefit of its membership.

With the support of the board of directors, national staff and over 600 volunteers who serve as chapter officers and board members, SCTE's chapters and meeting groups offer a wide variety of highly beneficial educational opportunities to the industry. Especially relevant in today's converging telecommunications market, technical sessions feature hands-on demonstrations of emerging technologies and hardware, as well as timely information presented by knowledgeable speakers from top manufacturers, suppliers and MSOs. Featured speakers often include local and national government officials who offer different viewpoints on topics of vital interest to the industry.

The following is a listing of SCTE chapters and meeting groups.

Adirondack Chapter
Saranac Lake, NY
Contact: Bob Corbin, Secretary/Treasurer
(518) 891-6009

Appalachian Mid-Atlantic Chapter
Altoona, PA
Contact: Ron Mountain, Secretary/Treasurer
(814) 672-5393

Ark-LA-Tex Chapter
Shreveport, LA
Contact: Randy Berry, Secretary
(318) 238-1361

Badger State Chapter
Fond du Lac, WI
Contact: Brian Revak, Secretary
(608) 372-2999

Big Country Chapter
Abilene, TX
Contact: Bill Neely, Director
(915) 646-3516

Big Sky Chapter
Harlowton, MT
Contact: Marla DeShaw, Secretary/Treasurer
(406) 632-4300

Bluegrass Chapter
Elizabethtown, KY
Contact: Alan Reed, Secretary
(502) 389-1818

Cactus Chapter
Phoenix, AZ
Contact: Harold Mackey, Director
(602) 352-5860, ext. 135

Cascade Range Chapter
Portland, OR
Contact: Cynthia Stokes, Secretary
(503) 230-2099

Central California Chapter
Turlock, CA
Contact: Jim Robinson, Secretary
(209) 835-4037

Central Illinois Chapter
Bloomington, IL
Contact: Richard Rohm, President
(309) 467-5107

Central Indiana Chapter
Indianapolis, IN
Contact: Al Orpurt, Secretary
(317) 825-8551

Chaparral Chapter
Albuquerque, NM
Contact: Bob Wiseman, Secretary
(505) 761-6253

Chattahoochee Chapter
Atlanta, GA
Contact: Mark Williams, Secretary
(912) 784-5104

Chesapeake Chapter
Baltimore, MD
Contact: Scott Shelley, 2nd Vice President
(703) 358-2766

Dakota Territories Chapter
Aberdeen, SD
Contact: Michael Schmit, Secretary/Treasurer
(605) 229-1775

Delaware Valley Chapter
Horsham, PA
Contact: Bob Lauer, President
(610) 876-5000

Desert Chapter
Palm Desert, CA
Contact: Greg Williams, President
(619) 340-1312, ext. 277

Dixie Chapter
Birmingham, AL
Contact: Charles Hill, Secretary/Treasurer
(205) 880-1673

Florida Chapter
Fort Lauderdale, FL
Contact: John Tinberg, Secretary
(407) 747-4998

Gateway Chapter
St. Louis, MO
Contact: Duane Johnson, Secretary/Treasurer
(314) 949-9223

Golden Gate Chapter
San Francisco, CA
Contact: Mark Harrigan, Director
(415) 358-6950

Great Lakes Chapter
Livonia, MI
Contact: Jim Kuhns, Secretary
(313) 578-9437

Great Plains Chapter
Omaha, NE
Contact: Randy Parker, President
(402) 292-4049

Greater Chicago Chapter
Chicago, IL
Contact: Bill Whicher, Executive Vice President
(708) 362-6110

Hawaii Chapter
Mililani, HI
Contact: Fred Gerstl
(808) 625-8412

Heart of America Chapter
Kansas City, MO

→

Contact: David Clark, Secretary
(816) 358-5360

Hudson Valley Chapter
Schenectady, NY
Contact: Robert Price, President
(518) 355-3086

Inland Empire Chapter
Spokane, WA
Contact: Roger Paul,
Secretary/Treasurer
(208) 667-5521

Iowa Heartland Chapter
Cedar Rapids, IL
Contact: Mitch Carlson,
Secretary/Treasurer
(309) 797-2580, ext. 3700

Lake Michigan Chapter
Grand Rapids, MI
Contact: Karen Briggs, President
(616) 941-3783

Magnolia Chapter
Jackson, MS
Contact: Steven Christopher, President
(601) 824-0020

Michiana Chapter
South Bend, IN
Contact: Russ Stickney, Secretary
(219) 259-8015

Mid-South Chapter
Memphis, TN
Contact: Keith Bell, President
(901) 365-1770, ext. 4110

Miss/Lou Chapter
Baton Rouge, LA
Contact: Dave Matthews,
Vice President of Treasury
(504) 923-0256, ext. 309

Mount Rainier Chapter
Seattle, WA
Contact: Art Hedstrom, President
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Video Technology News®

The Executive Report on New Video Technology for Consumer and Professional Markets

Vol. 6, No. 10

Dear Executive:

CABLE COMPANIES ACCELERATE TOWARD DIGITAL SUPERHIGHWAY

The rush to develop the "digital superhighway" turned into a stampede in the last month, as both cable and telephone operators announced important hardware and software deals for their networks of the future.

The events demonstrate how rapidly the digital superhighway is moving from pipedream to reality. They also indicate that, despite having cornered the
market so far in c ... competition
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Among the imp ...

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ordering, VCR programming, on-screen menus, downloadable software upgrades, add-on cards to upgrade memory and "virtual channels" for data services.

In what could be a momentous acquisition of software, TCI signed a letter of intent to invest up to $90 million in four Carolco Pictures films during the next four years.

In return, TCI will show the films three times on the weekend before theatrical release. The pact is the first chink in the Hollywood armor around the sacred theatrical release and was greeted by a storm of protest from exhibitor organizations. After the Carolco deal, TCI announced a $10 million investment in interactive services provider and developer, Interactive Network.

The history behind the SCTE

(Continued from page B8)

end membership figure was 2,500. This figure grew to 2,700 in 1985, 3,200 in 1986 and 3,800 in 1987, with SCTE reaching the milestone figures of 5,000 members by the end of 1988, 6,000 members by 1989's end and 7,000 members by the beginning of 1991. At the 1992 Cable-Tec Expo, it was announced that the Society had passed the historic 10,000 mark.

Emerging Technologies

SCTE's Annual Conference on Fiber Optics, first held in 1988 in Orlando, FL, was renamed Fiber Optics Plus for the 1992 event, as it began to incorporate additional new technologies. By 1993, it became known as SCTE's Annual Conference on Emerging Technologies to incorporate other important technological advances impacting the industry.

Technical standards

In recent years, SCTE has been instrumental in establishing technical standards for the industry through its engineering subcommittees. The Interface Practices Subcommittee has created standards for coaxial cable and connectors, including the standardization of F-connectors. Also working to define standards are the Society's Design and Construction, Emergency Broadcast Service (EBS), In-Home Cabling, and Maintenance Practices and Procedures Subcommittees.

Looking forward

The Society currently has over 11,000 Active members, more than double the membership of six years ago, in addition to the more than 1,900 members who joined at the Installer level to participate in the Society's Installer Certification Program, introduced in 1989.

1991 saw the revitalization of the Society's newsletter *Interval* from a small magazine insert to a full-size, colorful periodical that is now mailed only to SCTE members, making it an exclusive benefit of membership in the Society. *Interval* continued its evolution when it was expanded from 12 to 16 pages with its January 1993 issue.

Acknowledging in print all the individuals whose tireless efforts have helped make these outstanding achievements a reality would fill a book. Yet, it is this dedication and belief in the professional development of industry technical personnel that has enabled the Society to make such tremendous advances.

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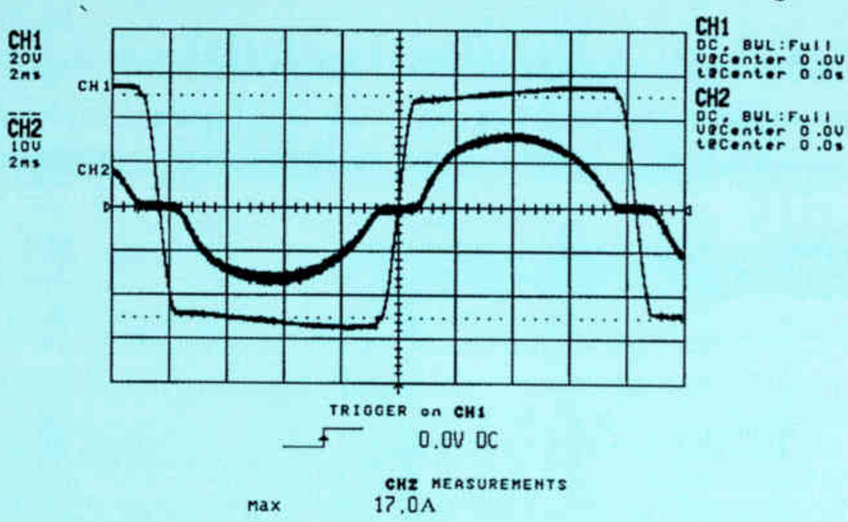
Figure 6: Steady state operation at nominal trunk voltage



Ch. 1: Power supply input voltage (20 volt/div., 50 V RMS)
Ch. 2: Power supply input current (10 amp/div., 9.6 A RMS)
Measurements: Peak load current

Comment: This frame illustrates steady state nominal cableTV trunk voltage conditions. This is a best-case condition where peak currents fall to acceptable levels.

ited by reduction of the transformer voltage. This "fold-back" characteristic limits the output current to an acceptable level. This important and desirable feature not only protects the power supply, but the coaxial cable and the power passing elements in series with the location of the short circuit as well. Under normal conditions, including reasonable transient overloads, the ferroresonant power supply will safely power the network actives.

Each segment of the network produces a corresponding voltage drop (V_{dropn}), which is proportional to the coax loop resistance and the current levels flowing in the segment. (See Figure 1 on page 112.) To ensure that adequate voltage is delivered to any active in the network, the length of the segments are managed so that the sum of voltage drops do not become excessive. In all designs, this is accomplished by placing the power source in a location that minimizes the voltage drops to the amplifiers at the extremities of the feeder. It is important to note that in the newer networks, especially where telephone and other services may be provided, some sort of network interface box will be attached to the side of each house. These may be powered by the feeder as well. This implies that power will be passed via the tap to the home and places


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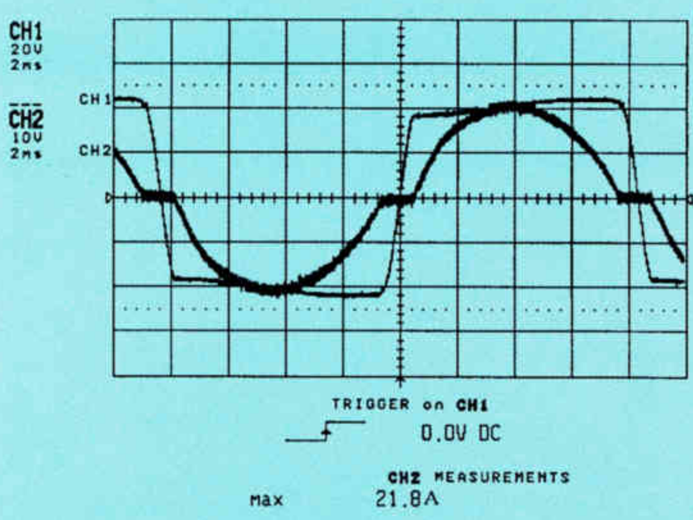
Figure 7: Steady state operation at reduced trunk voltage



Ch. 1: Power supply input voltage (20 volt/div., 40 V RMS)
Ch. 2: Power supply input current (10 amp/div., 14.3 A RMS)
Measurements: Peak load current

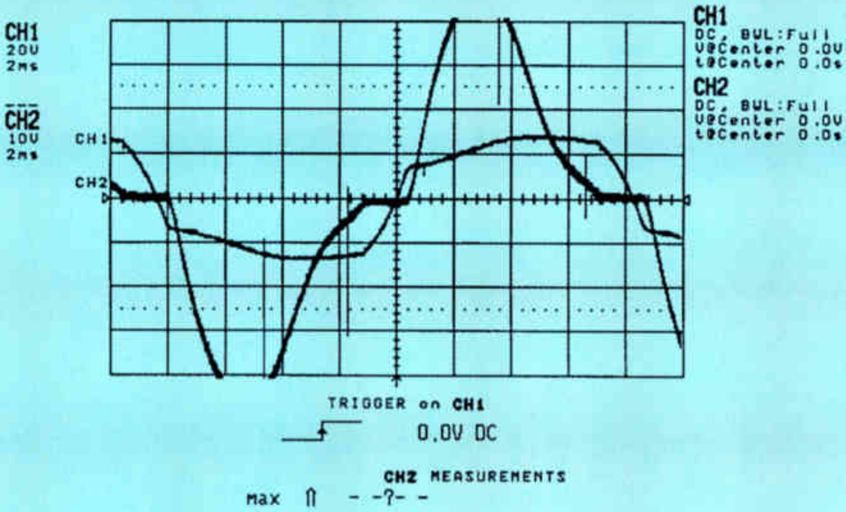
Comment: This frame illustrates steady state nominal cable TV trunk voltage conditions. The amplifier power supply's constant power characteristics has increased the peak and RMS currents to maintain internal regulation. However, current levels are still within the ferro UPS's output voltage fold-back characteristics. Voltage drop across the loop resistance is nominal and the network remains stable.

stringent requirements on the allowable voltage drop — not only to each amplifier but to each home.

In the past, the active devices contained power supplies that utilized linear regulation techniques. This produced a load similar to that shown in Figure 1 (page 112). As the voltage fluctuated from low-line to high-line (40 to 60 VAC), the current consumed by the amplifier power supply remained fairly constant. Once the line voltage fell below low line (40 VAC), the active powering current consumption fell proportionally as the linear power supply lost its regulation. This is further illustrated in the curve shown in Figure 3 (page 113). This linear design, however, resulted in a lower overall efficiency. At higher line voltages, the extra power flowing into the amplifier power supply was simply wasted as heat in the regulator. The amount wasted by the regulator fell to its lowest point just prior to a low line condition.

Modern switchmode power supply regulation techniques eliminate the need to waste significant amounts of energy to achieve regulated DC output voltages. This is accomplished by reducing the input current to the power supply at high line voltage (60 VAC) and proportionally increasing

Figure 8: Tranfer from line to standby



Ch. 1: Power supply input voltage (20 V/div., 26 V RMS)
Ch. 2: Power supply input current (10 A/div., ? A RMS)
Measurements: Post transfer ferro output voltage collapse

Comment: This frame illustrates the putput voltage after a line loss. The disturbance causes the amplifier power supply's constant power characteristic to force the ferro UPS into a voltage fold-back condition. The fold-back, in turn, produces a cascading sustained or oscillating collapse of the entire network.

the input current as the line voltage falls. From Ohm's law, this implies that the power supply has a constant power characteristic. This is illustrated in Figure 4 (page 114) along with the network diagram in Figure 1 (page 112).

Combining three elements: a 60 VAC source, coax loop resistance, and constant power switchmode power supplies in the amplifiers, produces a potential stability problem. Referring to Figure 1 (page 112), the "key network relationship" box demonstrates that a regenerative loop condition is formed (i.e., a cascading snowball effect). As the 60 VAC power source attempts to power up the network, the amplifiers' power supplies attempt to fulfill their regulation and startup goals with reduced input voltages, thus requiring high currents. These currents combine to levels that cause the ferroresonant power supply to begin to reduce its output voltage. The low supply voltage and corresponding higher currents drawn by the amplifiers' power supplies cause even more voltage drop because of the high current flowing through the coax loop resistance. This, then, makes the actives draw even more current and the situation quickly becomes progressively worse.

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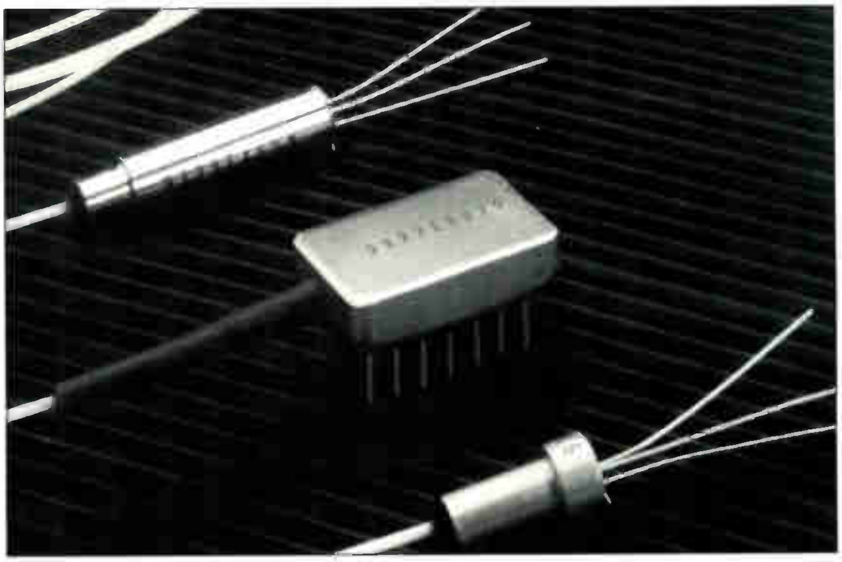

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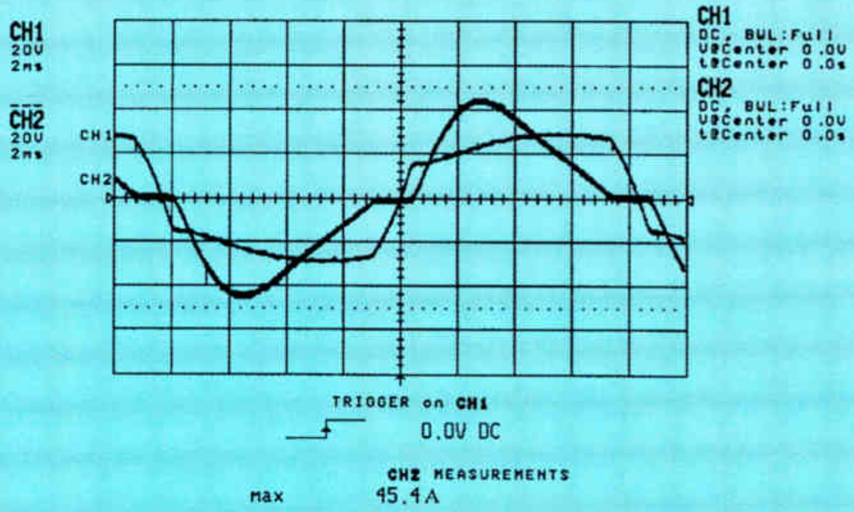
Figure 9: Maximum power supply current at low-line



Ch. 1: Power supply input voltage (20 V/div., 24 V RMS)
Ch. 2: Power supply input current (10 A/div., 25 A RMS)
Measurements: Power supply worst-case input current

Comment: This frame illustrates the peak current condition of the line amplifier power supplies. As the input voltage is reduced further, the current begins to decline as the power supplies fall out of regulation.

internal linear supply, the 60 VAC current would reach a maximum well within the ferroresonant transformer protection limits and the network would operate satisfactorily. Even in this scenario, the worst condition that would occur would be starving the farthest amplifier for sufficient voltage to maintain proper operation.

In summary, the older linear power supplies provided a "self-stabilizing" load, whereas the new switchmode power supplies can be unstable in certain applications. It is very important for the network designer to recognize and avoid this potential problem.

Laboratory testing

Alpha Technologies performed several laboratory tests to obtain data that supports these findings. Figure 5 (page 114) depicts the test fixture used in these tests and contains several simplifications. The distributed coax loop losses were lumped into a 1 ohm series resistance (approximately 1,000 feet of 75 ohm coaxial cable) with all SMPS actives connected to a single node. An adjustable autotransformer was used to simulate low coax line voltage conditions. This configuration allowed Alpha to investigate the combined effects of loop resistance, the ferroresonant transformer's foldback feature, and the actives' SMPS constant power load characteristic.

Figure 6 (page 116) is a data

Gould Fiber Optics has developed 1 x 3 Wavelength Independent Couplers (WIC™) with asymmetrical splitting ratios. These components help reduce fiber counts and costly transmitters in CATV systems. The broad wavelength range allows for future upgrades. The uneven splitting ratio gives system designers the flexibility they need. The 1 x 3 asymmetrical WIC Coupler comes in the following splitting ratios: 20/40/40; 30/35/35; 40/30/30; 50/25/25; 60/20/20. Call a Gould sales engineer today for more information.

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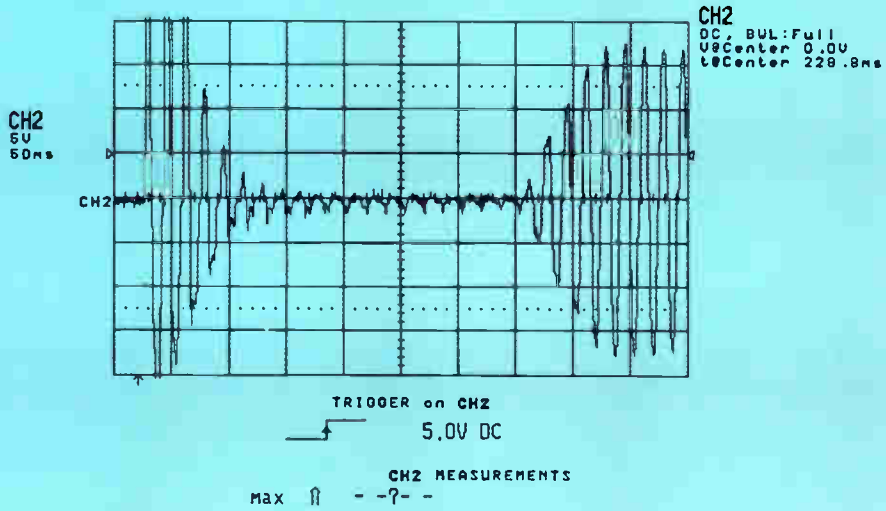
"Previously successful network designs, which deployed older active devices, are now potentially unstable at power-up or during transitions or disturbances in the electric utility grid."

frame taken from the oscilloscope while the test fixture was operating in a steady state condition with nominal 60 VAC line voltage applied to the amplifier power supplies. The peak currents were well within the ferroresonant transformer's specification and operation was stable. As the voltage was decreased on the coax, the SMPS produced a proportional increase in current draw (Figure 7 on page 118). Under these conditions, operation remained stable. However, the constant power characteristic of the SMPS was evident.

Instability was produced in the test fixture when the load was initially powered up. It also occurred when the utility line connection to the ferroresonant transformer was disconnected, causing the power supply to initiate standby mode (Figure 8 on page 120). Due to low line voltage, the SMPS was demanding high peak currents to maintain internal regulation. These high currents produced a substantial voltage drop across the series loop resistance that combined with the ferroresonant transformer's characteristic of output voltage foldback. This produced a "voltage starvation" that could cause the actives farthest out not to start. In other words, in the most distant network segments, it is possible that the actives could never start, irrespective of the AC power source voltage, since they are being starved as a result of the coax loop resistance. In the test fixture, this condition existed typically for several seconds before the system would "climb out" and become stable. The adjustable autotransformer was used to lower the SMPS voltage input to the point that would produce maximum current

Figure 10: Amplifier SMPS startup input current profile



Ch. 2: Power supply input current (10 A/div.)
Measurements: Peak current (out of range)

Comment: This frame illustrates the startup current profile of a trunk amplifier switchmode power supply. The SMPS initially draws current from the line then stops for a period of 250 ms before restarting for steady state operation. This delay in steady state operation is probably intended to assist in network startup. However, we feel that additional testing would be necessary to verify that it did not possibly resonate with a ferroresonant AC power supply's natural regulation properties.

draw (Figure 9 on page 122). Under these conditions the ferroresonant power supply was in a voltage foldback mode and could not pull itself back, even as the output of the autotransformer was increased.

During lab tests, several startup properties of the SMPS were analyzed. Figure 10 illustrates this particular power supply's startup by initiating four cycles of high-peak current draw, followed by 250 milliseconds of little, or no, current consumption. This was followed by a sustained steady state current draw. It is quite likely that the intent of this startup pattern is to moderate the impact of a cascade of several such actives on a network. Further, this sequence was only initiated at startup and may, or may not, contribute to stability.

Conclusions and recommendations

Equipment suppliers and network designers have worked quite hard to advance the state of the art and improve system efficiencies. This, however, has resulted in a potential powering stability problem. There are several immediate measures that can be taken to moderate this problem and provide a long-term solution.

Cable TV network designers and operators can implement one or more of the following near-term measures:

1) Carefully evaluate and, if possible, reduce the coax cable's loop resistance by minimizing the distance from the furthest actives to the power supply or by using larger cable with lower loop resistance.

2) Reduce the number of actives powered by each power supply to stay within the steady state and peak current specification. CableLabs recommends a typical loading of 85% of rated output current to provide a safety margin for peak current requirements.

3) Scale the AC power supply up in output current capacity. If low amperage power supplies are in use, simply going up to the next larger unit may be sufficient. In some cases, the larger 15 ampere power supplies can be retrofitted into these locations to provide additional output current capacity, thus improving stability. Note: Extreme caution must be taken in network design to prevent excessive short-circuit current that could be harmful to active and passive equipment.

4) Over time, manufacturers of amplifiers may introduce features to

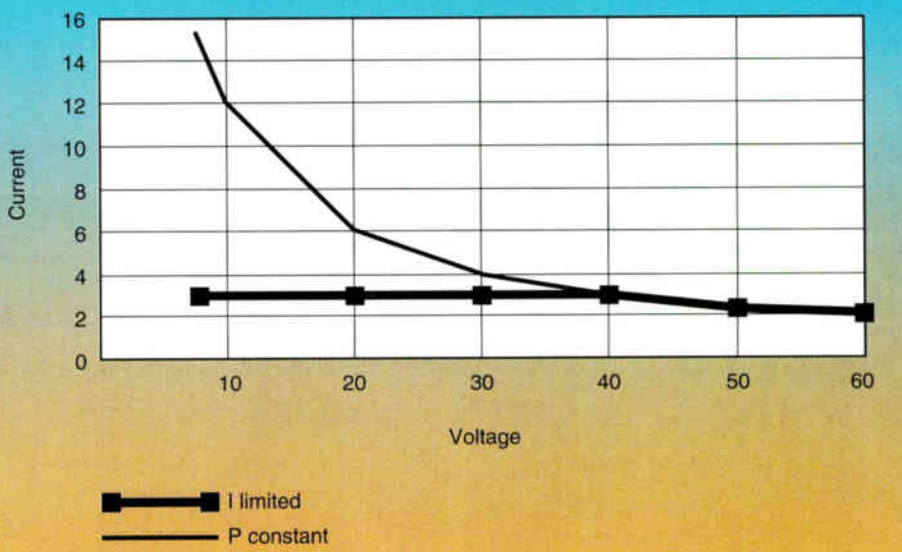
the switchmode power supplies that will contribute to better stability such as power factor correction, low voltage disconnect and restart, "soft start" and peak current limiting. These characteristics also should be present in the power supplies used in the network interface devices that will eventually be located on the side of each home to provide telephony, interdiction and other services.

All of these measures, in one way or another, may affect the benefits offered by using SMPS in actives. The best possible solution is to modify the network elements to eliminate this regenerative condition. Very little can be done to modify the fundamental properties of a ferroresonant transformer (the heart of the 60 VAC power supply). Over the past 20 years, these properties have demonstrated themselves invaluable in protection, reliability and maintainability of cable TV networks.

In many instances, as fiber penetrates farther into cable TV plant, coax feeder and distribution distances are being reduced. This also will result in a reduction in the number of active devices required, thus improving network powering stability.

In the design and construction of a switchmode power supply, the dynamic properties of its operation can be tailored to meet varying requirements. The addition of a peak current limiting function could eliminate the snowballing voltage starvation condition. The power supply would operate in a constant power mode over a low line to high line AC input range (40-60 VAC). Below this point, the power supply would transition to a constant current mode, thus reducing the possibility for extremely high network peak currents. As the amplifier's current draw rises in response to the falling input voltage, it would reach a limit and protect the network from a run away condition (Figure 11).

Figure 11: Current-limited SMPS



Comment: Modifying a SMPS operating characteristics to switch into a current-limit mode below a nominal low line voltage, 40 VAC in this case, would eliminate the runaway current stability condition.

There are a combination of elements that produce a cable TV network power instability problem. Several recommendations for immediate and corrective, or moderating, measures have been suggested, along with a final, long-term recommendation for eliminating this problem. Further evaluation and testing by the manufacturers of the active network devices, along with the AC power supply manufacturers, is proceeding. It may be of benefit to the cable TV industry as a whole to continue establishing guidelines through the auspices of CableLabs. This will greatly aid operators and manufacturers in ensuring their products will be compatible for use in new and existing networks. **CT**

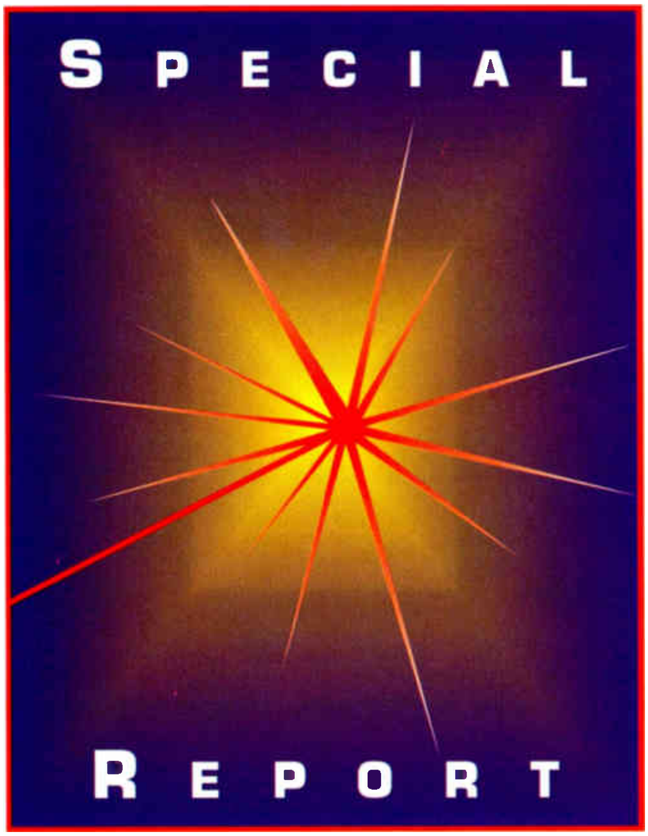
Organizing the headend with fiber management

This is the fifth in a series of special reports by CT's West Coast correspondent on the deployment of fiber optics.

By George Lawton

When fiber was first introduced into the cable TV headend, it was relatively easy to manage and make changes. After all, the average headend only had a few dozen fibers at the most. Jury-rigged connection systems and pen and paper were adequate to handle most jobs.

But as cable systems move to deploying fiber to nodes feeding only 2,000 homes, the number of fiber terminations in the headend has grown substantially. In addition to that, many operators are pulling extra fiber for future services like video-on-demand (VOD) and personal communications services (PCS). Consequently, the fiber count in the headend can grow into the hundreds or even thousands.



"Fiber management will play an important role in making it easier for cable companies to move into new services like telephony and data communications."

A number of different vendors have begun to offer fiber management systems that include hardware for more efficiently organizing the fiber and/or software that can be used to keep an accurate record of the current fiber configuration. Vendors in the market include AT&T (Figure 1) , C-COR, Porta Systems, Moore Diversified, 3M (Figure 2 on page 130) and ADC Telecommunications.

Cleaning out the closet

TCI is one company that has been studying the deployment of fiber management technology extensively. Richard Rexroat, vice president of engineering at TCI in Denver said, "About a year ago we decided that we needed fiber management. We were doing it with notebooks and it dawned on us, after hearing about different kinds of fiber management, that we could control it much more efficiently."

Since then, TCI has experimented with fiber management from AT&T, C-COR and ADC Telecommunications. Rexroat said that TCI is planning on installing fiber management in every market that has more than 48 fibers in the headend.

TCI Cablevision of Westchester, NY, used to have a wiring mess on its hands. Since the company pulled eight fibers to every neighborhood, there are currently 618 fibers leaving the headend. However, only about 90-100 of these fibers are now actively used. The system has 51 lasers and 17 fibers that are used for return path communications.

All connections between lasers, splitters and outgoing fiber were fusion spliced together. In some cases, up to four optical splitters were cascaded together.

Seven or eight binders were in use at any given time to track the connections. But owing to the difficulty in updating all the binders, they did not always accurately indicate the current fiber configuration. Cambron Gough, technical operations manager of the system, said that it could take hours to make a change.

AT&T recently installed a fiber management system for Gough's system. AT&T pulled out seven racks of fiber equipment strung together by a spaghetti-like mass of fibers, and replaced it with five racks connected by a methodically organized network of fibers. Gough said, "We did it because we were having problems keeping up with the fiber."

For example, if a laser failed, a technician would have had to break a fusion connection and make a mechanical splice or refuse it to some other fiber. Gough said that a technician now has the ability to pull a patch cord to a new laser in about two minutes. Gough pointed out, "The beauty of this is that it is a plug-and-play deal."

Gough also is finding that AT&T software gives him a better idea of how the headend is configured. Gough said, "We originally kept a set of fiber splicing documents. We discovered a couple of times that the updates were not always kept in one master place, so there was some confusion. The software still requires some human input but it is a lot easier than keeping six or seven binders updated."

AT&T's software uses a graphical user interface that contains screens that look like the front of the fiber patch panels. A technician can make changes to the fiber layout recorded by the software by taking the end of a fiber and moving it to another termination point.

Furthermore, the software includes exact instructions for doing the change, including diagrams of what to get and where to route it. This enables a technician new to the equipment to perform any required changes without additional instruction.

Rexroat, who has been following TCI's fiber management implementations, said that AT&T has an advantage in its software over the others he's experimented with. For starters, it is the only one that can be incorporated into automatic dispatch systems. This could result in improved response time to a given problem.

Secondly, Rexroat said that AT&T is the only package with good graphics: "I think it makes it a lot easier if there are good graphics involved."

Is it worth it?

TCI paid AT&T about $80,000 for the Westchester fiber management system. Gough said, "The savings are that the time required to respond to a problem is now seconds instead of approaching an hour. In the future, that will make a big difference in how much unforeseen events cost us."

Gough believes that fiber management is required to move into new services like telephony, or business communications, in which down time can be quite costly. "Even now in normal cable TV if something happens, it gets fixed a lot faster."

Owing to the savings in configuration time, Rexroat believes the systems could pay for themselves within a year. "It gives us more flexibility and control. You don't have to go back and splice things up all the time."

Figure 1: Before and after AT&T's fiber management system

Shrinking the box

Most fiber management products can shrink the space required to house fiber-optic equipment and 3M has taken a rather innovative approach that can shrink it even farther. At the Society of Cable Television Engineers' Cable-Tec Expo this month in St. Louis, it is planning to begin shipping the 3M 2750 Hub In A Box system, the most densely packable fiber patch panel on the market. A single 11 x 23-inch box can connect up to 408 total fibers together. Bill Seim, a senior specialist who designed the product for 3M, said it can handle about six times as many connections as conventional patch panels.

The system does away with the conventional patch cords used in other systems and replaces it with a connection system based on 3M's mechanical Fiberloc connectors. Seim claims that the gelfilled connectors have the same or less loss as SC and FC connectors used by others.

Another benefit of the system is that it eliminates the need to determine the length of all connections beforehand. In a traditional fiber patch panel, the cable operator needs to determine in advance how long all of the connections will be. If the operator runs out of patch cords that are long enough, he has to either fusion splice one together or special order one.

In 3M's system, all of the patch cords come from a roll of fiber, which can be cut to the appropriate length. Since the fiber used for patch cords only needs to be cut and not polished, a technician can create a new patch cord of the appropriate length in a few seconds.

3M also has a number of different kinds of connector cards. The basic card can patch up to 12 fibers to 12 other fibers. Another kind of card has a built-in optical splitter, so that one fiber can be connected to a maximum of 12 fibers on one card. A third type of card contains an optical attenuator, which can be used for short runs. Seim said that 3M also was considering making other types of cards in the future.

Figure 2: 3M high-density cross-connect system

Seeing the light

ADC telecommunications has introduced a novel kind of patch cord, called LighTracer that enables technicians to quickly find both ends of a patch cord. Although accurate record keeping should enable technicians to tell which ends to work with, these patch cords can prevent technicians from accidentally unplugging an active fiber.

The patch cords each contain an additional fiber that is used to carry visible light along the length of the patch cord. When a technician attaches a flashlight to a special connector on one end of the patch cord, the second end glows, indicating the connection to be worked with.

The patch cords are available with all standard connectors, and are compatible with most fiber distribution frames. ADC representatives said the LighTracer patch cords cost about 30% more than normal ones.

Conclusion

Vendors are certain to introduce a variety of new fiber management systems in the near future as the idea catches on. These are sure to include a variety of features no one even thought of today. But as Rexroat pointed out, "Everybody has what they say are nifty tricks but you don't really know until after it is installed how much is sales pitch and how much is real."

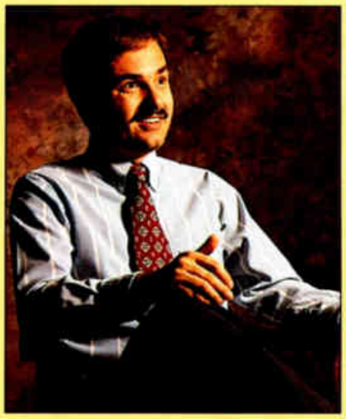
But even without all the nifty tricks, fiber management will play an important role in making it easier for cable companies to move into new services like telephony and data communications. **CT**

The smallest, fastest, lowest priced, most comprehensive Cable TV test equipment available.

Stealth System Sweep and Stealth SAM

WAVETEK

The evolution of the cable to challenge system man



"Working for a company that really cares what the customers think is a great experience," says Rick Jaworski, Marketing Manager of Wavetek Communications Division. Rick's previous experience with another cable test equipment manufacturer has given him a unique perspective on Wavetek and the Stealth.

"I see a division that is focused on the cable industry as its primary business - and is much closer to its customers than other broad line suppliers. Wavetek is incredibly responsive to the customers' needs."

"When the Stealth product line was researched, customers said they wanted more measurement capabilities in one package. They didn't want to buy multiple instruments. And it had to be lightweight, hand-held, easy-to-use and inexpensive - a productivity enhancer. Many companies would have deemed that impossible."

Rick comments, "Wavetek's Stealth design team concluded that the customers would get what they wanted at a price they could afford. The resulting Stealth Sweep and Stealth SAM have far exceeded customer expectations. I believe these products will revolutionize the way testing is done in the cable industry. And I feel privileged to be a part of it."

System architectures are rapidly developing to improve reliability and increase service opportunities. FCC standards and proof of performance requirements now require specific system test and logging procedures. New rate regulations necessitate increased efficiency to maintain profitability. And competition looms from the telcos, DBS and wireless cable.

Surviving the Whirlwind

The evolution of the cable television industry is challenging even the most efficient system managers, engineers, and technicians. Cable television professionals are realizing that the key to continued prosperity is to deliver a complete range of quality programming and services through efficient management and competitive pricing. These services translate into more frequency bandwidth, a well-maintained system, and an efficient and productive technical team.

Future growth and financial success will depend on maintaining customers and attracting new ones with increasingly higher levels of service and capabilities. As budgets tighten and competition grows, management is forced to become more efficient by investing in equipment that contributes to customer service goals and increases productivity. Capitol investments must provide more bang for the buck and meet the needs of today's evolving cable industry.

Optimal System Performance

Today's technical manager must deliver excellent system performance with an increasingly strained budget - a very difficult balancing act. One important aspect of improving customer service is consistent system testing in addition to FCC proof of performance and logging requirements. And the search for unregulated revenue sources has also led systems to be tested to their full range of capacity - and ready for new services as soon as they develop.

Increased productivity can be achieved with cost-effective test equipment that performs a broad assortment of tests that meet the needs of engineers and technicians facing today's cable industry challenges. Features such as user-friendliness, portability, speed and durability allow cable professionals to get their testing done quickly and efficiently. Smart managers look for experienced manufacturers providing equipment with a broad range of measurement capability at competitive prices.

The new hand-held Stealth Sweep and Stealth SAM give cable technicians the capabilities they've always wanted in affordable, high performance units.

evision industry continues ement and their budgets.

STEALTH SYSTEM SWEEP

- 1 GHz Frequency Range
- 2nd/3rd Order Distortion Measurement
- Continuously Referenced, Non-Interfering Sweep Frequency Response Measurement
- Spectrum Analyzer Display
- Extremely Fast Sweep Update
- Receiver is also a High-Powered SAM
- Hum & Carrier-to-Noise Tests on Modulated Carriers
- High Resolution LCD (320 x 240 Dot Matrix)
- Automated 24 Hr. Testing & Logging
- Depth of Modulation

3SR Receiver and 3ST Transmitter

The Stealth System Sweep features a hand-held receiver for convenient field use and a full-featured, non-interfering transmitter for the headend. Stealth's continuously referenced sweep method eliminates headend drift errors, and a proprietary DSP technique is used to make hum and carrier-to-noise measurements on modulated carriers. Ready for emerging technologies, Stealth tests to 1 GHz; is compatible with scrambled and digital signals; and has frequency agile telemetry.

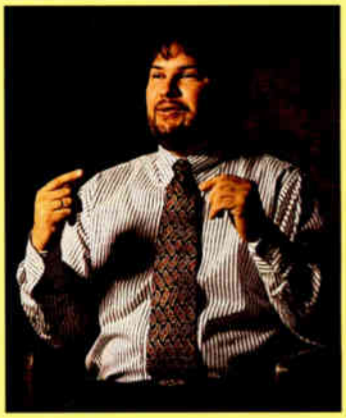
STEALTH SAM Model 4040

- 1 GHz Frequency Range
- Easy to Read Graphic Signal Level Measurement
- Spectrum Analyzer Display
- Sweepless Sweep® Frequency Response Measurement
- High Resolution LCD (320 X 240 Dot Matrix)
- Hum and Carrier-to-Noise Tests on Modulated Carriers
- Comprehensive Tilt/Scan Analysis Modes
- Automated 24 Hr. Testing & Logging
- Depth of Modulation

More Portable, Just As Affordable

The hand-held Stealth SAM incorporates non-intrusive carrier to noise and hum testing, making it possible to perform FCC tests without interrupting service to subscribers. Signal levels are easily read on the graphical and numerical display format. The Stealth SAM's fast tuning enables efficient SCAN testing, which shows all carrier levels on one display, and a Sweepless Sweep mode for passive frequency response testing. Both modes update in about 1 second for 200 data points.

WAVETEK



"Amazed is the first word that comes to mind when I think of the reaction of the cable industry to the Stealth System," comments Dan Chappell, Senior Project Engineer at Wavetek Communications. "We're providing customers with what they need now, at a price they want to pay."

Dan and his design team spent several days with cable technicians as they performed their jobs. "I was stunned by the sight of these men lugging more than 30 lbs. of sweep and SLM equipment around with them," states Dan. "I asked them how Wavetek could make their jobs easier. And, their comments always included removing the burdensome equipment."

Challenged by fitting everything that the customer wanted into a small, ergonomic box, Dan's team worked many long hours making all the pieces fit perfectly. "Our primary goal was to design a comfortable, hand-held product that was easy and safe to use, containing all the necessary testing features that the customers wanted at an affordable price." Streamlined and weighing less than 5 lbs., the Stealth System Sweep is exactly that and more.

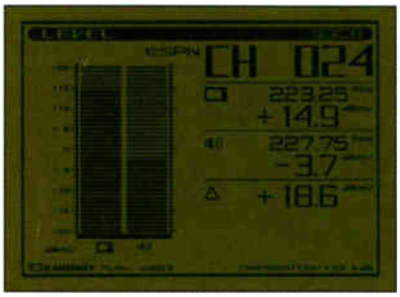
Wavetek Products Fit Customers' Needs

High-Tech Test Equipment That Won't Break Your Budget

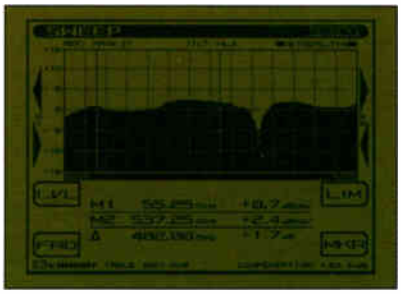
For over twenty-five years, Wavetek has manufactured quality test equipment for the cable television, wireless communications, and general purpose test and measurement industries. Service and installation professionals worldwide rely on Wavetek equipment for accurate, cost-effective results on the bench and in the field. By utilizing direct customer input, innovative product design, and rugged construction techniques, Wavetek offers equipment that improves both productivity and customer service.

Wavetek continues its commitment to the evolving needs of the cable television industry with products designed to meet specific needs. The new Stealth System Sweep™ and Stealth SAM™ present the latest technology, features and hand-held convenience at an incredibly low price. Our comprehensive product line includes cable television & LAN test equipment, including: sweep systems, signal level meters, system analyzers, signal generators, leakage detection, and bench sweep equipment.

In addition to its system sweep function, the 3ST Stealth Transmitter provides insight into what's happening in the headend.



Scans video and audio carrier levels for all channels



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June 1994

BACK TO BASICS

The training and educational supplement to Communications Technology magazine.

Highlight on the drop

Geri Saye

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Drop cable shielding

By Henry D. Pixley
Product Development Engineer
Comm/Scope Division, General Instrument

When selecting coaxial drop cable, one of the most important factors is perhaps shielding performance. Aside from the strict Federal Communications Commission regulations, cable signal leakage problems can have a disastrous effect on system performance. This is especially true for full service networks utilizing digital compression where cable shielding performance will become an even greater concern. Since the shielding performance of a CATV drop cable system is partially dependent on the shielding performance of the drop cable, it is important to understand the leakage mechanisms associated with the drop cable shield.

This article explains the signal leakage mechanisms associated with the coaxial drop cable's outer conductor construction and flexure due to simulated aging. The latest measurement technique used within the CATV manufacturing industry for measuring shielding performance also is covered within this article and is seen to correlate with open area test site measurements.

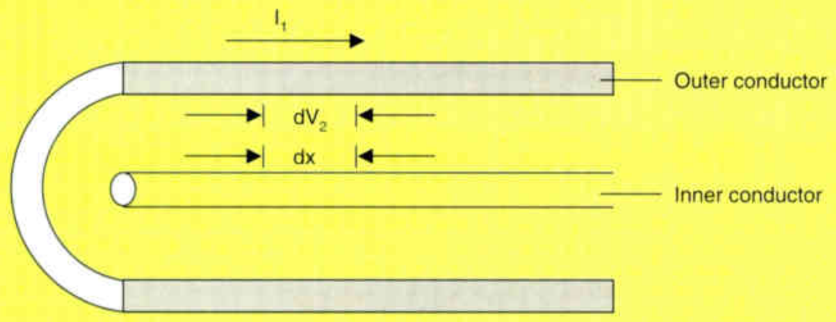
Typical shielding construction

The shielding performance of any coaxial cable is controlled by the cable's outer conductor construction. A coaxial cable with a solid continuous shield with no openings and of high conductivity material, for example, would confine the electromagnetic fields within the coaxial cable and have virtually no detectable signal leakage as is the case for trunk and distribution cable designs. This construction, however, would not be feasible for coaxial drop cable application because of the flexibility required. Within the cable TV industry, coaxial drop cable outer conductor constructions are more complex, consisting of multiple layers of tapes and braids, in order to achieve the required shielding and flexibility. Different constructions are available and provide a trade-off between cable cost and shielding performance.

"The shielding performance of coaxial drop cable is not simply dependent on the number of tapes and braids and braid coverage, but also on the bonding and overlapping techniques used within the shield construction as well as the mechanical performance of the LST."

Coaxial drop cable is available in standard, tri-shield and quad-shield constructions. The first outer conductor is usually a laminated shielding tape (LST), constructed of two aluminum foils laminated to a strength member. The LST is designed with an emphasis on mechanical strength so that when flexed, the foil tapes would not break apart or crack as easily as if no strength member were present. The LST is applied longitudinally with sufficient overlap and bonded to the dielectric core. An aluminum braid with a specified percentage of coverage is then applied over the LST to complete the standard shield design. The tri-shield design has an additional LST over the braid, whereas the quad-shield design utilizes both an additional LST and second braid to provide superior shielding performance compared to the first two designs.

Figure 1: Transfer impedance



Transfer impedance = $Z_t = (dV_2)/(I_1 dx)$

Signal leakage mechanisms

The signal leakage mechanisms associated with tape and braid constructions include the following:

- Diffusion of electric fields through thin foil tapes.
- Coupling of magnetic fields through openings in braid.
- Scattering of electromagnetic energy because of the terminating of current densities at radial cracks in the foil tape, which are caused by flexure.
- Opening of foil tapes at the seam during flexure, due to insufficient mechanical seal.

Foil tapes

In theory, electromagnetic fields propagate between the inner and outer conductors along the cable length and are accompanied by currents on the inner and outer conductor walls. For walls of finite conductivity, these currents penetrate into the walls, attenuating with distance according to the factor $e^{-\alpha z}$. The depth of penetration or skin depth is the distance the wave must travel in order for its amplitude to decay to e^{-1}, 37%, of its initial value at the conductor surface.[1] The depth of penetration can, therefore, be obtained by setting the exponent $-\alpha z = -1$. Therefore:

Depth of penetration = $1/\alpha$

$= \sqrt{2/(\omega\mu\sigma)}$ meters

Where:
$\omega = 2\pi f$ and f = frequency
μ = permeability of material
σ = conductivity of material

The result is inversely dependent on the square root of the frequency, permeability and conductivity of the material. The signal leakage of a foil tape with no openings is, therefore, a result of the diffusion of fields through the metal. Since the depth of penetration decreases with an increase in frequency, the tape's shielding performance improves with increased frequency. Refer to Table 1 for skin depth vs. frequency for aluminum.

Table 1: Depth of penetration for aluminum

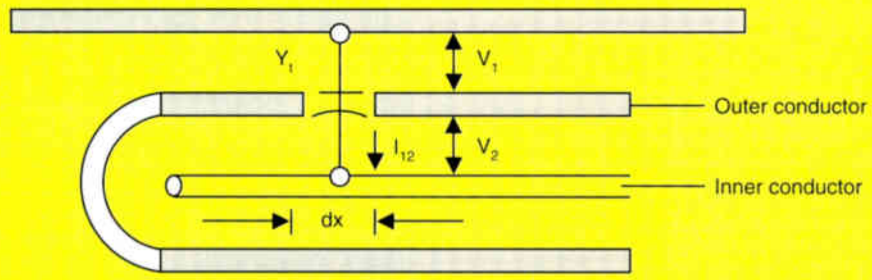
Frequency (MHz)	Skin depth (inches)	Skin depth (mm)
10	0.001	0.026
100	0.0003	0.008
1,000	0.0001	0.003

The mechanism of energy transfer for the foil tape shield is known as the "transfer impedance."[2] This is simply the ratio of the current, I_1, flowing on the outer surface of the outer conductor to the incremental voltage drop, dV_2, developed across each incremental length, dx, of the inner surface, as shown in Figure 1. The transfer impedance (Z_t) is the ratio $(dV_2)/(I_1 dx)$, generally expressed in ohms or milliohms per meter and can be calculated for solid shield constructions.

Braids

At low frequencies the leakage from a braided shield is due primarily to the diffusion of energy and is dependent on the braid angle. At higher frequencies, however, the primary leakage mechanism is a result of the coupling of magnetic energy through the holes in the braid. The coupling

Figure 2: Transfer admittance



Transfer admittance = $Y_t = I_{12}/(V_1 dx)$

Table 2: F6 series nominal shielding effectiveness (dB)

Construction	Before stressing	After stressing
Standard shield	80	65
Tri-shield	115	80
Quad-shield	115	100

of magnetic energy increases with frequency and is controlled by the percentage of braid coverage.

The mechanism of energy transfer is the "transfer admittance" and takes into account the fact that, where there is appreciable mutual capacitance, C_m, between the center conductor of the cable and the outside environment (i.e., through openings in the shield) energy may be transferred due to voltage difference without regard to current flow as shown in Figure 2.[3] A voltage difference between the two conductors will cause current to flow in Cm and thus energy will be transferred. The formula for transfer admittance is $Y_t = 2\pi f(C_m)$

Simulated aging

Flexure is used to simulate cyclic stress from temperature changes, wind and ice loading. Flexure has greatest effect on the tape shield and does not significantly degrade the braid's performance. Degradation of the tape shield can include radial cracks and openings in the overlap if a proper mechanical seal does not exist. Table 2 shows typical shielding effectiveness values for the three different F6 series drop cable shield constructions, before and after flexure.

It is important that the cable undergo the harsh flexing that is necessary to simulate real world cyclic stress. This could involve, for example, placing the cable within a tube that is bent around a mandrel and rotating the cable within the tube approximately 10,000 revolutions. Data has shown that the shielding effectiveness degrades to a certain point with no further significant degradation with flexure.

Radial cracks, caused by flexure, in the foil tape result in the scattering of electromagnetic energy due to the terminating of current densities. This mechanism is similar to that used by radiating cables and waveguides, where slots are used to terminate current densities with specified amplitude and phase, in order to produce radiation patterns. Since the currents on a transmission line travel longitudinally, however, a slot in the longitudinal direction causes much less radiation compared to a slot placed normal to the direction of currents. This is because the slots must terminate the current densities in order to scatter the fields.

Another leakage mechanism associated with flexure is the opening of the foil tape at the overlap. With sufficient bonding of the first LST to the dielectric core, a significant improvement in the shielding performance is obtained, preventing the shielding tape from opening when the cable is flexed.

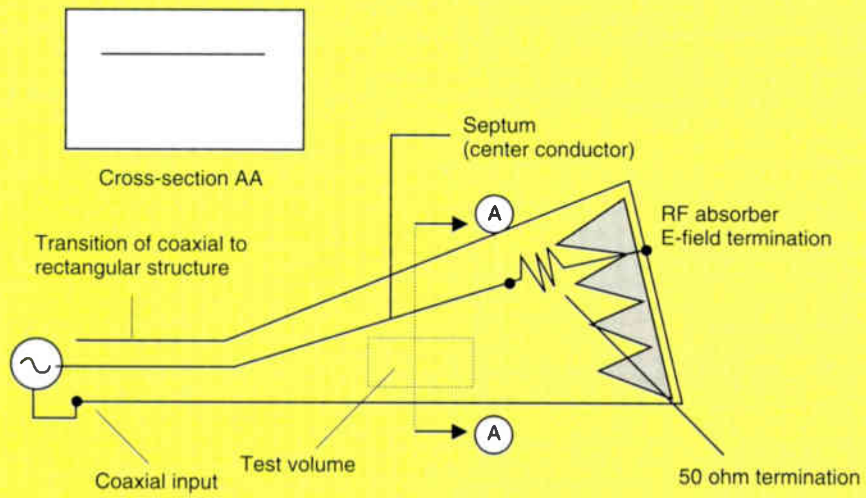
It should, therefore, be noted that the shielding performance of coaxial drop cable is not simply dependent on the number of tapes and braids and braid coverage, but also on the bonding and overlapping techniques used within the shield construction as well as the mechanical performance of the LST.

Radiated fields

Depending on the strengths of the leakage mechanisms mentioned before, a portion of the internal energy within the coaxial cable will partially propagate on the outer surface of the cable in the form of surface waves. These surface waves are responsible for the radiated fields. A cable that exhibits these characteristics is commonly referred to as leaky or inductive. The electromagnetic energy is concentrated in the close vicinity of the cable and travels along its length.

When these surface waves are diffracted by obstacles and discontinuities within the cable's immediate environment, such as clamps, connectors, etc., a fraction of the energy is radiated radially outward into the environment, and is referred to as egress. Conversely, a signal transmitted near the cable can be coupled into the cable and is referred to as ingress. Both horizontally and vertically polarized signals are randomly radiated into the surrounding environment and their signal strengths decrease when moving away from the

Figure 3: Physical description of a GTEM cell



cable as a function of free space propagation loss. The radiation pattern is not very directive and, in fact, it is localized about the cable's environment.

Measuring shielding effectiveness

Due to the complexity of the coaxial drop cable's shield construction, computation is not possible and shielding effectiveness must be determined by measurement. The most obvious way to do this and the method that most closely simulates actual performance of the cable is to measure the energy within the cable resulting from a known external electromagnetic field, or conversely to measure the external field resulting from a known energy level within the cable. For the measurement to be meaningful, however, the cable must be positioned in a manner similar to how it is used and the measurement distance specified. The system engineer would then be able to use this value to design the system specifications and calculate signal leakage within the system with a high reliability.

This fundamental method, however, is not considered practical because the need for an electrically controlled environment. Some other method must be found that provides an accurate and reproducible measurement of shielding effectiveness. An enormous amount of effort has been devoted to this end. Within the wire and cable industry, there are a number of shielding effectiveness definitions and measurement techniques from around the world. It is therefore necessary to use precise definitions of the parameters, in order to be able to develop proper relationships between shielding parameters.

The two basic parameters used by the nuclear hardness community to describe electromagnetic energy penetration of a cable shield are the transfer impedance and transfer admittance as described earlier in this article. These measurements have been used within the CATV industry to give a comparison between cable shields and is quite useful for this purpose. However, their ability to determine the cable's shielding effectiveness (i.e., radiated field strengths) has been questionable. In order to be able to accurately measure the cable's shielding effectiveness, an actual measurement of the radiated electromagnetic fields must be made within an electrically controlled environment.

GTEM cell

A new test cell that offers such a controlled test environment where either emissions or immunity testing can be performed is the gigahertz transverse electromagnetic cell (the GTEM cell) and is illustrated in Figure 3.[4] The GTEM cell represents a significant advancement in state-of-the-art EMC testing and has been gaining wide acceptance within the CATV industry. As part of a measurement system, it allows more types of testing to be done in less time while improving accuracy and repeatability of results.

The GTEM cell is an offshoot of the TEM cell, as developed at the National Institute of Science and Technology. It is a section of 50 ohm transmission line with a unique geometry. At the input a normal 50 ohm coaxial transmission line is transformed into a rectangular cross-section. The cell is flared along the longitudinal axis to increase the cross-sectional dimensions of the transmission line. The septum, or center conductor, is transformed from a round cross-section to a flat wide conductor, located well above the center of the cell. This maintains the 50 ohm characteristic impedance while increasing the volume of the cell under the septum, allowing a larger test volume. The GTEM cell can perform measurements from 30-1,000 MHz and emissions testing has been found to correlate with open area test site measurements. Connectors and other components also can be tested for emissions or immunity, allowing their shielding performance to be measured.

Summary

This article has touched briefly on the signal leakage mechanisms associated with the coaxial drop cable's outer shield construction and has given some understanding to the behavior of the radiated fields. Some of the key points could be summarized as follows:

- Shielding performance is frequency dependent.
- Shielding perform depends on bonding and overlapping techniques as well as the mechanical performance of the LST.
- Shielding performance after flexure is of greater importance than shielding performance before flexure. **BTB**

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Approaching the "seamless drop"

By Brian Bauer
Broadband Access Product Manager
Raychem Corp.

Future interactive cable TV technologies will demand new coaxial connectors and passives that deliver digital signals to subscribers' home terminals with optimal signal integrity. The enhanced drop system must provide:

- Consistently high shielding effectiveness.
- Reliable, stable connections that eliminate intermittent signals.
- Low return loss.
- Isolation of signal between terminals.

Low bandwidth digital systems must be designed to handle transmission effects, such as reflections, as well as carrier-to-noise effects, including signal ingress, impulse noise and attenuation. Higher bandwidth and return path systems (causing upstream noise funneling) will require even greater signal shielding.

In existing drop systems, poor installations, substandard indoor cabling, corrosion, tampering and vibrations all contribute to signal degradation. The source of most drop problems, now and for the digital realm, is rooted at the F-interface where the continuity of the cable shield and the characteristic impedance of the cable may be disturbed. The ideal drop would be one that virtually eliminated discontinuities.

Approaches to creating and maintaining a reliable drop system can be categorized into three areas: the permanent drop concept, drop topology and component features. Early field trial results indicate that prototype "permanent drops" and improved connectors succeed in minimizing system degradation because of theft/tampering and/or loose connections.

Figure 1: Permanent drop system

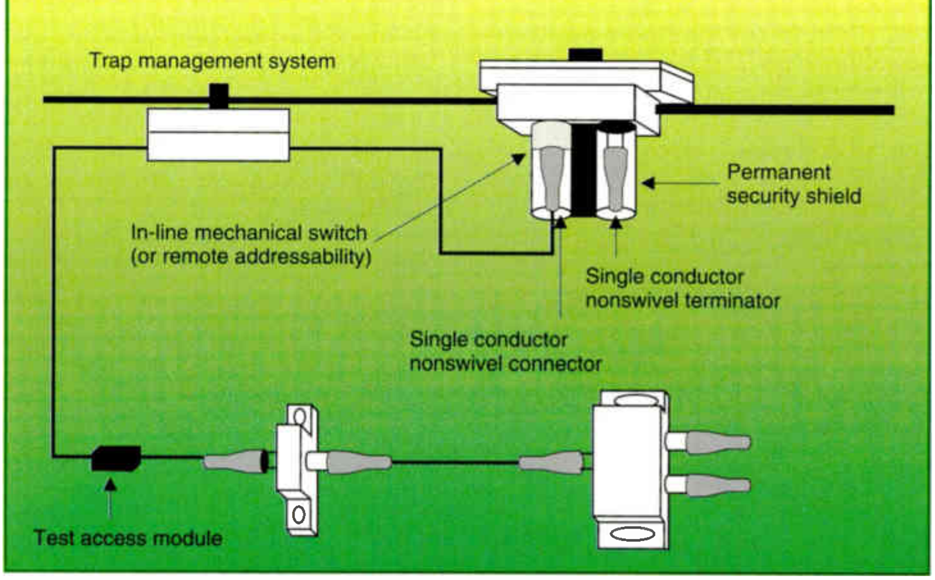
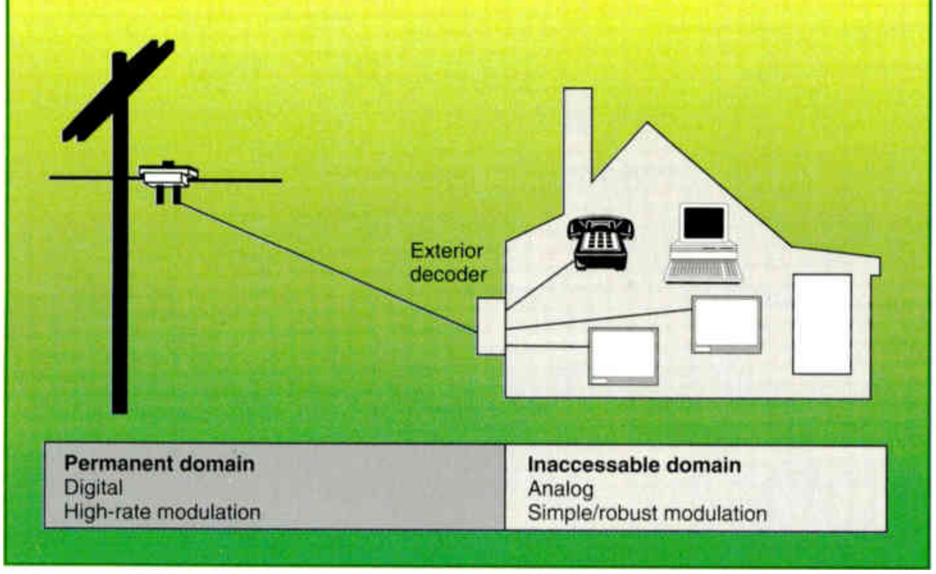


Figure 2: External network interface layout



Permanent drop concept

Creating a permanent drop system would greatly reduce the widely recognized source of service calls — craft error. Such a system (Figure 1) would eliminate the current need to disconnect the F-fitting. Beginning and ending service to the home would be achieved by installing a permanent switching component. As systems approach full addressability, the need for the in-line switch will diminish and the drop system will be "hardwired." A passive in-line access device would provide signal testing without disconnecting the cable.

Drop topology

Another approach to creating a more reliable drop and assuring a clean signal to the TV set is to demodulate the digital signal before it enters the home. In this scenario, the signal is converted to low-frequency analog, which is less sensitive to in-home microreflections, ingress and attenuation. The decoder is moved from the top of the TV set to the side of the home. This approach (Figure 2) also reduces the distributed electronics in the home, transmits at a low attenuation frequency and, being narrow bandwidth, does not require equalization.

Component features

The Society of Cable Television Engineers is currently developing standards for in-home cabling and drop architecture to assure that quality components are used to minimize impairments (such as component reflections) and the additive effect of having multiple passives in series.

Connectors

Components must be designed to reliably maintain strong mechanical and electrical outer conductor continuity to assure that reflections, noise and intermittence are kept to a minimum. Maintaining connector robustness requires environmental sealing, theft/tamper deterrence and minimizing training requirements.

Traditional connectors have been designed with a swiveling nut that brings one connector subassembly in contact with a female port. The hex nut allows the craftsman or subscriber to inadequately tighten a connector and thus create a connection that has signal ingress problems. An alternative approach would be to use a connector that cannot be put on loosely (Figure 3). Such a connector would:

- Require little training (craft-friendly).
- Go on right or not at all (a "digital installation").
- Be impossible to put on in a "loose" manner.
- Provide enhanced corrosion protection.
- Reduce signal theft through tamper deterrents.

The improved design consists of a one-piece connection from the cable outer conductor to the female port. The cable and port are installed simultaneously. Either the connection is done completely in one step or it is not done at all (i.e., a "digital installation"). There is little or no room for error. Industry studies repeatedly indicate that improper installations cause a large percentage of service calls. A new, one-piece digital installation connector would contribute to a much more reliable system and would minimize the training for installers.

Figure 3: "Permanent" yet tool-removable connector

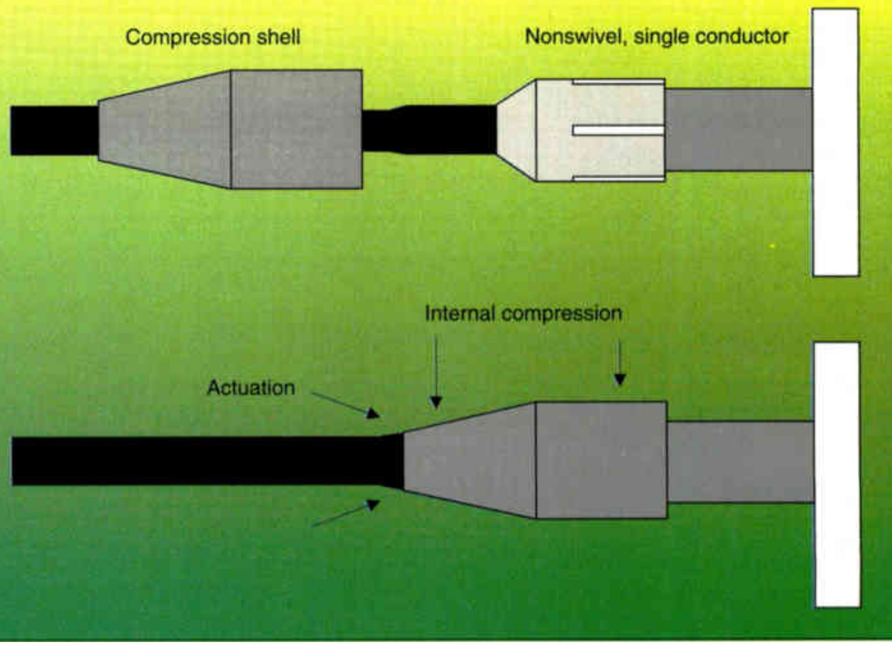
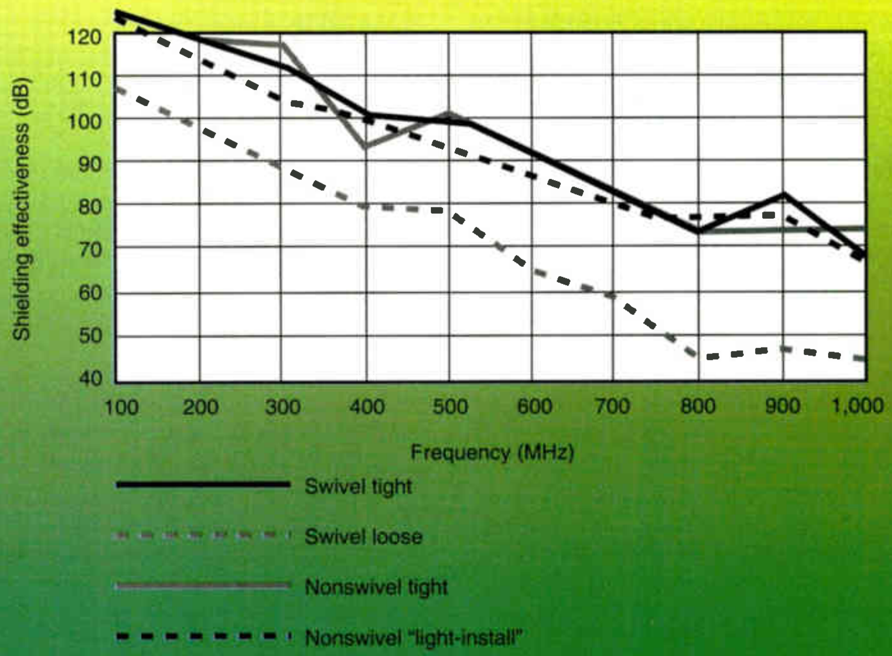


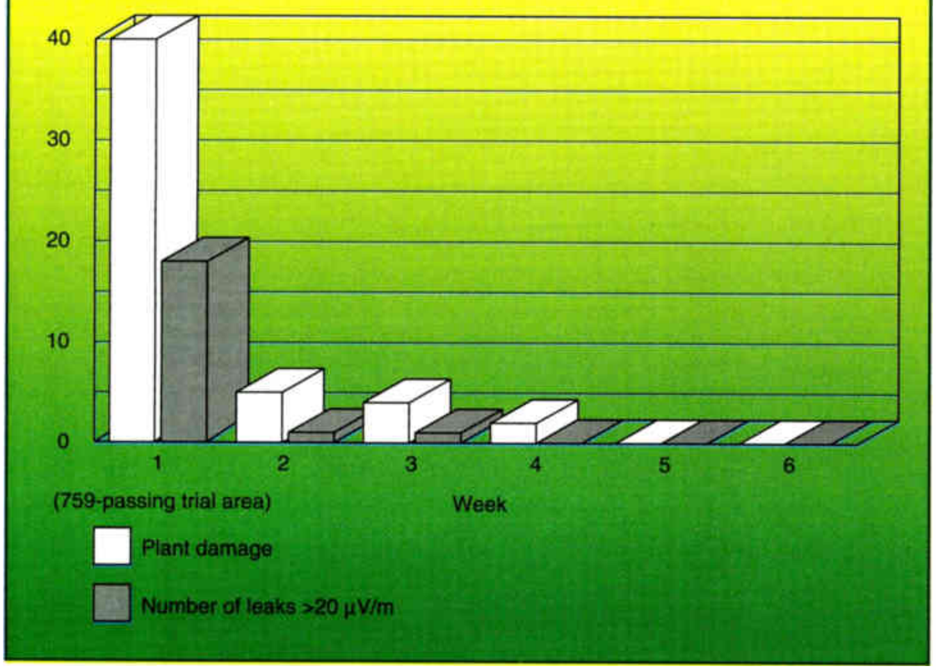
Figure 4: Shielding effectiveness of swivel and new nonswivel indoor connectors



Similar one-piece digital installation connectors have been designed for indoor use. The graph in Figure 4 shows the performance of a one-piece indoor connector. When the new one-piece connector is installed as loosely as possible to still deliver signal, the shielding degradation is comparable to the degradation measured with an optimally installed swivel connector.

Corrosion is another significant cause of service calls and a threat to shield integrity today. Any new approach to connectorization should include environmental sealing. The need for sealing is increased by the potential of electrical loads on the drop. These loads, as well as pervasive drop sheath currents, accelerate

Figure 5: Preliminary field trial CLI rideout results



galvanic corrosion in the presence of moisture.

Connector design also should minimize the potential for theft and tampering because such interference often results in shielding degradation. Physical theft in the drop, such as illegally hooking up to unused tap ports, is not uncommon. In those areas where signal theft is common, signal leakage is an ongoing problem, and the potential of nonpaying subscriber ingress can be substantial.

One approach is to use connectors that provide visual deterrents to theft and tampering such as connectors that require a special tool to install and that expose no opportunity for removal, e.g., no wrench flats. (See Figure 3 on page 139.) Additional deterrents and protection of electrical integrity can be provided by a permanent, tap-adjoined security sleeve (see Figure 1 on page 138). Placement of trap housings sufficiently far from the pole in aerial installs also minimizes access to taps, facilitates auditing and ultimately reduces tampering.

Passives

Signal disruption is most likely to occur inside the home when consumers install their own equipment. Much of the equipment installed by the "do-it-yourselfer" has very poor electrical performance. The interactive digital systems of the future will require components designed to minimize discontinuities and reflections. Splitters must provide low return loss characteristics. High port-to-port isolation of the splitter also should be required so that reflections of one splitter downstream leg will not affect adjacent splitter legs. Currently, splitters typically have approximately 20 dB of isolation but future systems will require greater isolation to provide high-quality communication. In special cases, the use of directional couplers with much higher isolation will be helpful.

Field results

A system employing semipermanent connectors and anti-tamper/theft components described previously was deployed in two separate systems, one in the Midwest and one in a Mid-Atlantic state. One area had a high theft rate, while the other had ongoing issues with RFI ingress.

Shielding vs. tampering

In the high theft city measures were taken to assure that the traps were inaccessible to potential thieves and the drop was well organized to allow easy auditing and prosecution. Also, "permanently" mated security sleeves were utilized on taps along with the one-piece, wrench flat-less connector and terminator.

Signal security results showed a high reduction of theft and substantial increases in revenue. Shielding effectiveness and CLI performance increased in inverse proportion with tampering. The 759 passings originally generated 19 major leaks with an average of 75 μV/m. Many leaks were due to broken ports on the tap where people illegally connected to the system without standard connectors. Immediately after installation of the semipermanent drop system and after six weeks, there was only one leak in the trial site (Figure 5). The next three weeks had no leaks.

In the high ingress city, trial sites were chosen that were immediately adjacent to or near powerful retransmission towers typically known to produce frequent ingress service calls. Approximately 500 connectors and 300 terminators of the one-piece, no-swivel, no-wrench-flat-type were installed. Service call tracking, cumulative leakage index (CLI) rideouts, and drop auditing were conducted before and after the one-month time frame.

In the first four weeks after installation, there were no service calls due to F-connector ingress. During the drop audit, there were no connectors found to be loose. All outer conductor shields were found to be tight and none of the connectors could be easily removed without special tooling. It is still early in each of these trials, but compared to similar time frames in the past for these areas, the results suggest that these approaches greatly enhance signal reliability.

Conclusion

Are we ready for the fully addressable, interactive digital transmission era? Advanced networks using asynchronous transfer mode (ATM) switching will combine with enhanced home terminals to provide the opportunity and the challenge of interactive digital transmission.

Since the drop system has been the major source of problems in existing cable TV systems, it is up to the suppliers in the industry to anticipate equipment needs and develop the components of the drop system for the digital future. Establishing a permanent or "seamless" drop topology and employing one-piece, craft-insensitive, tamper-resistant F-connector interfaces like the ones currently being tested would put us on the right path toward the interactive digital transmission era. **BTB**

Full service drops

By Don Williams
Technical Services Supervisor
Columbia Cable of Oregon

Our industry is rapidly moving away from providing only traditional entertainment services. As an industry, we are making small steps to position ourselves as full service networks that will ultimately include voice and data applications. It is an exciting time as we reach another plateau of technology and services.

Our systems are literally starting to deliver wares of the "Jetson Age." Examples of technologies unheard of 10 years ago include: digital music services with remote interactivity; channels that can be digitally compressed into a 6 MHz bandwidth; and a thread of glass that can deliver broadband with never before seen performance over distance. And there is much more to come.

If our fiber-rich systems, with minimized hybrid cascades, all or in part make up a full service network termed the "superhighway," then naturally our service drops will be the on and off ramps to the mega express. All indicators today suggest the final delivery system to our customers will be done through coax, at least in the nearest future.

Planning tomorrow's drops

Unfortunately, national service averages continue to indicate our 55 million service drops rank very near the top of trouble call causes. The time is approaching when we will expect the drop system to deliver more than ever before. Since digital delivery over coax is believed to be much more susceptible to impedance mismatches and ingress energies as compared to analog, it may be difficult to deliver digital services without a quality drop. The last thing any of us want to do is increase customer frustration and trouble calls as new and enhanced technology is rolled out.

The good news is there is a lot that can be done today to reduce trouble calls and increase customer satisfaction while paving the way to successfully deliver expanded services. It will be hard for many of us to admit it, but the crux of our drop and in-home wiring problems have not really changed much. Lack of training is still simply a factor for low reliability.

F-connectors continue to be a leading interface problem for our industry. Solving this problem is more than purchasing a hot new connector. Many of us believed if we switched to using a internal weatherproof type connector, water migration as a failure type would simply go away. Two systems owned by my parent company are located in the Northwest and everyone knows F-connectors in this region get rained on a lot. The fact is, water damaged connectors (solely because of their design type) make up less than 5% of the change-outs in our system. Connector failures related to poor craftsmanship or improper installation make up the other 95%, and this we can control.

Craftsmanship

If I take four people who have been trained to cut connectors using the traditional old fashioned method, hand them a regular plain crimp connector, razor knife and crimpers and have them make jumpers, the end result will likely be two or more interpretations of how a connector should be properly cut, fitted and crimped.

Why is this? There is, believe it or not, a lot of craftsmanship and interpretation involved in hand cutting cable in preparation for the connectors. Much like a person's handwriting, everyone's technique is just a little different and some are just plain wrong.

An area of concern using this old technique is the ring that appears all the way around the center conductor. This ring is an unavoidable result when routinely hand cutting cable and it will just about assure lowered return loss as we move into even higher frequencies with digital transmission. We need to keep in mind this potential future source for high bit error rates that could result in intermittent losses in service. The skin effect tells us that freehand cutting of coax cable must be a procedure of the past if we are to deliver more bandwidth and digital services through our drops, without increased trouble calls.

F-connections of the future will be cut and fitted to precision and treated with the same care and attention as our hard line connections. To get quality long-lasting F-connections today, I offer some of the following tips and solutions.

The right tools

Equipping field personnel with the right tools is essential. Specifically, tools that make possible precise trimming and preparation of the coax. Tools of this type will ensure repeatable cuts time after time and remove much of an individual's style. They also will reduce the chance of injury. There are many brands and models on the market but not all of them work well. Carefully select a model that makes precision cuts for your connector and cable application.

Crimpers are probably one of the most overlooked highly precisioned hand tools carried. Crimpers must be periodically maintained and calibrated for proper tolerances (refer to your manufacturer's recommendations on care). This will eliminate almost every repeat service call for connectors that seem to suddenly fall off in the customer's home.

If you utilize externally waterproofed F-connectors, the products used should have a life expectancy that matches the life expectancy of the connector. Using a five-year weather boot on a connector designed to last 20 years can make a good connector a bad one. The F-connector reality is this: Whatever design you use or select as the best value, if the connectors are installed correctly on the cable size intended, they will work reliably with few exceptions.

"The F-connector reality is this: Whatever design you use or select as the best value, if the connectors are installed correctly on the cable size intended, they will work reliably with few exceptions."

Our underground drops throughout the United States have suffered many damages. The largest percentage of drops are cut by our own customers, primarily as a result of a shallow drop. In most cases you will find the customer was just performing routine yard work when the cable was severed. This is a very good indicator of a drop that is not buried at a proper depth.

Splicing the drop and reburying the affected section does not solve the primary problem in this circumstance. We must realize that the fact the line was cut is a secondary problem. Replacing and burying drops between 12 to 18 inches will pay dividends in reducing repeat cuts.

I have to be honest and share that I have actually seen drops come out of the ground with as many as three splices. In these cases, a substantial investment was made in a drop that ultimately failed and would have continued to fail and generate additional service calls had it not been replaced correctly. Splicing shallow drops is old thinking.

If a drop at proper depth is spliced, I recommend adding a unique tag at the ground block end. This will quickly identify a drop with an existing splice. The purpose of installing this tag is to eliminate my example of multiple splices in a single drop. Typically, multiple splices in a service line are electronically and mechanically unreliable for long-term service. It is questionable how well a drop like this will perform in delivering expanded services in a 750 MHz format. I do acknowledge there are now many promising products on the market to seal RG splices and these products are a must in order to maintain mechanical reliability in a spliced drop.

Home wiring

Some parts of the country are seeing tremendous growth in new home building. Much of the time electrical contractors perform the work that is intended to be a CATV prewire in the home. Often electricians do not fully understand the correct methods of prewiring CATV. The cabling ends up being wired like electrical outlets, daisy chained room to room, and most often with very low-grade cabling not intended for CATV application.

Our customer presents to us the same problem with a different twist. I'll call this customer Joe Fixit. He is an episode right out of *Home Improvement.* Now that there are no additional outlet charges, he will attempt to install his own additional outlets right after making a trip to the local supply house. Mr. Fixit will pay top price for his wire and splitters and may even pick up an amplifier that is built in compliance with Part 15 of the Federal Communications Commission Code of Federal Regulations.

In these two very common examples, we will run many thousands of interesting trouble calls, not to mention carrying out our responsibilities and obligation of Parts 76.605 Technical Standards and 76.611 Basic Signal Leakage.

If we do not take positive action, we face the result of our customer blaming us for the poor pictures from his own additional outlet installation and of the builder or the new customer wanting to know why we will not hook up to the prewire. Then there's the government wanting to know why our cable leaks and does not meet the technical criteria. Sound familiar?

The fact is, we do not want to be the bad guy and neither do our customers and contractors. To turn these situations around we simply must be proactive and resourceful. Taking the time to draft installation instructions to explain exactly how to home wire and prewire for your services will save a lot of grief for everyone.

Items to include in this installation document are the minimum requirements each product must meet, as well as applicable local, state and federal requirements pertaining to installations. As an example, your prewire policy could state: "Cable must be UL-listed, tri-shielded with bonded foil, and be home-run to the central utility location of the home."

Explaining signal leakage in simple terms also is highly recommended. To really put some teeth into this program, offer installation products through your office at a value that makes it unattractive to buy substandard materials. Encouraging your customers to use your products is desirable since it will reduce trouble calls and leakage. Best of all, it fits nicely into your long-term plans.

Get the message out by visiting and acquainting your company with your local home builders association. Leaving literature on prewires at county or city building permit offices also is a good way to get the knowledge out. Bill stuffers are an excellent tool to use to communicate with your customers. Running additional outlet instruction videos on your systems information channel(s) also can be helpful. A well-made videotape showing additional outlet installation also could be loaned out to do-it-your-selfers and contractors and can be a good way to head off problems that one way or another you will end up dealing with.

The training factor

Good quality plant at every level starts with training. Knowledge is power and every staff member should be properly armed with it. We need to help our employees to be part of the solution instead of the problem.

There are several ingredients to a good training program. I call these the deposits of success! If our people are successful then so are we.

The one program that is popular by all of us is regular and informal in-house training reinforced by on-the-job experience. However, this by itself almost never creates a well-rounded and knowledgeable installer or technician. Correspondence courses specific to the industry introduce a very thorough and broad background of electronic subjects. This coupled with vendor-specific training on the products utilized in your system are the building blocks of sharp installers and technicians that ensure our continued success.

It is no secret that the Society of Cable Television Engineers chapter meetings are a great training resource and provide a wealth of technology and training. The certification programs, as well as the local chapter meetings are invaluable. Personally, I believe our industry could do a better job of supporting programs like this. The SCTE Installer Certification program is one of the finest, yet most of the industry has not required installation staff to obtain certification. We must embrace programs like this as our technology is so rapidly advancing. Our field staff must be more knowledgeable if we are to enjoy another generation of success. **BTB**

CALENDAR

June

13-16: Siecor fiber-optic training course, fiber-optic installation, splicing, maintenance and resoration for cable TV applications, Hickory, NC. Contact (800) SIECOR1, ext. 5539.

14: SCTE Central Indiana Chapter seminar, BCT/E exams to be administered. Contact Al Orpurt, (317) 825-8551.

14: SCTE Southeast Texas Chapter seminar, Installer and BCT/E exams to be administered, Warner Cable office, Houston. Contact Rosa Rosas, (409) 582-4855.

14-15: Scientific-Atlanta training session, design considerations and sweep and balance, Atlanta. Contact Bill Brobst, (404) 903-6306.

15: SCTE Central Indiana Chapter seminar, BCT/E certification exams to be administered. Contact Al Orpurt, (317) 825-8551.

15: SCTE Snake River Chapter seminar, basic system troubleshooting. Contact Mike Dudley, (208) 377-2491.

15-18: Society of Cable Television Engineers Cable-Tec Expo '94, Cervantes Convention Center, St. Louis. Contact SCTE national headquarters, (215) 363-6888.

16: SCTE Southern California Chapter seminar, trunk systems: bridger-to-headend, Alhambra, CA. Contact Tom Colegrove, (805) 252-6177.

20-23: WCA '94, Las Vegas Hilton, Las Vegas. Contact Wireless Cable Association International, (202) 452-7823.

21: Hewlett-Packard CATV Measurements Course, Fullerton, CA. Contact (800) 472-5277.

23: Hewlett-Packard CATV Measurements Course, Van Nuys, CA. Contact (800) 472-5277.

24: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.

27-29: Northeast Cable Television Technical Seminar and Equipment Show (co-sponsored by the SCTE), Roaring Brook Ranch Resort, Lake George, NY. Contact New York State Commission on Cable TV, (514) 474-4992.

28: Hewlett-Packard CATV Measurements Course, Bellvue, WA. Contact (800) 472-5277.

28-29: Scientific-Atlanta training session, 8600 System operation and maintenance (System Manager 10), Atlanta. Contact Bill Brobst, (404) 903-6306.

July

10-13: New England Cable Show, Newport, RI. Contact (617) 843-3418.

12: SCTE Chattahoochee Chapter seminar, Atlanta. Contact Mark Williams, (912) 784-5104.

12: SCTE Desert Chapter seminar, distribution systems, San Goronio Inn, Banning, CA. Contact Greg Williams, (619) 340-1312, ext. 277.

12: SCTE Magnolia Chapter seminar. Contact Robert Marsh, (601) 932-3172.

13: SCTE Heart of America Chapter seminar, Kansas City, MO. Contact Dave Clark, (913) 599-5900.

13: SCTE South Jersey Chapter "Gone Fishing" social event. Contact Mike Pieson, (609) 967-3011.

13-17: Colorado Cable Show, Vail, CO. Contact (303) 863-0084.

14: Society of Cable Television Engineers Satellite Tele-Seminar Program to be shown on Galaxy I, Transpon-

Planning ahead

Aug. 1-3: Eastern Cable Show, Atlanta. Contact (404) 252-2454.
Sept. 18-23: Great Lakes Cable Expo, Indianapolis. Contact (317) 845-8100.
Oct. 5-7: Atlantic Cable Show, Atlantic City, NJ. Contact (609) 848-1000.
Oct. 11-13: Mid-America Cable Show, Kansas City, MO. Contact (913) 841-9241.
Nov. 13-15: Private Cable Show, Atlanta. Contact (713) 342-9826.
Nov. 30-Dec. 2: Western Cable Show, Anaheim, CA. Contact (510) 428-2225.

der 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.
14: SCTE Central Indiana Chapter seminar, fiber-optic architectures and applications, Holiday Inn North, Indianapolis, IN. Contact Al Orpurt, (317) 825-8551.
14: SCTE Greater Chicago Chapter seminar, digital basics, Centel Videopath, Chicago. Contact Bill Whicher, (708) 362-6110.
18-21: Siecor fiber-optic training course, fiber-optic installation, splicing, maintenance and resoration for cable TV applications, Hickory, NC. Contact (800) SIECOR1, ext. 5539.
19: SCTE Floribama Meeting Group seminar, Crestview, FL. Contact Rylan Bishop, (205) 476-2190.
19: SCTE Oklahoma Chapter seminar, Oklahoma City. Contact Rick Martin, (405) 525-2771.
19: SCTE Pocono Mountain Chapter seminar, Holiday Inn, Hazelton, PA. Contact Anthony Brophy, (717) 462-1911.
20: Hewlett-Packard CATV Measurements Course, Valley Forge, PA. Contact (800) 472-5277.
20: SCTE Dixie Chapter seminar, Brimingham, AL. Contact Charles Hill, (205) 880-1673.
20: SCTE Great Lakes Chapter seminar, distribution systems, Holiday Inn, Livonia, MI. Contact Jim Kuhns, (810) 578-9437.
20: SCTE Piedmont Chapter seminar, basic technical operations, Raleigh-Durham, NC. Contact Mark Eagle (919) 477-3599.
21: SCTE Lake Michigan Chapter seminar, digital compression, Days Inn, Grand Rapids, MI. Contact Karen Briggs, (616) 941-3783.
21: SCTE Southern California Chapter seminar, headends: satellite systems, off-air and LO signals, Alhambra, CA. Contact Tom Colegrove, (805) 252-6177.
21: SCTE Wheat State Chapter seminar, Wichita, KS. Contact Jim Fronk, (316) 792-2574.
23: SCTE Big Sky Chapter seminar, Big Sky Resort, Big Sky, MT. Contact Marla DeShaw, (406) 632-4300.
23: SCTE Chaparral Chapter seminar, HDTV. Contact Scott Phillips, (505) 761-6253.
24: SCTE Old Dominion Chapter social event. Contact Maggie Fitzgerald, (703) 248-3400.
25-28: Fotec fiber-optic installers' conference, Sheraton Hotel, Long Beach, CA. Contact 1-800-50-FIBER.
26: SCTE Desert Chapter meeting, BCT/E and Installer certification exams to be administered. Contact Greg Williams, (619) 340-1312.
28: SCTE New England Chapter seminar. Contact Tom Garcia, (508) 562-1675.
29: SCTE North Country Chapter seminar, drop wire characteristics, installation proceedures, safety, direct burial services, customer service, Sheraton Midway Hotel, St. Paul, MN. Contact Bill Davis, (612) 646-8755.
29: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.

Addressable control developments

(Continued from page 94)

The immediate challenge

All of that futuristic potential hinges on a cable operator's ability to pay for such advanced technology out of today's business. In part, that means deploying affordable technology in an appropriate manner to control basic channels and tiers, analog premium and digital services. Today's analog terminals, analog/digital hybrids, as well as tomorrow's high performance multimedia appliances have a key role to play. Local telephone companies also may use addressable interdiction in tandem with set-tops to provide the full range of services. Likewise, cable operators who want control of signal flow over the drop to the home, especially as higher value services are added, will want to consider a layered conditional access approach that combines several techniques.

So long as frequency division remains a fundamental transmission technique, used by either a cable or telephone operator, the ability to control blocks of frequency flowing down the drop line will remain an important asset. In fact, as services delivered over the cable network increase in value to include telecommunications functions, the security of the drop plant becomes far more critical. Indeed, one worry many telecommunications planners have had about the use of fiber/coax plant for delivery of telephone-type traffic is the "broadcast" nature of the network in which messages intended for a single customer pass by network ports serving other customers. The tiered, addressable tap may offer a partial solution.

So long as the "passband" approach to multiplexing remains crucial, so too will the ability to control blocks of frequency on a tap port by tap port basis. **CT**

Microwave antennas

(Continued from page 100)

this is a company that let's say is sending different programming to each receive site on Ch. 3. Each of the receive sites is looking at the transmit site and seeing all the antennas. If each of the Ch. 3 modulators is not phased-locked to the same source, then there will be a slight frequency offset that will cause a beat. With each of the modulators locked to the same reference, the RF beat will in fact be zero. At that point we find we can get by with a less than 60 dB C/I.

Remember that receivers look at transmit sites so the interference can come from any place. The receive antenna can see not only from the front but the back and sides also. Know the pattern of the antennas you are using. Make sure the proper feed and feed guys are used with each antenna. Don't mix manufacturers.

If the feed guys are loose then there is a problem. Reread the instructions and correct it. Properly installed systems cause less problems than ones that are put up just to get on the air and generate profits. If it is done right the first time you will not only have a better running system but customers will be much happier because of lower downtime. You won't be taking the system down to correct little built-in problems.

This has been just a brief look at antennas and some of the problems I have seen over the years. If you run into a problem the best people to contact are the manufacturers of the product. As always ask questions when in doubt. Attend Society of Cable Television Engineers meetings, and above all talk to one another. **CT**

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

A. Are you a member of the SCTE (Society of Cable Television Engineers)?
01. ___ yes
02. ___ no

B. Please check the category that best describes your firm's primary business (check only 1):
Cable TV Systems Operations
03. ___ Independent Cable TV Syst.
04. ___ MSO (two or more Cable TV Systems)
05. ___ Cable TV Contractor
06. ___ Cable TV Program Network
07. ___ SMATV or DBS Operator
08. ___ MDS, STV or LPTV Operator
09. ___ Microwave or Telephone Comp.
10. ___ Commercial TV Broadcaster
11. ___ Cable TV Component Manufacturer
12. ___ Cable TV Investor
13. ___ Financial Institution, Broker, Consultant
14. ___ Law Firm or Govt. Agency
15. ___ Program Producer or Distributor
16. ___ Advertising Agency
17. ___ Educational TV Station, School, or Library
18. ___ Other (please specify)______

C. Please check the category that best describes your job title:
19. ___ Corporate Management
20. ___ Management
21. ___ Programming
Technical/Engineering
22. ___ Vice President
23. ___ Director
24. ___ Manager
25. ___ Engineer
26. ___ Technician
27. ___ Installer
28. ___ Sales/Marketing
29. ___ Other (please specify)______

D. In the next 12 months, what cable equipment do you plan to buy?
30. ___ Amplifiers
31. ___ Antennas
32. ___ CATV Passive Equipment including Coaxial Cable
33. ___ Cable Tools
34. ___ CAD Software, Mapping
35. ___ Commercial Insertion/ Character Generator
36. ___ Compression/Digital Equip.
37. ___ Computer Equipment
38. ___ Connectors/Splitters
39. ___ Fleet Management
40. ___ Headend Equipment
41. ___ Interactive Software
42. ___ Lightning Protection
43. ___ Vaults/Pedestals
44. ___ MMDS Transmission Equipment
45. ___ Microwave Equipment
46. ___ Receivers and Modulators
47. ___ Safety Equipment
48. ___ Satellite Equipment
49. ___ Subscriber/Addressable Security Equipment/ Converters/Remotes
50. ___ Telephone/PCS Equipment
51. ___ Power Suppls. (Batteries, etc.)
52. ___ Video Servers

E. What is your annual cable equipment expenditure?
53. ___ up to $50,000
54. ___ $50,001 to $100,000
55. ___ $100,001 to $250,000
56. ___ over $250,000

F. In the next 12 months, what fiber-optic equipment do you plan to buy?
57. ___ Fiber-Optic Amplifiers
58. ___ Fiber-Optic Connectors
59. ___ Fiber-Optic Couplers/Splitters
60. ___ Fiber-Optic Splicers
61. ___ Fiber-Optic Transmitter/Receiver
62. ___ Fiber-Optic Patchcords/ Pigtails
63. ___ Fiber-Optic Components
64. ___ Fiber-Optic Cable
65. ___ Fiber-Optic Closures & Cabinets

G. What is your annual fiber-optic equipment expenditures?
66. ___ up to $50,000
67. ___ $50,001 to $100,000
68. ___ $100,001 to $250,000
69. ___ over $250,000

H. In the next 12 months, what cable test & measurement equipment do you plan to buy?
70. ___ Audio Test Equipment
71. ___ Cable Fault Locators
72. ___ Fiber Optics Test Equipment
73. ___ Leakage Detection
74. ___ OTDRs
75. ___ Power Meter
76. ___ Signal Level Meters
77. ___ Spectrum Analyzers
78. ___ Status Monitoring
79. ___ System Bench Sweep
80. ___ TDRs
81. ___ Video Test Equipment

I. What is your annual cable test & measurement equipment expenditure?
82. ___ up to $50,000
83. ___ $50,001 to $100,000
84. ___ $100,001 to $250,000
85. ___ over $250,000

J. In the next 12 months, what cable services do you plan to buy?
86. ___ Consulting/Brokerage Services
87. ___ Contracting Services (Construction/Installation)
88. ___ Repair Services
89. ___ Technical Services/ Eng. Design
90. ___ Training Services

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

AD INDEX

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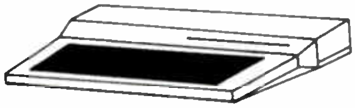

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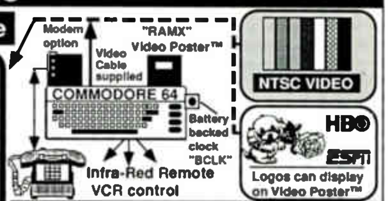

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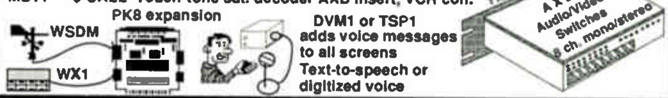

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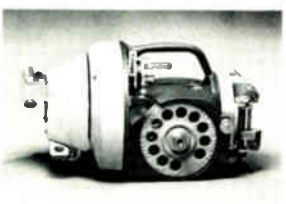

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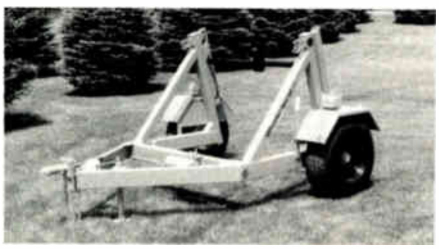

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The following is a listing of videotapes currently available by mail order through the Society of Cable Television Engineers. The prices listed are for SCTE members only. Nonmembers must add 20% when ordering.

☛ *Digital Compression* — This presentation, featuring Bob Luff, provides an introduction to digital video and compression. Topics include: weaknesses of analog NTSC video, why digital, why compression is necessary, intraframe compression vs. interframe compression, vector quantization concept, DCT (discrete cosine transform), how digital compression may be implemented cost-effectively in CATV systems, where the digital signals be located in the frequency spectrum, what the next generation of digital set-top converters be like, and digital audio. (105 min.) Order #T-1147, $45.

☛ *Fiber Optics, A Practical Approach* — This program, featuring Tom Staniec, covers the "pros and cons" of working with fiber, as well as a frank discussion on how to implement fiber and what to expect. Topics include: why use fiber, what architectures are better for new-builds/rebuilds/ upgrades, fiber backbone, CAN (Cable Area Network), flexible CAN, FSA (fiber-to-the-service area), FITT (fiber intermediate terminating trunk), FTF (fiber-to-the-feeder), how many fibers to run, where to expect significant labor costs, and how to plan for system and/or bandwidth expansion. (120 min.) Order #T-1148, $45.

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

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

To order: All orders must be prepaid. Shipping and handling costs are included in the continental U.S. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. To qualify for SCTE member prices, a valid SCTE identification number is required, or a complete membership application with dues payment must accompany your order. Orders without full and proper payment will be returned. Send orders to: SCTE, 669 Exton Commons, Exton, PA 19341 or fax with credit card information to (610) 363-5898.

Listings of other publications and videotapes available from the SCTE are included in the April 1994 issue of the Society newsletter, "Interval."

Meter box ground clamp

Diamond Communication Products introduced the Meter Box Ground Clamp, designed to provide a convenient and reliable ground for CATV or telephone drop wire runs. Made from high quality steel, the unit is mechanically galvanized to B695 specifications, which equates to 25 years of corrosion protection. Installation only requires the tightening of one bolt and attachment of the ground wire.

Dual steel points on the slotted bracket and pointed bolt assure a positive ground connection. The slotted head ground screw accommodates #12 through #16 ground wires. This eliminates the need for costly ground rods. Two sizes are available: a short version that fits 7 to 10-1/4 meter panels, and a long version to fit 11-1/2 to 15-1/4 meter panels. The unit is UL listed.

Reader service #202

Signal level meter

Wavetek Corp. unveiled the Stealth SAM, a hand-held signal level meter (SLM) that incorporates nonintrusive carrier-to-noise and hum testing, allowing the performance of FCC tests without interrupting service to subscribers.

The 3.5 pound unit features Sweepless Sweep, which measures and compares active system carriers to a stored reference, determining system frequency response. Fast tuning enables an efficient scan mode that shows all carrier levels on one display, as well as permits the Sweepless Sweep mode for passive frequency response testing. Both modes update in about one second for 200 data points.

Signal levels are read on the 320 x 240 dot matrix LCD that shows measurement data in both graphical and numerical form. The level display provides a large bar graph for video and audio carrier levels, along with a numerical readout of these levels and the difference between them.

The tilt mode simplifies the system sweep rough balance step by displaying a bar graph with a representation of up to nine different user-selected video carrier levels. Hum measurements require pressing only one key, displaying hum modulation in either percent or dB, as selected. Soft keys offer selection of 60, 120 or <1,000 Hz filters for help in troubleshooting.

Pressing the carrier-to-noise measurement key displays the C/N ratio of the tuned channel, along with the noise measurement frequency and bandwidth. A proprietary DSP technique enables hum and C/N measurements on modulated carriers.

An automated testing feature allows the unit to perform unattended 24-hour FCC tests with logging of results for later download to PC or printer. A variety of spans may be shown on the spectrum display, enabling a visual search for ingress or other distortions.

Reader service #208

Cable placement

The Cable Blow-in system from Pyramid Industries Inc. is a new technology and method for placing fiber-optic cable. The system uses an air compressor for back pressure, a piston or projectile to create an air-tight seal within the duct, and the mechanical pushing force of the blow-in system.

The system can place up to 260 feet of cable per minute. This self-contained portable unit has a digital readout for exact location of potential bends in the duct that assures accurate dig-ups when necessary. Automatic shut-off will occur if a severe bend is located. The cable is installed "stress free," ensuring the safety of the duct by leaving the cable relaxed.

A caterpillar drive with a large contact area is utilized to eliminate any slippage or scoring of the cable sheath. Potential savings derive from the elimination of pull tape, reduced lubricant use, less expensive smooth wall used in place of other ribbed-type ducts, and a reduction of manholes.

Reader service #203

Network interface

Scientific-Atlanta Inc. introduced its Broadband Integrated Gateway (BIG) product line, which will seamlessly select, convert and deliver a wide variety of industry standard digital video, voice and data communications signals in advanced telecommunications and cable TV networks.

The product line serves as an interface between data networks formats, such as SONET, video file server and other LANs, ATM switches, MPEG transport layer and cable satellite distribution networks.

BIG can accept a broad range of digital signal inputs and data rates, and provide selectable outputs in a wide variety of digital or formats on the other end. The interface product can take the OC-3 (optical carrier) standard data transmission format and divide it into five 30 Mbps data streams. Each of these 30 Mbit data streams can then be modulated onto individual cable channels of 6 MHz. These channels can then be delivered over broadband hybrid fiber and coaxial networks to digital home communications terminals.

The unit will be available in either a 19- or 22-inch Electronic Industries Association (EIA) standard chassis. Software provides the capability to mix and match channels through the channel banks and platform.

One benefit is the product's ability to take compressed videos from an MPEG file server and transform that output into a number of standard data formats. These MPEG videos can be delivered over any system that utilizes these standard formats. For instance, several compressed videos could be multiplexed onto a DS-3, which could then be handed off to any provider of DS-3 service, such as a local telephone company, a long distance provider or a private carrier. The system also could be used on the other end to convert the DS-3 transmission back to baseband data outputs for decoding, storage onto a local file server or modulation onto a broadband delivery network.

Reader service #207

Optical wavelength selector

Santec Photonics Laboratories announced the OTF-100 electronically controlled optical tunable filter with tuning speed of ≤10 ms, adopting the company's polarization independent interference filter. This filter is designed for EDFA applications, precise wavelength selection in high density WDM systems, coherent communications and CATV applications. In addition to the high speed tuning, the unit features very low polarization dependent loss (PDL<0.1 dB P-P) and can be integrated easily in optical modules such as EDFA (rack-in type is available).

Reader service #206

Videotape library

Nesbit Systems Inc. introduced a new version of its Video Tape Library System (VTL) for Windows that merges the power of the DOS-based system with the graphical interface and ease of use of the Microsoft Windows operating system.

VTL for Windows is a fully functional application and not simply a DOS task running under Windows. It will provide a newly designed and simplified user interface that takes advantage of all Windows graphical design components using mouse support and system icons. Also, it will provide all of the powerful capabilities of the current DOS system.

A key component of the system is

The *Flash* provides a big time OTDR in a small package – 6.6" wide by 8.2" long and 2.5" deep. At 3.4 pounds it's only a little heavier than this magazine – but it has all the OTDR functionality you could want:

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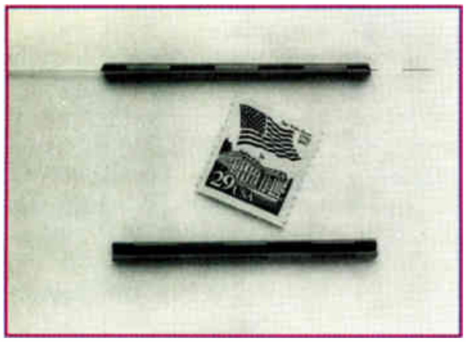
Reader Service Number 138

its compatibility with the new Microsoft Video standard. This will allow for storage and retrieval of graphic skills and other video inputs as part of the data base. One of the defined attributes of a tape record can be graphic stills or full motion video. A query of the data base (e.g., all tape records with shots of New York) will provide a summary list of these tapes with all defined record attributes, including the video or still store graphics associated with the tape, as well as its current location.

Other features allow the operator to use a VGA monitor as a high resolution NTSC or PAL monitor for logging, save video stills or live video with log entries, accept input from any NTSC source, import video stills from any PCX source and display as NTSC video, and view two sources simultaneously in a split video window.

The multitasking capabilities of Windows allow for more efficient overall system use. Reports may be generated in the background as data entry occurs, or system queries may be submitted while tapes are being scanned into the library.

Reader service #205



Fusion splice protector

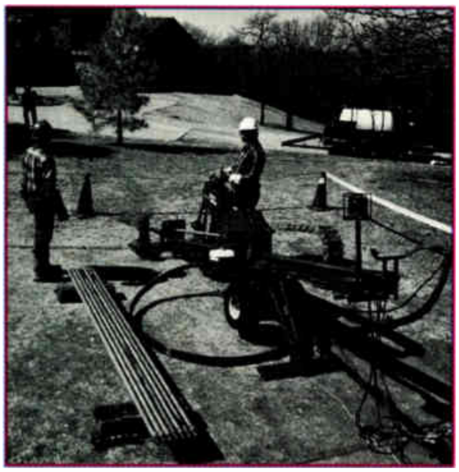
To meet the demand for a nonheat cured fusion splice protector, Advanced Custom Applications Inc. introduced ULTRAsleeve, a plastic injection molded hinge-type mechanical protection device that shields fused fiber(s). A special mechanical tool is recommended for closing the cover.

The unit is composed of two halves that are hinged together to form an open U shape. Neither half of the sleeve has grooves nor any other fixed alignment guides. The unit accepts either single fiber (any combination of 250 to 900 micron buffers) or multifiber fused joints up to four fiber ribbon, and is available in 40 or 60 mm lengths. It is applied after the fiber joints are fused (the fibers are not prethreaded) and the fibers are placed into the fold of the hinge. Along with the acrylic sealer inside the cover, the mechanical snap-together housing keeps the unit in the closed position.

Once the cover is snapped together, the protector is permanently closed. The unit requires no heat shrink, gluing or curing. The inside of the cover has a double-coated acrylic foam closed cell tape that seals the buffer along with the fused fiber joints and protects them from many chemicals and environmental hazards. No apparent degradation of the tape is noted when splash tested with most common solvents, including gasoline, JP-4 jet fuel, mineral spirits, motor oil, ammonia cleaner, acetone or methyl ethyl ketone (MEK). The company says moisture resistance for a 12-month period shows integrity remains excellent when submersed in water or salt water, and that outdoor weathering tests resulted in excellent UV resistance.

The main body is plastic injection molded from liquid crystal polymer and is delivered in a 60° open position so that the fused fiber joints can be placed into the opening. Before the fibers are placed into the protector, the user has to remove the tape guard, which will make the acrylic tape ready to seal the fiber(s). Once the cover halves are closed, due to mechanical engineering of the unit, it cannot be reopened or used for any other fiber joints.

Reader service #204



Directional boring system

The new JT910 fluid-assisted directional boring system from Ditch Witch is designed to bore faster, with greater precision, on a wide variety of trenchless service installations. With its self-contained ground drive system, the unit can be unloaded easily and driven to the job site. The ground drive is powered by a 5-HP class Honda engine that is mounted directly to the drill unit.

Other features include a hydraulic drill pipe breakout system, hydraulic drill frame leveling, variable drilling fluid flow, and a wide selection of wing and cone compaction backreamers. An optional auger anchoring system enables the crew to hydraulically drive and remove drill frame anchors.

A 50-HP class power pack and power-efficient drill frame hydraulics give the unit exceptional thrust for boring in hard soils, as well as powerful pullback power for backreaming and long distance service pullbacks. The unit features the company's ESS electrical strike system, which the company says is the most comprehensive in the trenchless technology industry, designed to indicate if a live electrical cable has been struck during a bore.

Reader service #201

Our response to your comments

By Bill Riker
President, Society of Cable Television Engineers

At the Society of Cable Television Engineers national headquarters, the arrival of the results of our annual membership questionnaire is greeted each year with great interest among the Society's national staff. It affords us our most direct opportunity to know the views and opinions of the Society's membership of the programs and services SCTE is offering. Through a series of questions, responding members can offer suggestions for areas they feel could use improvement, comment on SCTE offerings they appreciate, and request programs and services they would like the Society to provide.

I would like to use this column as a forum to discuss some of the comments gleaned from these questionnaires.

Suggestion for article

The following suggestion for an *Interval* article has been given: "'Tech Tips' — real-life application of troubleshooting, new ideas, etc."

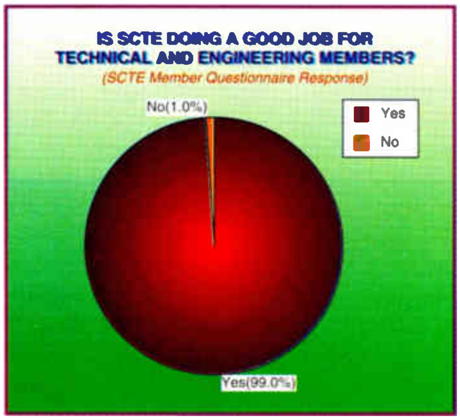
While we don't call it "Tech Tips," each year, through our Field Operations Award Program, the Society solicits and publishes CATV technical innovations and problem-solving techniques that are entered in this competition. While *Interval* (the Society's monthly newsletter) is primarily a membership-oriented publication geared toward reporting the activities of the Society's members and local chapters and meeting groups, the Field Operations Award enables us to solicit and publish just the type of "real-life" solutions and tips this respondent was requesting. Look for the publication of each of this year's entries in the July issue of *Interval*.

More for the membership

The following suggestions were made: "Work with corporations to allow/encourage more (SCTE) participation"; "Work harder at convincing management to allow system personnel to attend meetings."

This objective has been the focus of the marketing program SCTE began in 1993. Based on the findings and recommendations of a marketing consultant, the Society inaugurated its efforts to encourage the industry's upper level management with the production of a calendar of technical terms that was distributed as an educational service to system managers across the country, as well as the publication *Interface*, a quarterly newsletter specifically developed to make the industry's management and executives aware of the many benefits of supporting SCTE. Watch for news of more marketing efforts in coming months.

Another suggestion was: "Make it easier to start chapters. National (headquarters) could assemble a task force to fill in dead spots in areas that need chapters."



While SCTE is not currently planning to establish a "task force," the Society has placed a great deal of emphasis on its Chapter Development Program recently. A new revised and expanded edition of the *SCTE Chapter Development Handbook*, a publication detailing how to establish a new SCTE local group and the requirements such groups must comply with thereafter, is in production and should be distributed to current SCTE chapter and meeting group officers, as well as members interested in starting new groups in their areas.

SCTE also has expanded its staff to promote the development of new groups and support of existing ones. New Manager of Chapter Development Rick Bechtel will be working closely with each of the Society's 73 chapters and meeting groups to increase and improve their efforts and will be aiding new meeting groups in their startup process, as well as encouraging the development of new groups in areas in which the proximity from other groups prohibits the attendance of local personnel.

Publications, videos

The following suggestion was made regarding what publications and audio/video products the SCTE should offer: "The ones you have, but in Spanish."

Producing Spanish or bilingual editions of SCTE publications, such as reference manuals for our certification programs, is something we are very interested in doing. In fact, we hope to have Spanish edition of our *Installer Certification Manual* available by year's end. If you are interested in such publications, please let us know.

Safety and driving safety

Safety in the telecommunications workplace is a vitally important area of our industry, one that is often overlooked or undervalued but can be potentially very expensive and possibly even deadly. SCTE has been very active in the safety arena in recent years, specifically with the publication of the revised and updated *SCTE Health and Safety Manual* (a comprehensive guide to health and safety in the CATV industry) in 1993, and the upcoming release of the new *SCTE OSHA/Hazcom Manual* (focusing on the government's Occupational Safety and Health and Hazard Communications Acts in terms of regulations and compliance), which we plan to premiere at this month's Cable-Tec Expo in St. Louis.

As you can see, many of the comments made by SCTE members in these questionnaires are already being addressed and others are in the works. SCTE is a service-oriented membership organization. It is our job as a Society to meet the needs of you, the members. And judging by the positive overall responses to the questionnaire (see this month's issue of *Interval* for complete questionnaire results), we're doing a good job of it. In the year of SCTE's 25th anniversary, I can honestly say we hope to continue these efforts into the next 25 years and beyond. **CT**

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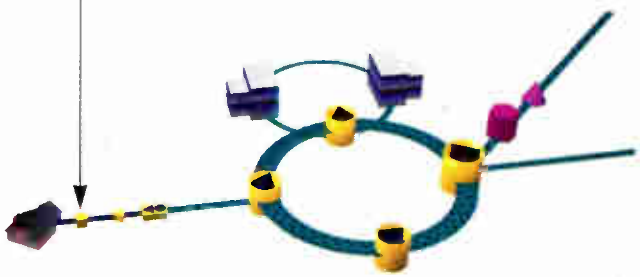

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