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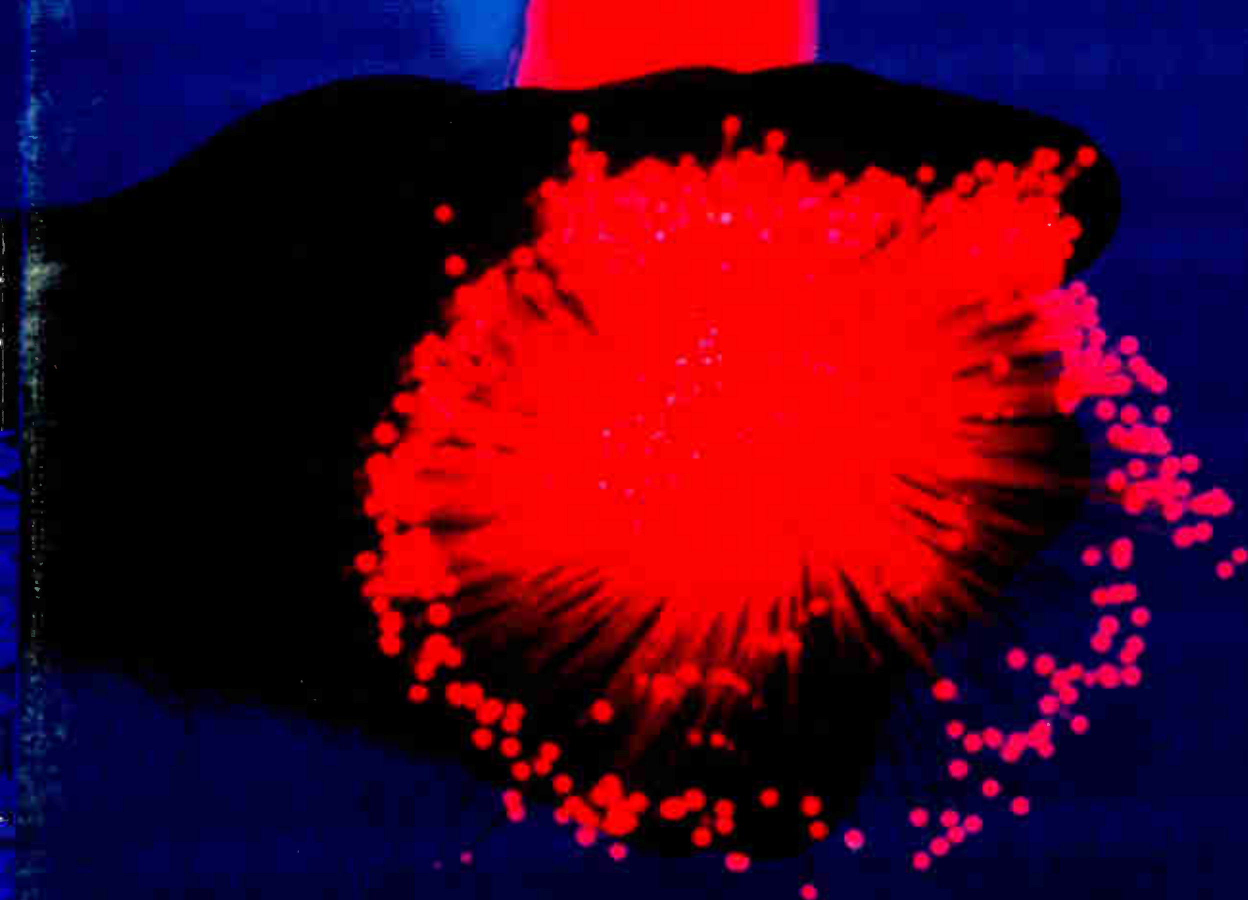
COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

Fiber and beyond: Engineering cable's future



Consumer interface challenges

Test and measurement essentials

September 1994

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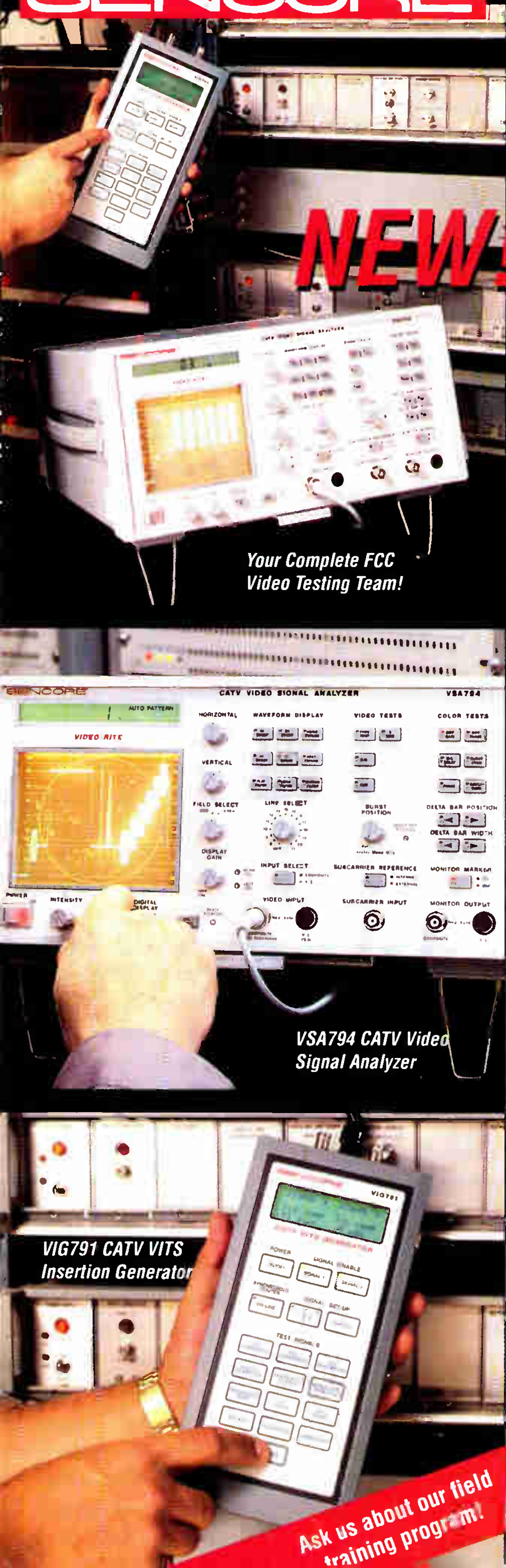

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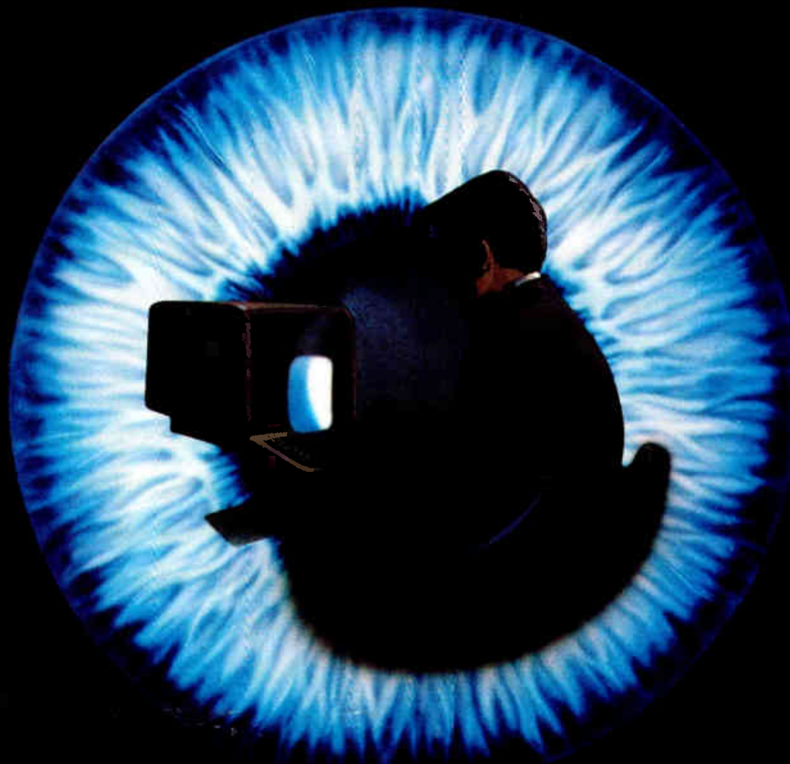
Reader Service Number 2

Signs of True Leadership



INNOVATION

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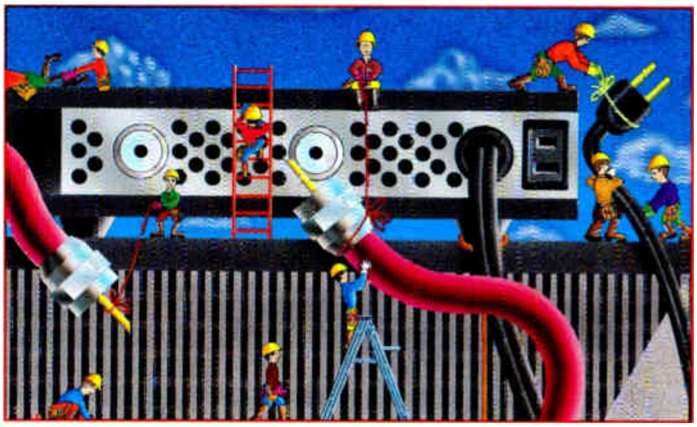
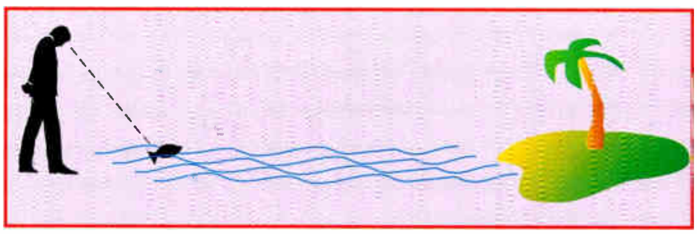
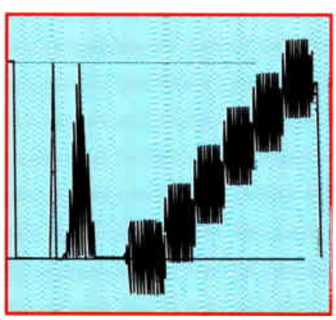
Departments


Geri Saye





Features

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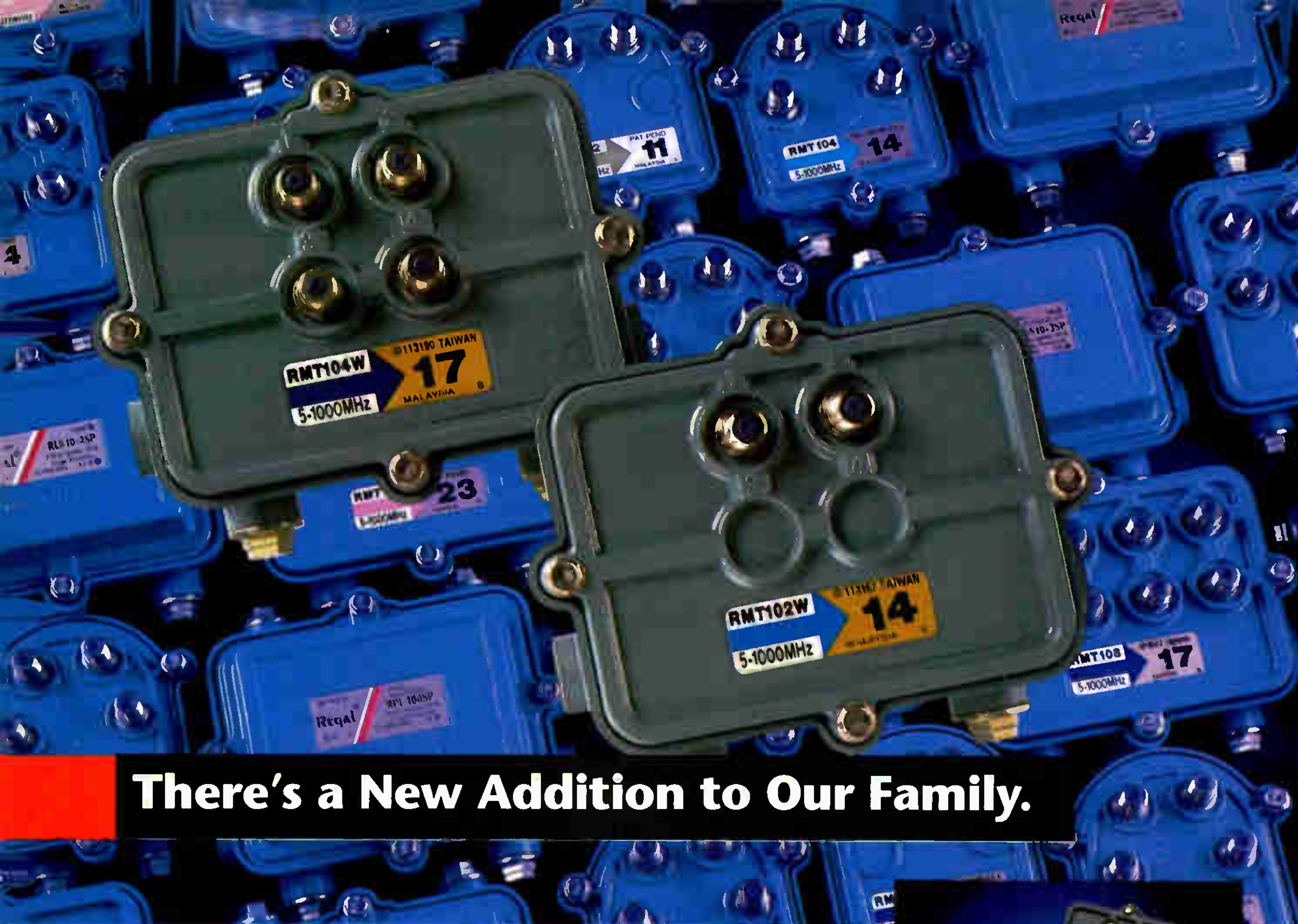
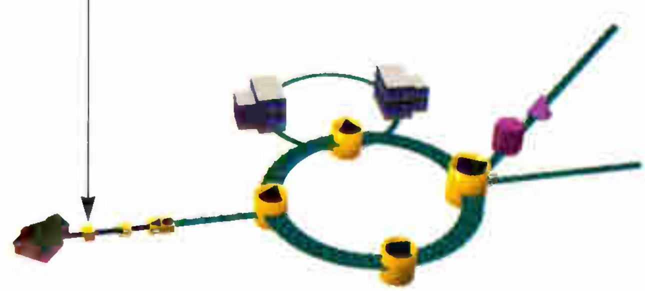


There's a New Addition to Our Family.

They're here! Regal wide body taps from ANTEC – developers of the first 1 GHz tap and line passive products for the cable industry.

Our Cable Integrated Services Network (CISN) is a "blueprint" for building a broadband network that accommodates interactive services in a 1 GHz spectrum. The Regal family of products by ANTEC supports this vision.



Regal 1 GHz two-way and four-way wide body taps meet the needs of your growing network by affording you flexibility in system design and construction. These wide body taps allow you to upgrade any existing plant to 1 GHz without extension connectors.

Regal wide body taps offer:

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Reader Service Number 5

REGAL
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EDITOR'S LETTER

DirecTv: An early report card

In case you missed it in the popular media, Hughes Communications' DirecTv is up and running. This new Ku-band direct broadcast satellite (DBS) service is being uplinked a dozen or so miles from Denver near Castle Rock, CO. Folks, we have potentially serious competition beginning to knock on our door.

Although signals are being beamed to much of North America, DirecTv's service is being marketed initially in Little Rock, AR, Shreveport, LA, Jackson, MS, Albuquerque, NM, Tulsa, OK, and Indianapolis. Several other markets are in the works and by later this year a national rollout is planned.

And how is it doing? Well, early indications seem positive, with dealers in the test markets claiming to be unable to keep dish/decoder packages in stock. The high entry price is so far having no impact on early buyers.

That high entry price is one of the reasons for our own industry's naysayers not giving much serious concern to DirecTv. An 18-inch dish, low-noise block downconverter (LNB) and basic receiver/decoder retail for $699, and installation — or those not inclined to do it themselves — is another $199. To connect two TV sets or to be able to record one channel while watching another requires the advanced receiver/decoder package at $899 plus installation. Add a slave receiver to the advanced package, and you've just spent another $599.

Grade for cost of entry: D. (Expect the equipment prices to drop in the next year or two, and with Sears, Circuit City, etc., selling the packages, I think many will treat it like buying a TV set or microwave oven. Put it on the charge card!)

The monthly basic service is $22, comparable to traditional cable service. The lineup includes a couple dozen of the more popular cable channels, which makes the basic package about the same as the local cable company. Grade: B.

Picture quality? I've heard comments that range from "better than laserdisc, better than VCR, better than cable" to "about the same as SVHS." Today's digital compression is far from perfect and DirecTv is not immune to some visible artifacts and occasional frame freezes. Most users seem very satisfied with the picture quality and are willing to put up with an occasional glitch. I think the picture quality looks very good although I personally don't care for the occasional digital artifacts. Grade for picture quality: B.

One not-so-surprising complaint is that of rain fade outages. Seems the 12 GHz downlink with an 18-inch dish is pretty susceptible to rain attenuation. This part bothers users quite a bit. Reliability grade: C-.

Overall grade: C. But it's still early, so DirecTv shouldn't be discounted too much. This is a competitor we should take seriously. At this point interactivity is a nonissue and the lack of local programming isn't a big concern either. (The receiver has a TV antenna input on the back.) Just for the record, I plan to become a subscriber and will keep you posted on what our competition is up to. Stay tuned!

Ronald J. Hranac
Senior Technical Editor

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Standard's TVM450 was a revolution – the first frequency agile, PLL-controlled, broadband heterodyne modulator capable of near-crystal performance without heavy post-filtering.

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And if that's not enough to make the TVM550 sizzle, there's more.

Talk about integration.

Short on rack space (and who isn't?) The TVM550 is designed to accept the seamless integration of options, including the CSG60 BTSC/MTS stereo generator and automatic high-level I.F. switching. By eliminating separate components for these functions, the TVM550 saves

rack space, external wiring and AC power requirements, and reduces heat generated in the headend.

A few refinements.

The TVM550 also offers some very refined, practical features to make operations simple and obvious.

Video and RF test ports, a seven-segment deviation meter and BTSC indicator are all conveniently located on the front panel, while preprogammed FCC frequency offsets are microprocessor controlled for exact system requirements. The TVM550's advanced circuitry, slim-line design and high level performance characteristics make it the hot choice of cable MSOs.

Get it while it's hot.

When you add up all the TVM550 can do, it's easy to see why it's becoming a very hot seller. But you don't have to take our word for it. Call us, and we'll send you complete specs and pricing. And if that's not enough to convince you, we'll set it up and show you – in your facility or ours.

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Hot idea.

Philips, CLI awarded Bell Atlantic contract

In the first step of a January 1994 agreement, Philips Consumer Electronics and Compression Labs Inc. (CLI) announced that they received a contract from Bell Atlantic for the first interactive digital entertainment terminals. The terminals will be used in the first commercial market digital TV and information services that will be transported over Bell Atlantic's video dialtone network in New Jersey.

Under the terms of the contract, the Philips/CLI team will deliver the interactive terminals, also known as digital set-top decoders, that will receive, decode and control a wide range of video entertainment services to be offered by program providers, including Futurevision.

The initial multimillion dollar order to Philips and CLI will be for installations in Bell Atlantic's Dover Township, NJ, service area beginning later this year. Bell Atlantic received approval from the Federal Communications Commission on July 6, 1994, to begin construction of an interactive digital network serving 38,000 lines. Service is expected to begin in early 1995.

The Philips/CLI terminals will use the MPEG-2 international standard for digital video compression, as well as the MPEG-specified Musican audio system. They will contain microprocessing capabilities equivalent to a powerful PC and more than 5 megabytes of random access memory.

Digital, GI ally for interactivity

Digital Equipment Corp. and General Instrument Corp. announced they are presenting end-to-end interactive video system solutions to network providers of interactive information services. The systems include Digital's open video and interactive information architecture and GI's DigiCipher II MPEG-compliant satellite encryption system and DigiCable addressable set-top terminals with LinX computer-powered interactive modules.

In other news, GI and T&L Publications of Corona, CA, entered into a consent decree settling litigation brought by GI in September 1993. This settlement is the first of its type in the cable TV industry involving the advertisement of cable signal theft devices.

GI's suit alleged that *Nuts & Volts* magazine, published by T&L, assisted in the illegal reception of cable TV programming by publishing advertisements for the sale of illegal cable devices and actively promoting the sale of this equipment. In the settlement, T&L has agreed to cease publishing advertisements for specific devices used for the sole purpose of pirating cable TV signals, including cable signal theft devices that were falsely advertised as genuine GI products.

Philips, Omnipoint hold PCS trial

Philips Broadband Networks Inc. and Omnipoint Corp. formed a strategic alliance to integrate and evaluate low-cost, high-performance cable TV-based wireless networks for operation in the proposed personal communications services (PCS) frequency band (1,850-1,990 MHz).

The initial focus is to establish a CATV-based digital PCS network trial in Syracuse, NY, using Omnipoint PCS base stations integrated into Philips CATV distribution platforms in a distributed architecture to provide wireless voice services with complete coverage and vehicular speed mobility within the test areas. The network will support wireline-quality voice, data and video communications using small, inexpensive, pocket-sized phones with long battery life.

S-A, H-P team with BellSouth

Scientific-Atlanta Inc. announced that it has been selected to supply a full range of advanced home communications terminals, fiber optoelectronics, RF distribution electronics, interactive digital video network components and telephony equipment for BellSouth Corp.'s planned video services trial in the Atlanta area.

BellSouth currently has a request pending with the FCC for authorization to conduct a 12,000-home trial in a demographically diverse community north of Atlanta in 1995.

Products expected to be included in the trial are S-A's 8600^X analog and MPEG-based 8600^{XD} digital home communications terminals; analog and digital headend equipment, including quadrature amplitured modulation (QAM); the recently introduced Broadband Integrated Gateway (BIG) hardware and Connection Management Controller software for digital video networks; RF and fiber-optic electronics equipment; RF passive components and the company's CoAxiom system for integrating telephone service into a cable TV network architecture.

In other news, Hewlett-Packard has been selected to provide BellSouth with H-P interactive video servers for the 18-month field trial. Initially, H-P's video servers will enable the regional Bell to deliver video programs and services "on-demand" to approximately 12,000 homes in the greater Atlanta area. H-P's interactive video server uses a new hardware architecture — video transfer engine — designed specifically for streaming large quantities of video data across networks. According to the company, focusing on moving data rather than processing data (as traditional large mainframe and supercomputers do) the video transfer engine provides high-performance video-on-demand at a low cost per video stream.

As described in a nonbinding memorandum of understanding from BellSouth, H-P will be working with Oracle Corp. and Scientific-Atlanta. Oracle Media software will be used to manage interactive video applications on the H-P interactive video server. H-P and S-A will develop interfaces jointly to network transport software and set-top boxes that will be supplied by S-A.

☛ Zenith Corp. announced a second quarter net loss of $8.4 million (20 cents per share), a 66% reduction from its 1993 loss of $24.7 million (79 cents per share). The company attributed increased sales in core products and lower costs resulting from

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Reader Service Number 20

downsizing and re-engineering as reasons for the improved performance. Total revenues were up 9% to $299 million, up from $275 million in 1993.

☛ Oak Industries Inc. reported record operating results for the quarter ended June 30, 1994. Operating income increased 38.6% to $15 million compared to $10.8 million for the quarter ended June 1993. Net income, excluding nonrecurring items, rose 68.7% to $9.4 million (51 cents per share) compared to $5.6 million (30 cents per share) for the corresponding quarter last year. Net income, including nonrecurring items, was $10.3 million (56 cents per share) for the current quarter. Sales for the June 1994 quarter of $65.7 million increased 12.8% over the June 1993 quarter and were the highest level in the past nine years.

☛ Bell Atlantic selected Vicorp Interactive Systems to provide software for the company's video dialtone trial in Northern Virginia. Vicorp is providing so-called gateway software that controls interfaces between customers, the service network and the video information providers. The Vicorp software presents menus of services, processes requests, establishes links and processes billing information.

☛ Rogers Communications plans to spend $73.8 million on cable TV, programming and new services pending regulatory approval of the Maclean Hunter takeover, *CableFAX* reports.

☛ David Rozzelle, former CEO, cable operations for InterMedia Partners; David Large, former director of engineering for IP; and Ted Liebst, former CFO and chief administrative officer for IP, have joined to form Media Connections Group, a San Francisco Bay Area consulting firm offering management services to the telecommunications industries. Its principals have 67 combined years of experience in the media businesses of cable TV, multipoint microwave distribution services, TV and radio broadcast, and various telco businesses with the preponderance of their experience in cable TV.

☛ The American National Standards Institute (ANSI) formed a new panel to accelerate the development and acceptance of standards critical to the establishment and deployment of the information superhighway. The new organization, Information Infrastructure Standards Panel, held its first meeting in New York in July. More than 60 participants attended, including non-ANSI members.

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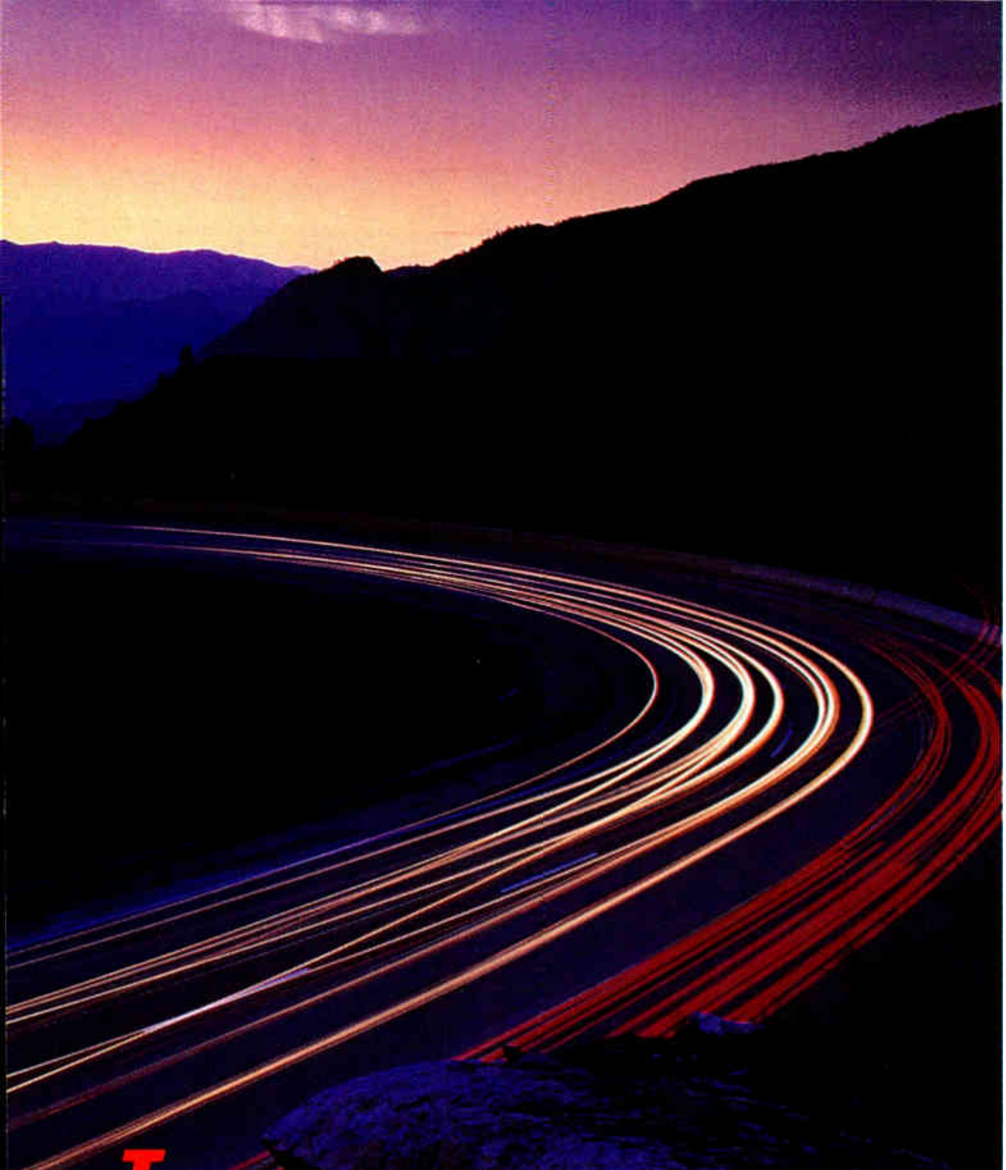

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ALPHA TECHNOLOGIES

Reader Service Number 27

OSHA course saves money, lives

Health and safety in the workplace are increasingly important issues in the cable industry. The establishment of OSHA and the implementation of federal regulations placed responsibility on employers to provide for their employees' safety, health and welfare. The consequences of noncompliance are more onerous than those of not complying with the FCC rules for signal leakage and cumulative leakage index (CLI), and have far more devastating effects for cable systems and companies.

Four years ago, when the SCTE began to address these issues, it found that most companies were not in compliance with OSHA standards and did not know what the rules and regulations were about. Although awareness has increased, systems are not completely up to compliance standards — usually in the areas of the Hazardous Materials Program and providing the required general safety training. Also, although many managers have appointed safety coordinators, they are not aware of the requirements of the job, have little idea of what they need to know about OSHA and are unaware of their liability for ensuring that safety standards are met. In response to these problems, SCTE created a one-day seminar for managers and safety coordinators.

Through the "Safety and OSHA Regulations" seminar, attendees will gain a comprehensive overview of:

1) *Management responsibility* — Learn who is responsible for employee safety and what are the consequences of noncompliance at each managerial level.

2) *Safety coordinator and committee* — The duties and responsibilities of the safety coordinator and guidelines for appointing a coordinator and selecting a safety committee.

3) *What is OSHA?* — An overview of OSHA, the resources and references available to you, and the steps to compliance (including required record keeping, reports and inspection preparation).

4) *The most cited OSHA standards* — Training on the most commonly cited standards and how to meet the requirements of each.

5) *Items specific to CATV and related requirements* — A review of personal protective equipment, vehicle and equipment safety and work environment issues.

The following is a preliminary schedule for the seminar for the remainder of 1994: Sept. 2, Seattle; Oct. 20, Columbia, SC; Nov. 10, Nashville, TN; Dec. 15, Albuquerque, NM.

Ham operator praises Society

The national SCTE was delighted to receive a copy of a letter from W. E. "Bill" Evans, president of EB Systems Ltd. in Winnipeg, Manitoba, Canada. Evans, who won the grand prize at the Amateur Ham Radio Operators' Reception held June 16 at Cable-Tec Expo '94, wrote this letter, addressed to Richard Barnes of Scientific-Atlanta, to thank S-A for its support of amateur ham radio operators in the CATV industry through its sponsorship of the reception. Evans also used the letter as an opportunity to pledge his support for SCTE.

"I have been involved in the cable industry since the mid-1960s," Evans writes, "and have always believed that my association with amateur radio gave me a dimension of 'hands-on' and 'real-world' exposure that greatly assisted the more theoretical considerations involved in my engineering and engineering management career. I think SCTE's acknowledgment and support for ham radio within the industry further bespeaks the highly successful or grassroots approach so successfully maintained by SCTE.

"As one who also has been involved for quite some time in the telephone and broadcast industries," Evans continues, "I can't bestow enough commendation on SCTE. There is no equivalent organization in either of these industries in terms of education, uplifting the professionalism of the technical personnel, and delivering down-to-earth technical services to its members. I'm sure the cable industry is a big winner because of SCTE."

The SCTE Cactus Chapter held its first Cable-Tec Games at the Arizona Cable TV Association annual meeting. Medal winners were: Tucson Cablevision's Marco Aquilera and Mike Cervantes, Desert Cablevision's Rick Peltonen (first place overall), Paragon Cable's Michael MacArthur, Desert Cablevision's Mark Martell, Paragon's Jeffrey Vaglio and Randy Hill, Tucson Cablevision's Les Lollar and TCI Cablevision's Scott Sayles.

Multimedia offers incentive program

The Society recently received a letter from Kansas Regional Operations Manager Percy Kirk of Multimedia Cablevision in Wichita, KS, concerning an ongoing tutorial of the seven categories covered on the BCT exam for Multimedia's employees.

The letter states that Multimedia has now made it a requirement of the job that technicians become certified within 2-1/2 years, three years for a new employee. Kirk says, "We believe that the SCTE training and certification at the technician level will be a necessity as our industry becomes more technically complex and demanding."

The letter continues, "In addition to providing training on company time for the categories, employees are rewarded with a bonus day off for each category passed. Our company also pays for enrollment into the program, ongoing membership dues, testing and also providing them time with pay while they are testing. Our chapter and company have put together an extensive library to help our members prepare for the topics."

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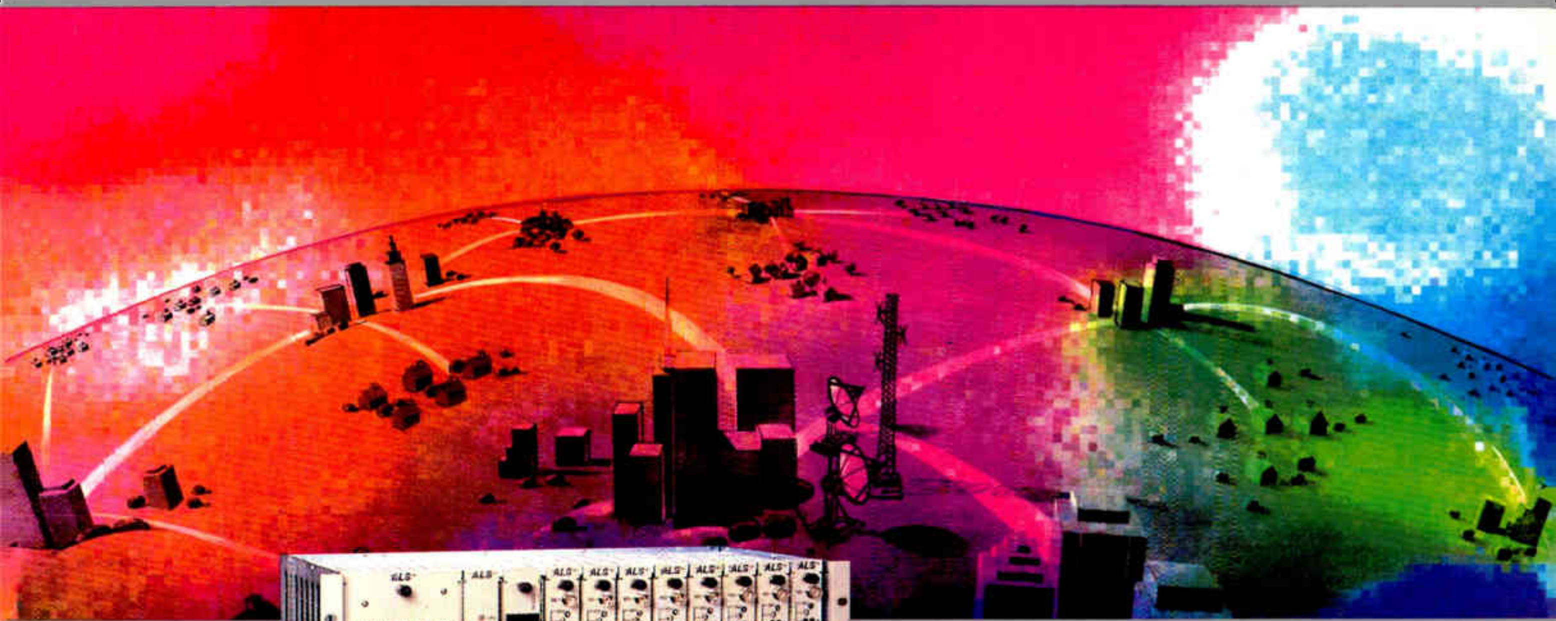

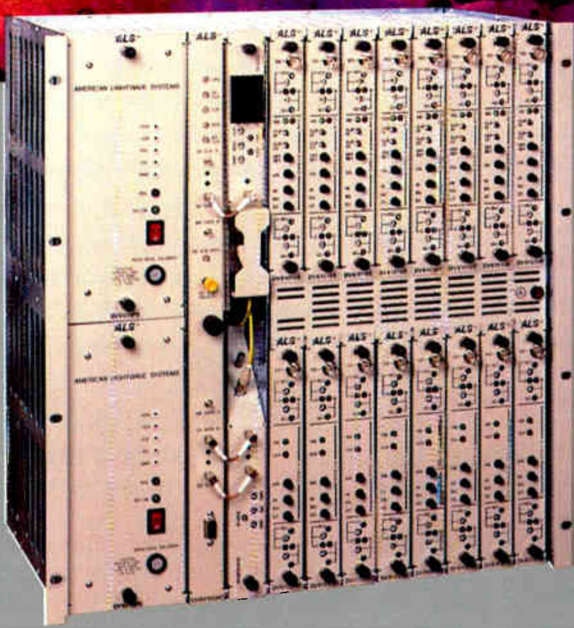

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Reader Service Number 23

Engineering the drop: Installing a digital-ready plant

By Bruce Habeck
Product Manager, ANTEC

As cable TV looks at a variety of ways to prepare its networks for the digital future, the subscriber drop has emerged as one of the most critical elements of plant reliability. Even in today's analog world, poor subscriber drops result in poor picture quality and less than overwhelming enthusiasm for cable services by subscribers who experience snowy pictures. As digital signal delivery becomes prevalent, what was a snowy picture in the analog world could result in a nonexistent picture in the digital world.

Today, noise and other interference simply degrade analog video. In many cases, degraded signals can still be viewed adequately. However, digital signals (long lauded for their robust performance in video, audio and data applications) may run into even more serious snags if they encounter poor subscriber drop systems. Faulty installation and substandard components such as F-connectors or improper crimping can cause a variety of problems in delivering digital signals to a subscriber's in-home devices. (Today, that's the TV set. Tomorrow, the device may be a TV set/computer.)

Last summer, Cable Television Laboratories went on the road to determine what effects poorly installed wiring and/or in-home components would have on digital signal delivery. A mobile truck equipped with a spectrum analyzer, network analyzer and link analyzer traveled through the United States and Canada to test some 20 cable systems and 300 subscriber homes. What CableLabs discovered was a mix of problems, including some homes with major shielding problems and others with high levels of reflections that could require a completely new drop when digital delivery arrives. In another case, problems occurred from high-powered over-the-air signals and impulse noise related to sudden spikes and surges from a nearby power station.

"Quality drops aren't just about components. The drop system also must be completely seamless and format-insensitive."

CableLabs' findings help to demonstrate the need for improved drop installation practices. It's important to note, however, that digital signal delivery isn't the only concern. Today, more than 70% of all service calls continue to be drop-related, indicating the need to improve drop performance now to enhance today's plant even before the digital future arrives.

Positioning for today, tomorrow

Near video-on-demand (NVOD), video-on-demand (VOD), residential telephony, subscriber vs. subscriber games, home shopping, interactive distance learning — the list of emerging services goes on. Yet with all of the many new applications touted in the cable industry, it's clear that most cable operators see the need to build their cable plants for both today's analog services as well as the interactive digital services of tomorrow.

Over the past two decades, cable has grown dramatically, from 12-channel systems up to nearly 80 analog channels, due mostly to the installation of fiber optics and sophisticated optoelectronics. Digital compression capabilities will exponentially increase the number of traditional video services and consumer enthusiasm for the "information superhighway" and all that implies is building. Voice and data applications, once alien territory for the cable operator, will bring new business opportunities to the industry and place even more pressure on the capacity of the broadband plant — including the subscriber drop.

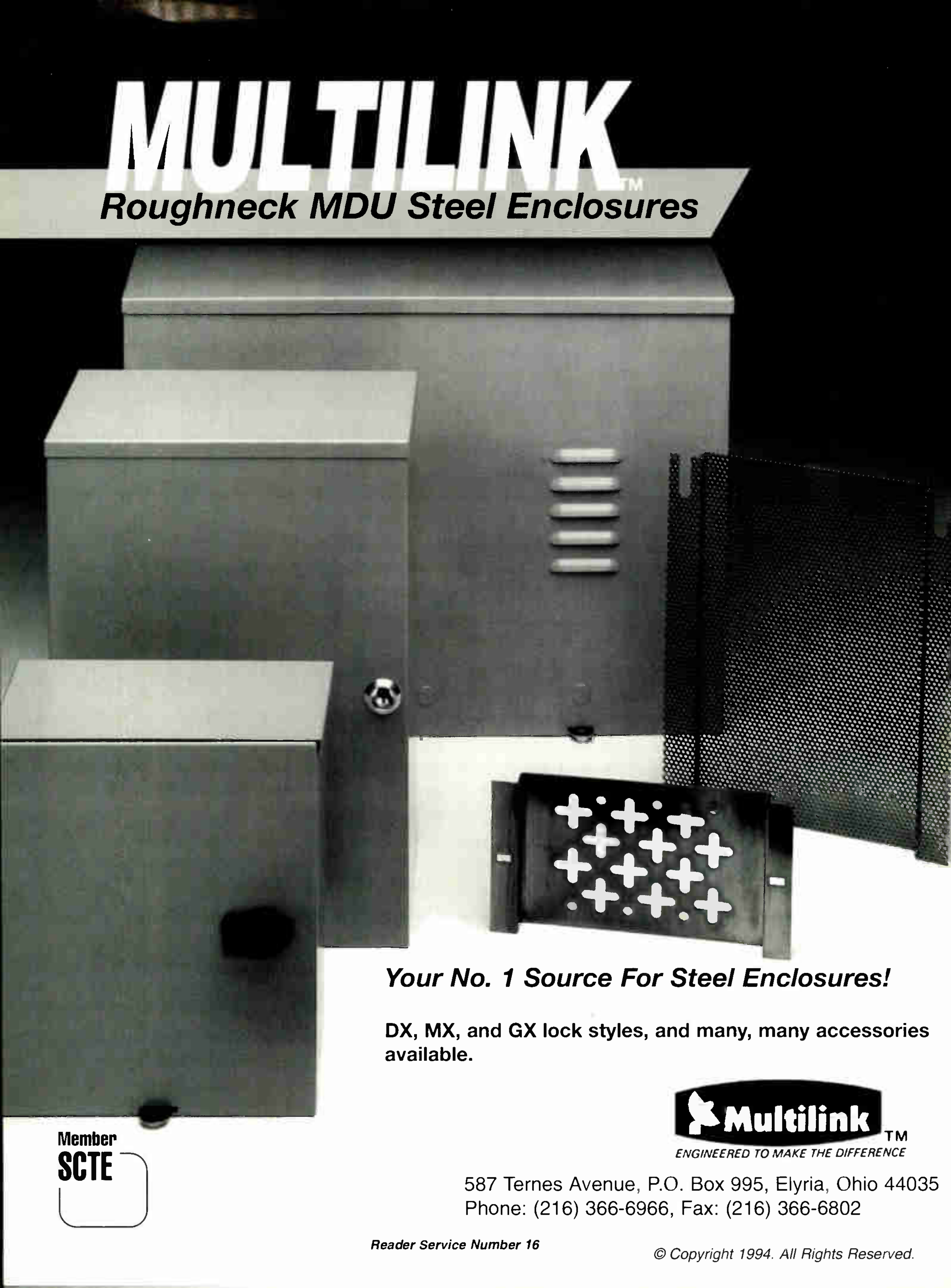
Barry Smith, now with Mega Hertz, wrote in the 1993 *SCTE Installer* (published by the Society of Cable Television Engineers): "The cable TV industry buys somewhere in the neighborhood of 2 billion feet of drop cable per year." That's enough to circle the Earth 15 times. Smith asks: "Can we, as an industry, afford to replace every drop every 3.5 years?" You shouldn't have to if you engineer your drop right!

Cable operators have been engineering their systems for years — first in the topology of their coaxial cable plants and now with their fiber-optic systems. In most cases, system design has led operators to spend considerable time and effort looking at fiber counts, node placement and sizing and the selection of optoelectronics. The subscriber drop, however, is rarely "system engineered."

In many cases, cable operators purchase individual drop components from many different sources without respect to consistency, longevity and component compatibility. By installing potentially noncompatible drop components, the cable operator (who otherwise is building a more reliable and high-quality system) may not only be limiting the capabilities of the cable plant to the home, but in many cases, substandard drops can cost cable operators time for numerous service calls and potential loss in revenue from subscribers dissatisfied with today's picture quality.

Consider the ramifications of a "nonengineered" drop:

- Will subscribers experience a complete loss of picture, frozen images, or other interference to picture quality because of poor connections, mechanical interfaces and poor installation practices?
- Is the current drop system bidirectional with an ability to handle high-level return signals and the upper bandwidth needs required for interactive services?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• What will it cost if the drop isn't installed cohesively and properly across the entire cable system and technicians are on-call constantly for drop-related problems?

An engineered solution

Engineering the drop is just as important as engineering the rest of the cable plant. By taking special care to choose components that don't affect the impedance of the cable and provide high shielding, problems associated with microreflections, ingress and impulse noise can be reduced.

The cable industry typically measures microreflections by the "return loss" method. Microreflections result when a signal traveling to the home encounters an imperfection, such as a dent in a cable or a mismatched connector. When this occurs, the signal "reflects" back through the cable in the opposite direction, effectively bashing into a "forward path" signal. This causes standing waves, cluster distortion and increased symbol error rate, all of which can create serious distortions to (if not a total loss of) digital signals to the home. These microreflections essentially thwart the digital signal by blasting away vital bits of the data stream — bits that are critical to the in-home reconstruction of a transmitted video signal or the reception of digital services. Noise thresholds remain largely unspecified. However, many groups in the industry like CableLabs, SCTE and equipment manufacturers, are aware that microreflections can cause a complete loss of a digital picture, or at the very least, an exaggerated tiling effect that makes viewing difficult.

Signal ingress such as burst noise interference caused by a two-way radio or cellular telephone also can result in digital bit errors. In this case, any over-the-air signal (from broadcast TV, airplanes, auto ignition systems, etc.) can cause interference of the TV picture in the analog world. For digital systems, the result may be a complete loss of picture depending on the severity of the problem.

Impulse noise, the third concern, is caused by electrostatic discharge, machinery, lightning and other transients that impact digital signals. Although these types of sudden surges are usually self-correcting in a matter of moments, there will likely be digital bit losses during this period.

Protecting the drop against these problems is twofold. First, high shielding standards for passives, connectors and cable will help improve the ability of the drop to withstand outside interference, especially for digital signals. Secondly, compatible components and a standardized "systems" approach to drop component selection and installation will go a long way to ensuring the reliability and performance of signal delivery to the home.

In 1991, the Committee for the Integrated Drop System was formed to help combat these problems. The committee's mission has been to identify and test components to ensure component compatibility along with the reliability and performance of both analog and digital signals through the drop. It developed a set of comprehensive specifications and installation procedures for each element within the drop, from the tap to the demarcation point — all of which meet or exceed Federal Communications Commission, National Electric Code and SCTE specifications. →

Drop installation

Quality installation will greatly increase the life and quality of the drop.

Aerial installation

Messenger drop wire clamps act as a strain relief for the drop cable, eliminating potential sheathing damage from improper messenger wraps around the cable. Proper diameter radius loops and reserve coils of 18 to 24 inches of drop cable add longevity and reduce maintenance calls. See Figure 1.

Figure 1: Proper diameter radius loops and reserve coils

"A grounding bracket offers an excellent method for an uninterrupted bond."

House attachment

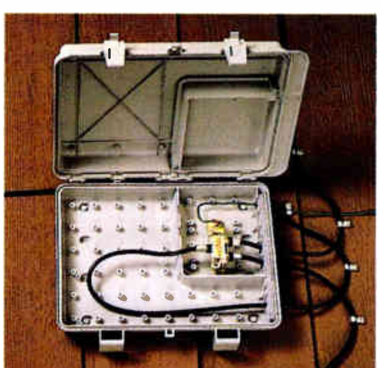
Transferring the strain of the cable to the messenger drop clamp is the primary function of the house attachment as shown in Figure 2. During wind, ice and snow storms, the cable and the drop wire clamp move as one.

Figure 2: House attachment

Service location

Protection, location, proper bonding, appearance and routing are all part of the critical interface link. A grounding bracket offers an excellent method for an uninterrupted bond while providing the ability to upgrade or downgrade a service by allowing the flexibility of installing either an F-81 for use with a ground block, or by inserting a 2-, 3- or 4-way splitter. See Figure 3.

Figure 3: Interface link



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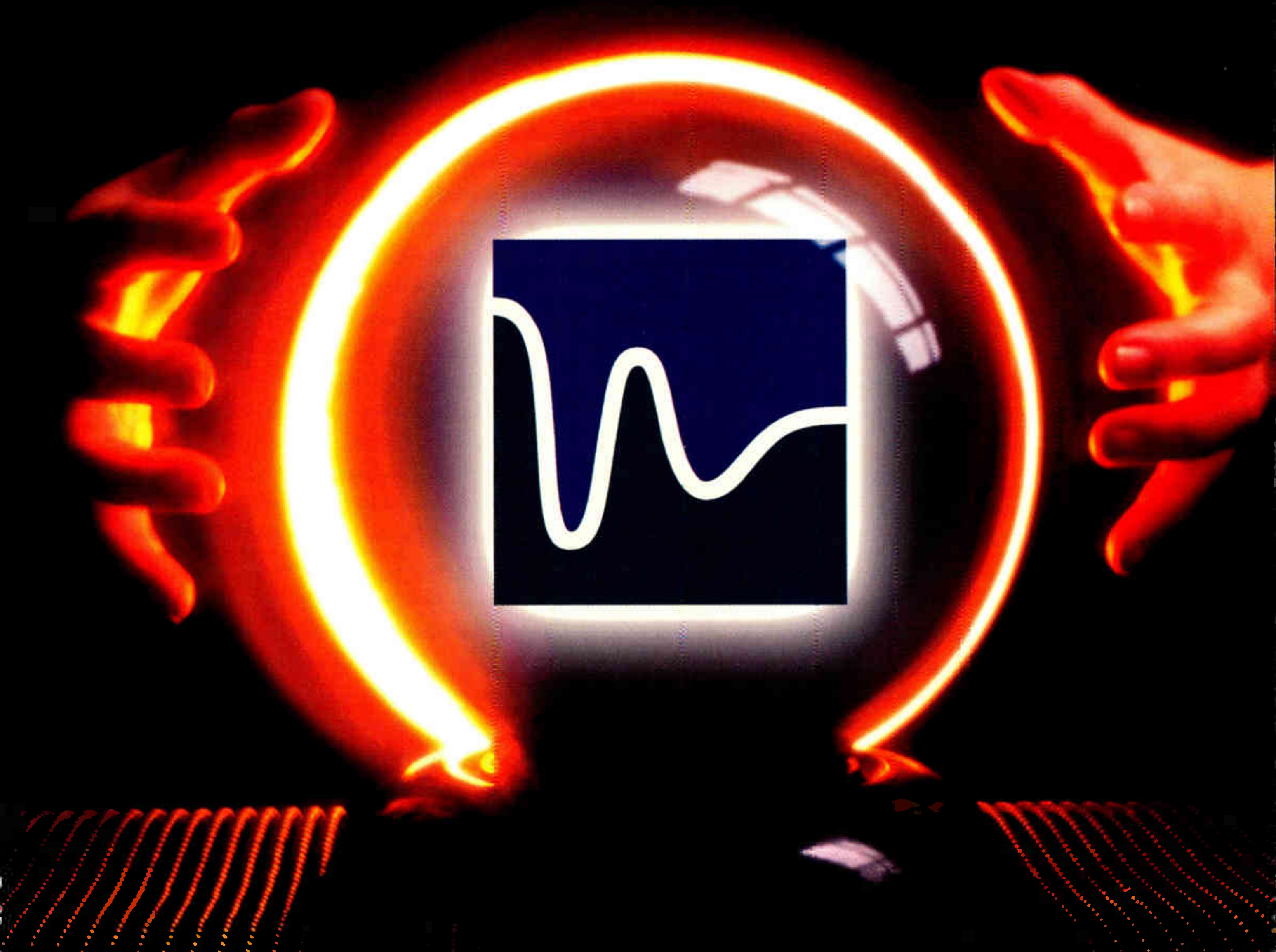

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Reader Service Number 26

What makes up a quality drop?

First, all passives should be sized to 1 GHz to provide full bandwidth capacity. RG-6 or RG-7 type drop cable will help to minimize attenuation and should be sweep tested from 5 MHz to 1 GHz to ensure the ability to deliver quality signals throughout the spectrum, even in the upper bandwidth not currently utilized. A minimum of 60% braid coverage should be included in drop cable and 110 dB EMI shielding should be used on passives to isolate the problems related to ingress, egress, microreflections and impulse noise. Further, passives should be housed in chromate treated zinc to protect against corrosion and other environmental concerns (wind, rain, snow, sleet). A circumferential seal around connectors will help keep water out. Finally, grounding devices should be Underwriter's Laboratories listed and approved. If the drop meets these specifications, corrosion and environmental concerns can be kept at bay, helping to extend the life of each subscriber drop.

Still, quality drops aren't just about components. The drop system also must be completely seamless and format-insensitive. Today, most drops can deliver high-quality analog signals. But will that same drop be able to handle any number of digital modulation techniques?

Comprehensive testing to ensure drop insensitivity to signal format type is being done. With test results to rely on, cable systems will have the assurance that the components put in place today will position the system to deliver emerging services — while providing the high-quality transmission needed for today's analog TV signals.

"Today, more than 70% of all service calls continue to be drop-related, indicating the need to improve drop performance now to enhance today's plant even before the digital future arrives."

And finally, proper installation of the drop is key. Installation personnel should be effectively trained on installation practices to ensure drop installation consistency throughout the cable system. As discussed in the sidebar accompanying this article on page 18, quality installation will greatly increase the life and quality of the cable drop, thus increasing the customer's level of satisfaction with service.

Summary

As issues related to microreflections, ingress/egress, impulse noise, and return loss become more important in the cable TV industry, it is obvious that quality drop installation will be even more critical to the reliability of the overall cable plant. Standards of performance and greater bandwidth needs will continue to grow, and cable companies are seeing the need to improve the overall capability and performance of the drop portion of their networks.

High-tech equipment trials and low-tech tests of consumer buying habits will help the cable industry understand the viability and new revenue potential of any number of new services.

However, even today, systems are seeking to prepare their cable plants to handle voice, video and data services. Those that recognize the importance of the subscriber drop in their overall cable plant are realizing the need to implement a drop system that provides high-quality and full component compatibility. Through this type of approach to their subscriber drops, cable operators can improve the delivery of today's existing analog signals, while positioning the network to accommodate the emerging digital services of tomorrow's interactive world without the need to change out the drop system for many years to come. **CT**

References

1) Smith, Barry, "The Cable Drop: No Big Deal?" *SCTE Installer,* 1993.

2) Bauer, Brian, "Advancements in the Development of the Drop System: Major Digital Issues and New Approaches," *SCTE 1994 Conference on Emerging Technologies Technical Papers.*

Fiber at the headend of the future

The following is adapted from a paper that was presented at the Society of Cable Television Engineers Emerging Technologies '94 conference held in Phoenix, AZ.

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As the number of fibers entering headends continues to increase, greater attention must be given to fiber organization, termination and connections to headend optoelectronic (O/E) equipment. The traditional practice of splicing outside plant fibers to fiber pigtails on optical couplers, laser transmitters and receivers is too restrictive when trying to flexibly and reliably manage advanced services to many optical nodes.

Fiber routing in 19-inch wide frames is too confining to accommodate graceful growth to the thousands of fibers likely to appear soon at headends. Accurate records of fiber locations on patch panels and their customer destinations is becoming increasingly important. Such records can be maintained manually or with computer software designed to help operators manage up to tens of thousands of fibers.

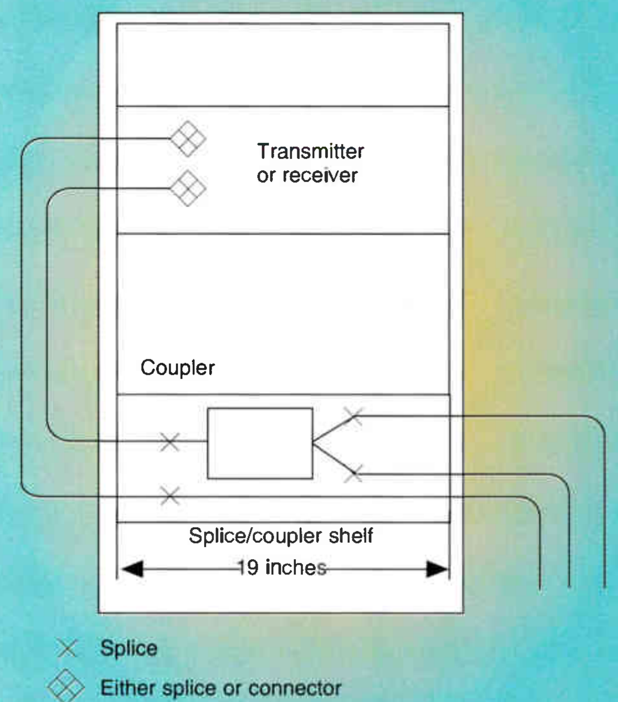
The selection of an optical connector should be based not only on its optical performance but also on its status as a standard connector and its ease of installation.

Fiber routing today

Fiber routing in today's headend (HE) typically consists of one or more outside plant optical cables (with black polyethylene jackets) entering the building and routed, either in overhead racks or beneath a raised floor, to a steel frame (Figure 1). Fiber splices and optical couplers (sometimes called splitters) are stored on splicing and coupler shelves mounted in the frame.

- *Frames*. Equipment frames commonly found in today's HE are either open relay racks or enclosed cabinets. The upright rails on these frames accept the mounting of 19-inch wide radio frequency (RF) equipment, such as amplifiers, modulators, descramblers and combiners.

Figure 1: Typical fiber routing today



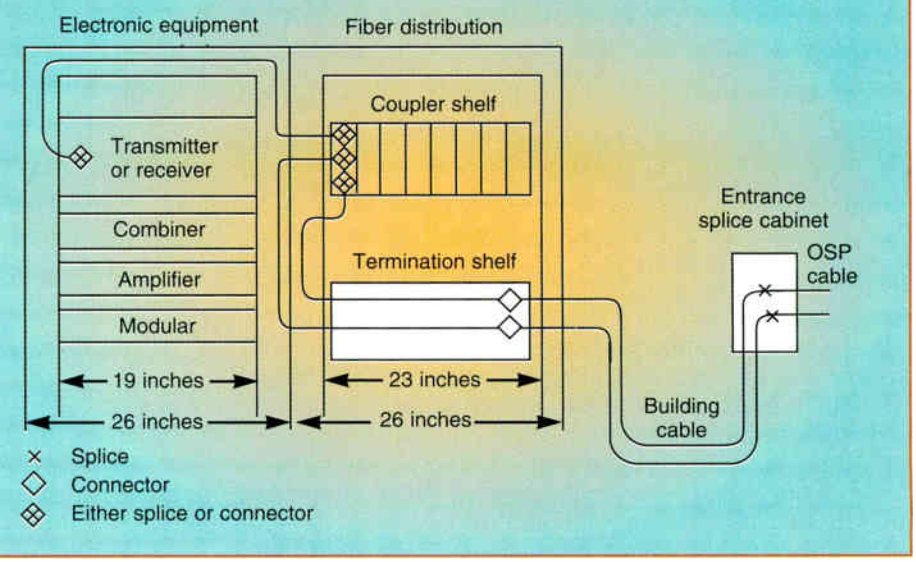
Because of the preponderance of 19-inch frames and the current limited use of optical fiber in HEs, fiber routing and splicing has adapted to the 19-inch frame environment. Although this adaptation has proved adequate for terminating small numbers of fibers, limitations are likely to arise as fibers grow.

Table 1: Current fiber routing practices

	Advantages	Disadvantages
19-inch frames	Widely used Narrow footprint	Unfriendly to fiber Much telco equipment won't fit
Splicing	Low loss Low reflectance	Obstacle to testing Impedes service restoration Inflexible circuit rearrangements
Splicing on frame	Short pigtail length	OSP cable limited to 50 feet Poor use of frame space

"The present preference for splicing OSP fibers to couplers and O/E equipment is too restrictive and should yield to the use of more optical connectors."

Figure 2: Proposed fiber routing



When routed to the frames, the outside plant (OSP) optical cables are clamped to shelves mounted in the frame, metallic members are grounded and the fibers guided onto a splicing shelf.

• *Splicing and couplers*. OSP fibers routed to splicing shelves are organized on trays and spliced to fiber pigtails, which lead to other devices including optical couplers or O/E equipment, such as laser transmitters and optical receivers. If spliced to optical couplers, the couplers may be stored on the same shelf as the splices or on a separate shelf. The input coupler pigtails, in turn, are spliced to other fiber pigtails that lead to O/E devices.

Advantages and disadvantages

The fiber routing procedures currently used at HEs are a natural consequence of an environment that has evolved over several decades of managing RF equipment. While fiber has acclimated to this environment, serious limitations are likely to arise as the number of fibers at HEs grows. Table 1 summarizes the advantages and disadvantages of the present HE fiber routing practices.

Each item is further discussed in the following sections.

• *19-inch frames*. These frames are widely used in HEs and have the advantage of leaving a narrow footprint. However, these frames are unfriendly to fiber routing and will not accommodate telecommunications equipment designed to fit into 23-inch frames. Fiber routing in 19-inch frames has been improvised by running fiber pigtails and jumpers vertically either through express holes in the top and bottom of splicing shelves, or within the small vertical cavity between adjacent frames.

However, because these frames were not designed for fiber, fiber frequently shares space with electrical and coaxial cables, creating congestion and an environment that is hostile to the fiber. Fiber rearrangement requires access to the rear of the frame and necessitates manipulating the fiber around obstacles.

Because 19-inch frames lack fiber retainers, guides, raceways and bend limiters, they severely restrict the ability of these frames to support the orderly growth and administration of many fibers. Further into the future, as operators expand their service offerings, telecommunications equipment will increasingly be used in HEs. Much of this equipment — digital multiplexers and transmission gear — will not fit into 19-inch frames.

• *Splicing*. Because of the low optical power budget (approximately 5 dB) of early AM analog systems, the superior loss performance of splicing was preferred to optical connectors for attaching OSP cables to inside equipment. Early connectors also generated reflectances with magnitudes that caused discomfort because of the widespread uncertainty about their effects on AM systems. The prudent course was to minimize both loss and reflectance by using splices.

Splices are generally considered to be permanent. With minimal or even no connectors at the HE, OSP fibers could be tested only by breaking and then remaking splices. This requires specialized equipment and training and takes longer than manipulating connectors, thereby increasing service downtime and impeding service restoration if a laser fails.

• *Splicing on the frame*. When only a few fibers enter a HE, it is convenient to route them directly to the frame for splicing. This minimizes the length of the device's fiber pigtail, or alternatively, eliminates the need for an intermediate cable to bridge between the pigtail and the OSP fibers. However, the flame propagation and smoke-generating characteristics of OSP cables limit their unprotected length to 50 feet indoors. Longer lengths must be protected by a fire-rated conduit or raceway. Additionally, the space occupied by mounting splicing shelves in frames can be more profitably used for other functions — mounting of O/E equipment or fiber connector fields.

Fiber routing tomorrow

The limitations of today's fiber routing practices can be mitigated by migrating to a fiber-friendly, more flexibly configured system capable of accommodating the thousands of fibers likely to converge on HEs in the future (Figure 2).

In this scenario, OSP cables are spliced to fire retardant (yellow sheathed) building cables in an entrance splice cabinet near their entry point into the HE. The building cables are then routed to an RF-friendly and fiber-friendly 23-inch frame.

• *Frames*. Ones that are 26 inches wide with 23-inch center-to-center mounting hole separations are used as the skeleton for mounting fiber termination shelves, O/E equipment and electronic equipment. The frame's greater width provides space for routing hundreds or thousands of

Table 2: Optical connector performance

	Requirement (dB)	Objective (dB)
Maximum loss	0.5	0.2
Mean loss	≤0.3	≤0.15
Maximum reflectance	-40	-50

(Bellcore TR-NWT-000326, Issue 3, June 1992)

fibers on the front of the frame, while restricting electrical and coaxial cables to the rear. Special hardware is used to carefully route fiber pigtails and jumpers vertically and horizontally and to preserve a minimum fiber bend radius.

In addition to accepting a variety of shelves for terminating fiber and securing optical couplers, the 23-inch frames also accept traditional 19-inch wide RF equipment and the full complement of telecommunications equipment.

• *Fiber shelves.* Optical building cables from an entrance splice cabinet are routed to termination shelves instead of splicing shelves. Mounted in the frame, termination shelves derive their name because they hold fibers that are terminated with optical connectors. The terminated fibers are attached to the rear of a connector panel (sometimes called a patch panel), and thus face the front of the frame.

Fiber-optic jumpers plug into these connectors from the front and are routed to optical couplers or O/E equipment mounted on other shelves in the same frame or in another frame.

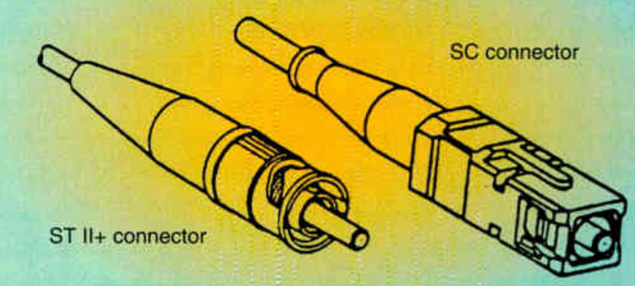
• *Optical connectors.* The termination of building cables in optical connectors on fiber termination shelves offers a convenient access point for testing OSP fibers, eases circuit rearrangements and enables rapid service restoration. Some optical connector types can be field-installed by technicians directly onto the building cable. However, the improved loss and reflectance performance demanded of today's optical connectors lessens the ability to achieve these results in the field.

The quality of connectors can be best assured by obtaining the connectors preinstalled at the factory on cables. Such "preterminated" cables can be obtained simply as cables with connectors on one end, as connectorized modules that snap into a termination shelf, or as completely equipped shelves. (A later section discusses connectors in greater detail.)

• *Coupler modules.* Many of the optical couplers now being used are fragile and have unconnectorized fiber pigtails for splicing to OSP and O/E fibers. Such couplers are being displaced with coupler modules that package one or more couplers into housings. Depending on manufacturer, the modules may fit into special organizing trays, (see L. Maiolo, J.H. Lehrman and J. Ganis, "Selecting a Coupler System for CATV," *Fiber Optic Product News*, May 1993, page 44), custom housings, (see S. Karaffa, "Preparing an optical cable system headend for the future," *Communications Technology*, October 1993, page 40), or snap into allocated spaces on termination shelves.

If the modules have optical bulkhead connectors on their optical ports, fiber-optic jumpers are used for connecting them into the optical circuit. Alternatively, if equipped with rugged connectorized jumper cables, the cables can be routed directly to other equipment, thereby eliminating one or more optical connectors and their associated loss.

Figure 3: ST and SC connectors



Connector considerations

Because optical connectors are generally used dry (without index-matching material), they typically have higher losses than fusion splices and index-matched mechanical splices. The higher loss, together with the limited loss budget of early AM analog transmission systems, dictated that optical connectors should rarely be used. This reluctance to use connectors was reinforced by the reflections that they produced and insufficient studies on how these reflections affect AM analog systems.

Recent advances in connector performance, together with better understanding of acceptable reflectance levels and the commercial availability of higher-powered lasers have combined to diminish the initial concerns with optical connectors.

• *Optical performance.* Table 2 shows Bellcore requirements and objectives for the optical performance of connectors. Most of today's optical connectors can readily meet the listed requirements. Some are approaching and have surpassed the objectives.

For example, connectors with various PC (physical contact) finishes, such as Ultra PC, can routinely meet a worst case -50 dB reflectance with average insertion losses of less than 0.25 dB.

Recent studies (see A.F. Judy, "Reflections and Fiber Video Systems," Southcon/'91 Conference Record, 1991, pages 181-188; T.E. Darcie and C.D. Poole, "Fiber Reflection-Induced Impairments in Lightwave AM-VSB CATV Transmission Systems," *Journal of Lightwave Technology*, Volume 9, No. 8, August 1991, pages 991-995; and B.L. Birrell, G.A. Olson, M.J. Labiche and R. Pidgeon, "Noise Due to Reflective Components in Fiber Optic AM-VSB CATV Systems," National Fiber Optic Engineers Conference, Vol. 4, 1993, pages 285-299) suggest that the reflectances achieved by today's nonangled PC connectors are entirely suitable for AM analog transmission. Thus, other criteria also should be used when selecting a connector.

• *Standards.* The principal single-mode connectors used today are the biconic, D4, FC, SC and ST. Of these, the most popular connectors for new applications are the ST and SC (Figure 3).

The ST connector was developed by AT&T. Volume production of the multimode version began in 1984 and a single-mode sibling was introduced in 1987. Most ST connectors have been used in private data communications networks, which are comprised largely of multimode fiber.

Developed by NTT, the SC connector debuted in Japan

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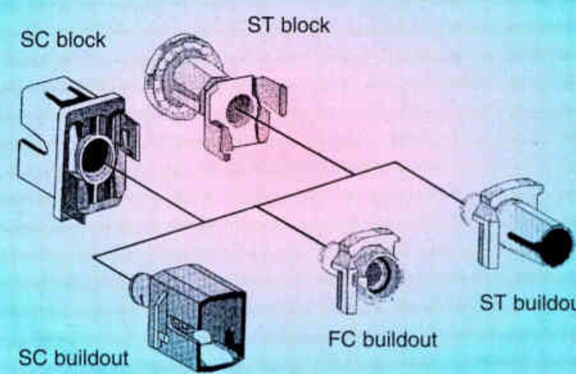
Figure 4: Hybrid buildout system



in 1984. Designed as a push-on, pull-off connector, the SC is gaining popularity in the United States. Several major telephone companies have chosen the SC as their primary single-mode connector, and others are seriously evaluating whether to do so. Forecasters expect the SC to dominate the domestic single-mode connector market within the next few years. (See "Connectors, Associated Hardware and Assemblies," *Fleck International — Fiber Optic Interconnect Market*, Volume 1, page 3-2.)

The migration to the SC connector by many telephone companies suggests that the SC will likely benefit from cost reductions resulting from high volume production. Additionally, some manufacturers of multichannel video AM transmission equipment are planning to introduce the SC connector on their products.

Push-pull SC connectors will have to compete with threaded FC connectors now being used by some AM equipment manufacturers. The parallel use of both connector types complicates the decision about which connector to use on new fiber termination shelves and optical coupler modules. Fortunately, some manufacturers offer hybrid optical couplings that accept an SC connector on one side and an FC on the other. Some of these couplings offer additional versatility by coming in two parts (Figure 4).

One part — the connector block — is a bulkhead component for mounting onto a panel such as the one in a termination shelf. Users anticipating a migration to SC connectors can install SC connector blocks in their termination shelves, SC connectors on OSP fibers, and plug the connectors into the rear side of the blocks. Then a jumper cable equipped with an FC connector can be mated with the SC connectorized OSP fiber via an FC "buildout" that snaps into the front side of the connector block. The migration to an all SC environment can be made at any time by simply removing the FC buildout and replacing it with an SC buildout.

Some digital telco equipment requires that the optical power at the receiver not exceed a maximum level. This is often achieved by placing optical attenuators in the optical path near the receiver. These attenuators can embody a variety of forms, such as being built into connectorized jumper assemblies, being inserted between the optical coupling and the plug, or being incorporated into the interchangeable buildouts previously discussed. Thus, buildouts can be used not only to configure hybrid couplings but also to insert attenuation.

"Fiber routing in 19-inch wide frames is too confining to accommodate graceful growth to the thousands of fibers likely to appear soon at headends."

• *Field mountability.* Most operators will likely prefer to purchase connectors preinstalled on jumper and building cables at the factory. This not only reduces installation time in the field but also tends to ensure the best optical quality. However, occasions may arise when it becomes necessary to install a connector directly onto a fiber in a HE. Because the time and skill required by a technician to field-install a connector varies widely depending on connector type and manufacturer, the ease of installing a connector should be another criteria in its selection.

Records and management

Manual records of fiber appearances at HEs, their destinations and the customers they serve rapidly become cumbersome to maintain for thousands of fibers. Fortunately, computer software is available for assisting in management of fiber distribution frames. In addition to recommending the length and optimum path for a jumper to be routed on a frame, the software keeps track of the equipment types and fiber appearances on the frame, the optical node that each fiber serves, the names of the customers served by the node, optical test data on the route, and other information.

These software tools can be made convenient to technicians by locating the necessary computer hardware in an operations center bay within the frame lineup.

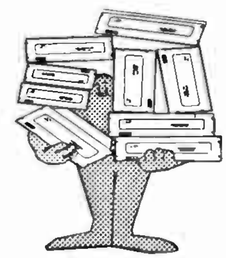
Conclusions

The increasing number of fibers entering headends requires a change in the way fibers are terminated, organized and managed at headends. The present preference for splicing OSP fibers to couplers and O/E equipment is too restrictive and should yield to the use of more optical connectors. To obtain the best quality performance, the connectors will likely be obtained from manufacturers preterminated on optical cables.

Optical couplers will migrate from being fragile components to becoming packaged assemblies equipped with bulkhead connectors and/or rugged connectorized pigtails. Nineteen-inch frames are too confining to accommodate graceful growth to the thousands of fibers likely to appear soon at some headends. This limitation can be overcome by using 23-inch frames designed not only for fiber routing, but also for RF and digital transmission equipment.

Manual HE fiber records will become increasingly cumbersome as the number of fibers grow. Software tools can be used to ease management of up to tens of thousands of fibers. Much of the hardware, knowledge, techniques and software already exist for migrating fiber operations in today's HE into the future. **CT**

The authors would like to thank R. Reagan, A. D'Alessio and P. Michaels for their contributions to this project.



The subscriber quandary

This article was adapted from a paper written for the SCTE Cable-Tec Expo '93 in Orlando, FL. Information in that paper was supplied in part by Vibha Rustagi of Scientific-Atlanta, Geoff Roman of Jerrold and Vito Brugliara of Zenith. The opinions are largely those of the author.

By James O. Farmer
Chief Technical Officer
Electronic System Products

In the 20 years I have been in the cable TV industry, I have never seen the type of quandary faced by the industry today as it seeks to define its interface with the consumer in the 21st century. Yet no issue is more germane to your future than how you interface to your subscribers. That interface, whether it be a cable box or some other less visible thing is what you are to your customer.

The accompanying table shows the way possibilities are evolving, though it really is not this simple.

MultiPort and son

A few years ago cable equipment manufacturers and consumer electronics manufacturers did something novel: They started sitting down and talking to each other. The topic of conversation was (and 10 years later still is) the difficulty of interfacing the world of the consumer to the cable. A solution that came out of this was the MultiPort, a connector on the back of a TV set that could interface with a descrambler that would be provided by the cable manufacturers. It simply monitored the video (and audio if necessary) of the tuned channel. The TV set passed to it the output of the video and audio detectors in the TV set. If the channel was not scrambled, the MultiPort box did nothing. If the signal was scrambled, the box checked to see if it was authorized to descramble it. If not, the box blocked the video. If it was, the box did the descrambling and passed the signal back to the TV set.

The MultiPort didn't catch on despite yeoman efforts on the part of certain leaders in both the consumer and cable industries. One well-known TV manufacturer put the MultiPort connector on a large number of high-end sets for two years and several manufacturers put it on selected sets. A few descramblers were purchased but the reception by the cable industry was less than enthusiastic. One of the problems was that in order to take advantage of the MultiPort, one had to buy a new TV set and, preferably, a new VCR. (I'm aware of only one high-end VCR that had the MultiPort connector. Some observers thought that the MultiPort standard would have been better served by putting the connector on VCRs before putting it on TV sets, because VCRs are purchased more frequently than are TV sets.)

The interface possibilities

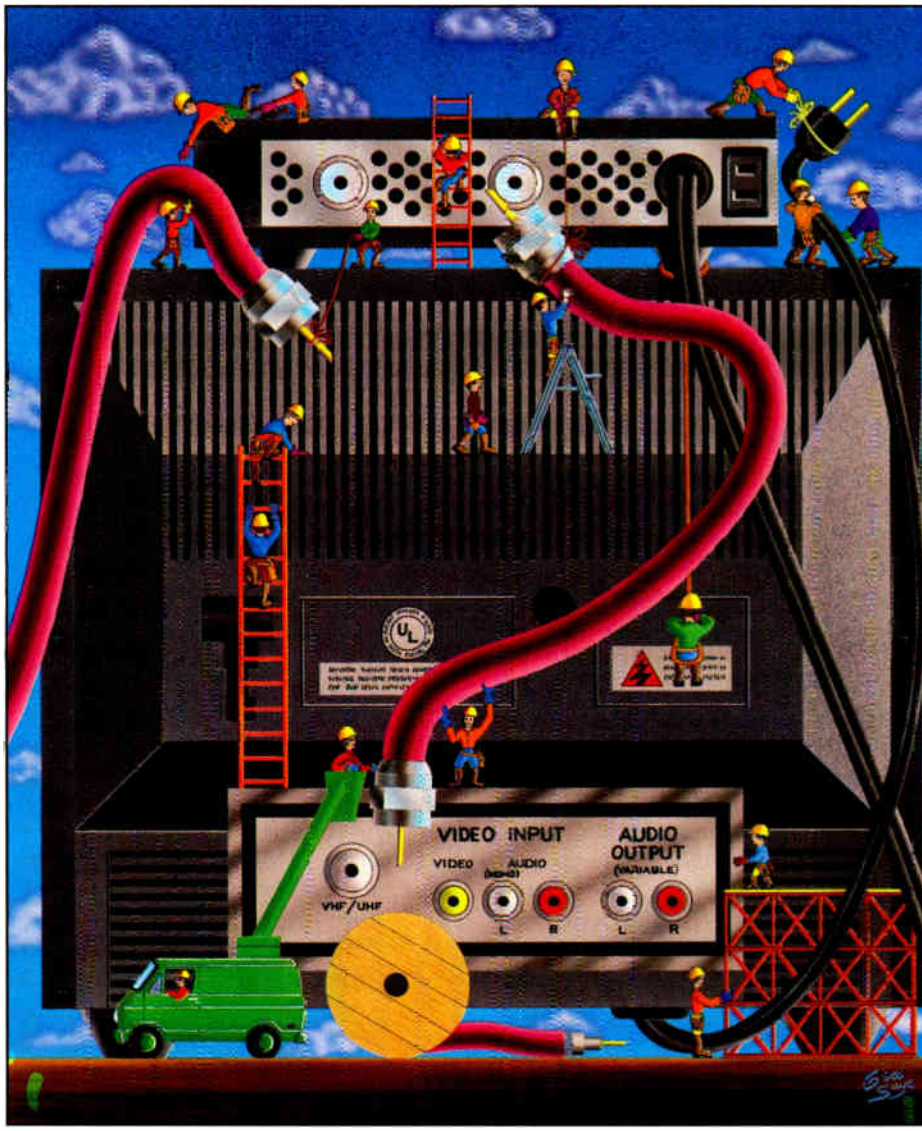
MultiPort and son	Interdiction	Improved set-tops	Alternate cable architectures
Poor prior acceptance by industry	Available now from multiple vendors	Operators and consumers have love/hate relationship	Trade processing in plant for lower cost digital delivery to home
Requires new TV set and VCR	Works with all existing consumer equipment	Gets in subscriber's way	Appropriate for communications-intensive applications
Demands high degree of industry cooperation	Some questions as to suitability of some consumer equipment	Most established of the technologies	
Now a government mandate	Cost and powering penalties	Improved features: • Program guide • VCR blaster • External control port	
	Negative option	Digital converters soon but at high cost	
	Security issues in some markets		

Another problem that caused some operators to reject the MultiPort was that it did away with remote rental revenues, a fait accompli now, thanks to the 1992 Cable Bill. Also, some operators may not have been willing to work through the economic implications: The manufacturing community estimated the ultimate cost of a MultiPort box to be about 60% of that of an addressable set-top converter. However, that cost estimate was based on comparable volumes. Because the initial volumes were so low, manufacturers priced the boxes similar to an addressable converter. At that, they arguably were losing money on them. The reaction by operators did not help get the standard going.

Because of all these reasons and more, the MultiPort as it was designed is dead now. In response to a Federal Communications Commission mandate arising from the 1992 Cable Act, the cable and consumer electronics industries have once again gone to the drawing board to come up with a decoder box that would go on the back of a TV set and stay out of the subscriber's way. The FCC has said that if the industries don't come up with a standard, it will, likely the old MultiPort. The two industries no longer would like to see the old MultiPort used. While it could have solved a number of problems, it would not have allowed digital signals to be handled in the same way analog signals are handled. (No one had contemplated digital signal transmission when MultiPort was developed.)

The new interface interim standard, officially known as the EIA IS-105, solves several nagging problems that remained in the old MultiPort standard. The new interface includes an IF out, taken at the output of the tuner. This allows all existing cable scrambling systems to work easily and allows for a future digital decoder (assuming the tuner specifications are adequate). The decoder includes improved AGC operations, a marginal area in the old MultiPort. The decoder must now include a video IF section and demodulator, so the cost of the decoder will not be quite as low as the potential cost of MultiPort, had it reached high volume production.

As of this writing, the industries continue to struggle with a last-minute FCC requirement for the use of a feature box separate from the decoder, which is complicating completion of the standard. In addition, some disagreement remains as to the command set to be included with the standard. By the time this is in print, these problems will have been resolved if the industries are to stay on the FCC-imposed time table.



Geri Saye

Interdiction

This idea has been around in some form or another for quite a few years. Interdiction systems are available from several manufacturers. While systems are in use now, the technology has not enjoyed widespread deployment despite some excellent subscriber advantages.

Interdiction systems work by transmitting all signals in the clear from the headend. The subscriber tap is replaced with the interdiction hardware, which generates interference on those premium channels not purchased. The system is truly transparent to the legal signals: No scrambling and descrambling is done so there is no signal degradation. The subscriber receives a complete spectrum of the signals to which he is entitled, in the clear. This is extremely friendly to the consumer who can watch and record as he pleases, retaining all of the advantages of the equipment he has bought. Studies of the systems that are using interdiction strongly suggest that because of the friendliness of the system, the pay-to-basic ratio and even basic penetration are enhanced by interdiction.

Nevertheless, interdiction has remained a niche market. (Manufacturers tell us that the interest level has increased considerably as a result of the cable bill becoming law. One large cable system has already announced that it will install the technology.)

Several reasons appear to exist for the niche market. The equipment must be installed for all subscribers, even those who take only the most basic

"No issue is more germane to your future than how you interface to your subscribers. That interface, whether it be a cable box or some other less visible thing is what you are to your customer."

tier of service. This raises costs compared with converters. Some studies have suggested that increases in revenue for more pay units, more basic subscribers and more additional outlets, more than offset the cost. This is not universally accepted, however.

Since not all subscribers have "cable-ready" sets that tune all desired channels, it is necessary for the cable company to supply some percentage of homes with a basic converter. We don't know if anyone has considered the practicality of letting the subscriber pay for the converter.

Interdiction systems sold in the past have been powered from the distribution plant. Indeed, there are good reasons that home powering is difficult for pole-mounted equipment. The power needed and the limitations on open circuit voltage due to Underwriters' Laboratories rules, make AC home powering impossible. The IR drop on a long drop cable doesn't leave enough power for the equipment. DC powering is not favored because of electrolytic corrosion of the mechanical joints in the drop cable. A new system has proposed to eliminate these restrictions but it has not been field tested thus far. The need for system power has discouraged some from committing to the system because of fears of the power cost. (Typically, the circuits to serve one home consume about 3 to 4 watts.)

Security is excellent with interdiction — at least after you get past the interdiction device. A carrier is injected very close to the picture carrier and a number of other tricks are pulled, to render recovery of a good signal much more difficult than with practical scrambling systems. Usually audio is scrambled, though it is possible to recover it with effort. A minor problem, which we have not heard from the field, could be that when the subscriber tunes to a nonauthorized channel he will hear a loud noise.

Before the interdiction hardware, the signals are in the clear. This presents no particular problem in some cases, but systems that can't effectively protect their plant against unauthorized connections will find premium programs subject to the same theft potential as are nonpremium programs. Of course, one can argue about how much if any lost revenue this theft represents.

Interdiction has the possible limitation that it must work with consumer TV sets, not all of which are suitable for connection to cable systems. Problems include tuner overload from too many signals, image rejection and direct pickup (DPU).

This latter problem is the worst: Some TV sets tend to pick up a lot of signal from local broadcasters (and hams and business band radios) when connected to the cable. This problem has generated quite a bit of heat and perhaps a little light in the joint Electronic Industries Association/National Cable Television Association Engineering Committee. The TV people need to see solid statistics that there is a problem worth solving.

Bear in mind that the solution will in most cases require the TV manufacturer to spend more money producing TV sets and the market has not allowed it to pass costs on to consumers in recent times. Also, DPU is not something that is a competitive advantage on the showroom floor. The TV manufacturer has little incentive to do something about the problem. The cable industry through CableLabs has done a lot of work aimed at quantifying the problem. We likely will see gradual improvements in tuners as a result.

Improved set-top converters

A few years ago I thought that the days of the converter were numbered. The product that the industry and consumers love to hate, has received a new lease on life as a side effect (probably quite unintended) of the cable legislation that passed over the president's veto in late 1992. Further, operators have come to believe that they must preserve the space they now occupy on TV sets so that introduction of digital services will not cause as much consumer backlash.

New analog converters offer improved services, which may restore some of their appeal to consumers. Electronic program guides will allow subscribers to sort programs by category, allowing them to see first those program categories that interest them. If desired, the subscriber will be able to read a synopsis of the program. When he finds a program he wishes to see, he presses a button and the converter tunes to the channel. Typically, future shows may be programmed in the same way. VCR blasters attached to the converter will be able to program VCRs to record future shows. External control ports will allow attachment of other devices such as printers, if a market for such a product develops. Downloadable software will allow the operator to accommodate new services and novel "looks and feels" without having to visit the converter.

A variation is a single fixed channel descrambler introduced two years ago by one manufacturer. It is used for the house that has only one premium subscription (the rule rather than the exception). The descrambler continuously descrambles that channel, putting out the descrambled signal on the low end of the UHF band. It looks to the subscriber much as if he has access to the signal the same as interdiction were being used. The exception is that he would tune to UHF Ch. 14 (for example), which may or may not be convenient depending on his TV set.

Alternate cable architectures

Some people are proposing system architectures that trade complexity in the home for complexity in the network. One proposal will perform signal processing in the network, which allows a lower cost converter in the home. Look for announcements possibly late this year.

A further benefit of some alternate architectures is enhancement in the ability to provide for two-way data communications on cable. While two-way communications has been talked about for many years, we now see real applications developing. The technology involved in the in-plant processing, combined with the widespread use of fiber-to-the-node architectures, will allow this communications to play an important part in future cable TV business.

Cable History 101

In order to appreciate the descriptions of what is coming in converters, it is useful to go back a few years and trace the history of converters and their appeal (or lack of same) to subscribers. Set-top converters were originally conceived of as a way of overcoming a problem that plagues the cable industry to this day: DPU. DPU was enough of a headache in the early days that operators were inspired to use converters that tuned nothing but the standard 12 channels, but which were shielded better than were the TV tuners of the day. We suppose that the converter would have proven relatively popular with the consumer back then because it would be used when needed to provide a demonstrably better picture.

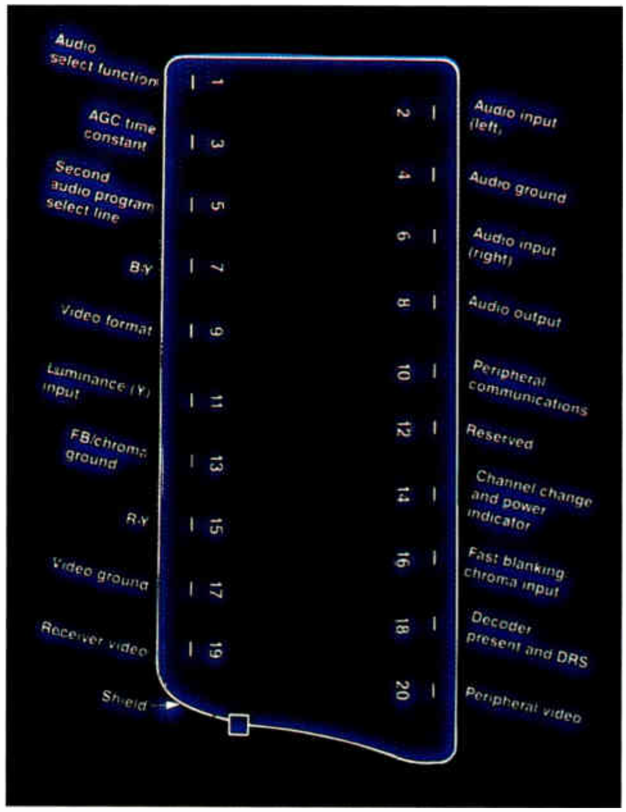
As cable systems added beyond the standard 12 VHF channels using frequencies that couldn't be tuned by the TV set, the converter was expanded to include these added frequencies. This was seen as a real boon by the consumer, as "the box" was a way of getting more channels that he couldn't get any other way.

Set-top converters began adding remote control before that was a popular feature on TV sets. (Some of the early remote controls were wired and carried analog tuning voltages, with sometimes unexpected results such as connectors corroding and dogs finding a new source of chew toys.) In the eyes of many consumers, the converter was a magic box that brought them more channels and made TV viewing more enjoyable by providing remote control.

This brings us to perhaps the early to mid-1980s, when two things happened to diminish the positive feelings of consumers to the product. It was at this time that TV manufacturers discovered cable and realized that they needed to produce a product that worked with it.

They added 75 Ω F-connector inputs and expanded the tuning to cover the mid-bands and superband. However, with design cycles in consumer

Courtesy Tom Mock (EIA). Design by Image Corp.



The pin schematic of the old MultiPort, which didn't catch on mainly for economic reasons. If the cable and consumer electronics industries don't come up with an interface standard, the FCC might likely mandate MultiPort use.

electronics being about three years, by the time they had come out with a tuner that hit the highest frequency (at the beginning of the design cycle), the cable industry had raised the maximum frequency and the TV sets still couldn't get all the channels. The TV sets were advertised as "cable-ready," and the sales people were trained to sell that advantage. It was when buyers got the TV sets home that the magic box started to loose its spell and the consumer electronics and cable industries started to get into real trouble. To begin with, the TV sets didn't use the same channels designations as did the cable operators, and different TV sets defined channels differently. Thus, a consumer who was accustomed to finding a favorite channel on Ch. A might now find it on Ch. 14. (Not to be confused with UHF Ch. 14. Try explaining that one to your grandmother.) Or the consumer might find it on some other channel, and not on the one that his neighbor tuned. (The problem has been mitigated fairly well now thanks to a standard channel identification system developed by the joint EIA/NCTA Engineering Committee, presently known as EIA IS-156.)

A second problem was that, while the tuner could pick up at least some of the CATV channels and had an F-connector, it didn't handle well the large number of signals on the cable system. It overloaded easily, producing beats and the image rejection was insufficient in some cases.

Perhaps the worst problem was that by this time the premium channels were in their heyday and were being scrambled by many systems. The consumer still had to have the box in order to receive the premium channels, which many times were the reason for getting cable in the first place.

About 1985 or 1986 the VCR revolution began in earnest with over 70% of all TV households today owning at least one. That's when the box really got its bad reputation. Subscribers found that there was no good way to watch and record different channels. Even if signals weren't scrambled, the box was in the path and frustrated attempts to do what the consumer wanted.

There were work-arounds of sorts, but we have not seen one that was sufficiently simple for the consumer to use. (As an aside, I used to have a VCR switch in my entertainment center at home. I removed it in frustration one day when the kids wanted to record one and watch one in a configuration that took rewiring of the signal path. I couldn't find the schematic of the switch and the labeling wasn't sufficiently descriptive for me to rewire without it. If an MSEE with 20 years in cable TV — who can program his VCR — can't get the darn thing to work, what will your grandmother do?)

Today

OK, now we are pretty much up to the present. The cable box has gone from being seen as a positive to being a real negative. We have TV sets that have gotten a bit more cable-friendly (depending on your definition). At least most of them tune all the channels now. (But have you ever tried to count the channels tuned and get the same number that the manufacturer advertises?) Unfortunately the number of pay units has shrunk in recent years, partly because of the VCR presence and partly because getting to the premium channels is so complicated.

Philosophy 101

What business are we in? Our customers (who, by definition, are right) don't care whether they get their favorite shows by cable, satellite, MMDS, local broadcaster or sewer pipe. All they want to do is watch television and have the process be as simple as possible. Are we in the program providing business or some other business? If we are in the business of supplying programs, then let us do that, staying as much out of the subscribers' way as possible. If we are in the business of putting hardware in homes, then let us concentrate on what our customer wants today.

We are using the term cable box intentionally. This is what we hear a lot of real people (aka subscribers, or people who pay our salary) calling it, not always with affection. As an industry we need to learn to think more as our customers do.

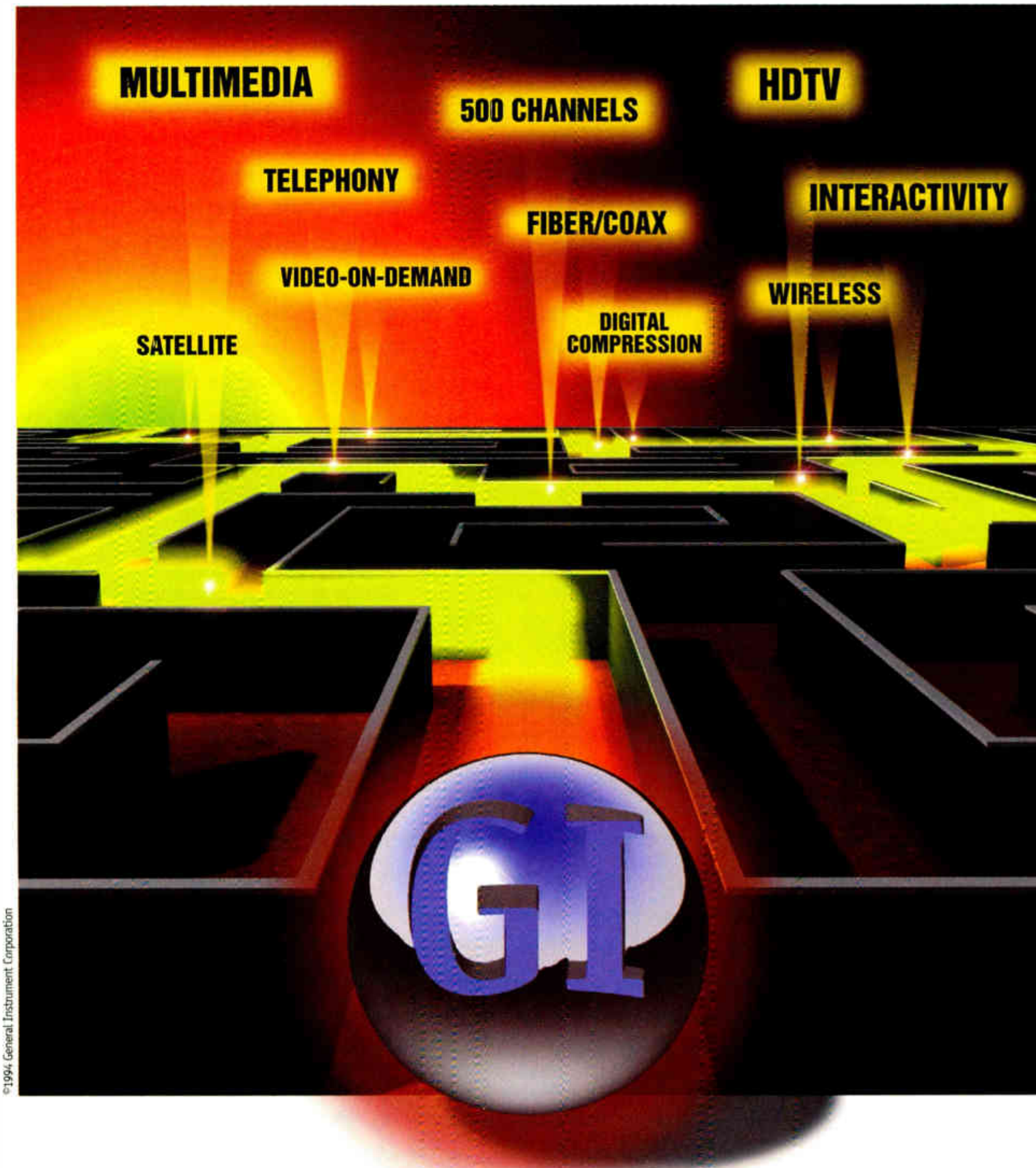
Cable boxes: The new generation

In an effort to make cable boxes be seen more as a desirable thing again and in the spirit that the cable industry is more than a program provider today, converter manufacturers are coming out with a new generation of boxes that do things unimaginable a year or two ago. Most of the following descriptions can be applied to both advanced-generation analog boxes and digital compression boxes when they become available.

On-screen display

The first of these enhancements has been out since early 1991. On-screen display (OSD) was added to overcome some of the long-time difficulties subscribers had in setting up features in the box (which they may or may not have wanted), with the limited input/output afforded by a keypad and LED display on the box. OSD is only possible with baseband boxes, which became popular a few years back in order to provide volume control.

With OSD, now consumers can have not only channel number displayed on



MULTIMEDIA
500 CHANNELS
HDTV
TELEPHONY
INTERACTIVITY
FIBER/COAX
VIDEO-ON-DEMAND
WIRELESS
DIGITAL
COMPRESSION
SATELLITE
GI

screen, but (a real advantage in my mind) can have a mnemonic identifying the channel tuned. In addition, the OSD allows set-up menus. These help the subscriber set the box for favorite channels, impulse pay-per-view (IPPV), parental control and so forth. It is much easier to see a display of all channels in the favorite channel list than to have to flip through them, editing on the fly. (I never mastered editing favorite channel lists with earlier generation converters, and remember, I can program my VCR.)

Another advantage to the circa-1991 first-generation OSD boxes is that messages can be downloaded to individual subscribers and to groups of subscribers. We may look back on the first-generation box and see this as an idea whose time had not quite come, however. The messaging capability is real but the full potential for messaging has not been realized. This is partly due to the lack of a full infrastructure to use the messaging fully.

For example, the feature could be used to download late notices to subscribers whose bills are in arrears. This would require as-yet nonexistent links between the billing computer and the point of message origination. Further, we haven't thought out just how consumers would want this presented. Imagine the scene: I have invited a few of my best friends over for Wrestlemania 152. Just as the main event starts, I'm notified that I have a message. I anxiously flip to it, assuming it to be from my stupid brother-in-law who was going to bet me a steak dinner on the fight. Instead of this message, in front of my buddies I see a message that my cable bill is late!

Other uses for the message include promotional (which is being done) and third-party messages, which also wait for the correct software infrastructure.

Second-generation advanced boxes, due out this year, will add additional OSD capability. The first enhancement will be to improve the display capability. First-generation boxes are limited to character displays in limited colors, a result of using off-the-shelf character generator chips designed mostly for VCRs. Second-generation boxes will have capability of producing more colors for more consumer appeal and will have some capability to do bitmapped graphics.

Text channels

With expanded OSD capability and higher bandwidth addressing systems, it will be possible to display virtual channels — channels that consist of only text and limited graphics. They don't take up 6 MHz of cable spectrum as do real channels, but they look like channels to the subscriber. These could carry messaging, news, sports scores or whatever else someone wants to program.

The virtual channels will look the same as would teletext channels, which introduces a whole set of marketing concerns. Teletext is big business in Europe, but all of the experiments here have led to discontinuance of the service. Many reasons have been advanced but they usually seem to come back to the fact that not enough people cared. Was this because none of the experiments of the early '80s reached a critical mass of users? Did the users not get the right services? Was the billing structure wrong? We will likely open up all of these old issues again as converters having the capability for virtual text channels are deployed.

"Of all the enhancements due out, probably none is as potentially as significant to the subscriber as is an on-screen program guide."

On-screen program guides

Of all the enhancements due out, probably none is as potentially as significant to the subscriber as is an on-screen program guide. These are often called electronic program guides (EPGs). A number of proponents are positioning themselves now to be providers of EPGs. These will display a grid (usually) of program choices now and for the next few hours. To watch a program, all a subscriber need do is to scroll through the list (which will take many screens). Program descriptions can be added. When he finds a program he wishes to see, he presses a button on his remote control and the box tunes to that channel.

The concept may be expanded to what has been called a mood guide — a packaging and presentation concept in which the subscriber indicates his preference for types of shows (sports, news, movies, etc.) and all of the available selections are presented to him. Some have even suggested that the subscriber could identify himself to the box, which would keep track of the programs he watches over some length of time. After that the box would recommend shows of the type he has watched in the past. Each member of the family would have his own profile.

Another advance is that with an IR blaster (described later) it will be possible to instruct a VCR to record the show on now, or to program it to record a later show. (The converter knows the selected show so it can tune accordingly.)

The technology to do this is in advanced development now, but several things must happen before on-screen guides become a reality. Several proponent systems are being developed and each has its own patents and proprietary developments. There may be some conflicts between these. In addition, the infrastructure must be completed to allow the correct program guide information to be downloaded to each headend, where the specific channel information and perhaps local times are added. Local programming information must be added somehow and last-minute changes must be accommodated. If the program guide information is sold to subscribers, it must be tagged as to what information is to be provided to which subscribers.

All of this will take time to work out but the boxes to use the displays are being designed now. Some manufacturers are planning to use their own proprietary format for data and display with a computer system at the headend to translate any providers' data to that format. Others are planning to offer the format of one of the on-screen guide providers only. The fact that this area is so fluid brings us to another of the new features.

Downloadable software

The cost of random access memory (RAM) is coming down sufficiently to encourage manufacturers to include the capability of downloadable software. The boxes will be shipped from the factory with software installed in some sort of RAM. (We prefer the

term modifiable memory as being more descriptive, but we shall reluctantly conform to the accepted practice of calling it RAM.) This RAM may be constructed of any one of several available technologies. It must be electrically alterable but it must survive for an extended time without power being supplied to the converter. This can be achieved with battery backup of static RAM or with electrically erasable permanent memory of several varieties. The only software in ROM (read-only memory) is a small kernel that permits the manufacturer to download new software using the normal addressable data link.

Security considerations will probably dictate that the download of new software not be something that can be done from equipment normally installed in the headend. The manufacturer will likely have to bring in new software and maybe hardware to effect the download.

Having the capability to download new software protects the operator from a situation in which new features are needed or the industry goes a different way with a certain "look and feel." He can download new software to meet new demands. (It would be a surprise if one or more converter manufacturers don't eventually need to do this for the EPG, because the concepts for EPG are so very new. The industry will likely decide in three to five years that whatever we did in 1994 was not right and we need to change it.)

IR blaster

This is a concept in which an extension from the converter contains an IR transmitter that is placed in front of the VCR's remote control receiver to allow the converter to talk to the VCR. The concept also can work in reverse: Some VCR manufacturers have announced VCRs with a blaster to control the cable box. Through this, the VCR can be controlled just as if you were using its remote control. This is the way that the EPG can be used to control recording of programs.

Expansion ports

The box needs to have some place to plug in the IR blaster as well as other not-yet-developed interfaces. Accordingly, new converters will incorporate some sort of interface with the outside world. The interface could be a PC-compatible serial port but will likely be something simpler and proprietary due to cost considerations. One concept is that it will be used for the IR blaster. Another possible application is to control a remote converter for recording. This port will likely allow access to much of the inner workings of the converter, allowing versatile use for things not yet thought of.

It may be that this will become a port to the home automation industry via its CeBus (developed by the EIA), allowing control between the converter and other equipment. Although this is not being planned at present, it is a possibility for the future. As well, this port, or the expansion slot discussed later, could allow future offerings of Prodigy or other such services.

One can let one's mind run to all sorts of blue sky applications for this port. I hate to put predictions on paper, but I'll go this far: While it is possible to hook a fax machine or printer to the port and have your newspaper delivered this way, don't look for it to happen in the foreseeable future. →

Remote or dual converter

A long-time problem has been that it is not possible to watch one scrambled program while recording another. A solution is to build a dual converter (one that has two tuners and descramblers) where one is used for the TV set and the other for the VCR. Most of the circuitry of the first converter must be duplicated for the second but there could be savings in the power supply, case, remote control and remodulator areas. The converter could interface at baseband to the VCR, since all of them have baseband inputs. Only one on-screen display is needed and the subscriber can use it to control either converter. Some manufacturers see a limited market for such a device and prefer instead to offer a second remote converter that would interface with the main converter through the expansion port.

Near video-on-demand

The industry is putting a lot of hope in some sort of near-video-on-demand (NVOD), in which the subscriber can use the cable system much like a video store, without the need to go out to get tapes and return them later. (There have been some "juicy conversations" in my home about big fees for tapes returned late!)

The system will work by having a number of channels dedicated to one movie at a time. Each channel bears a start time for the movie that is later than the last channel by maybe 15 or 30 minutes. The subscriber buys the movie and gets a choice of start times as well as the ability to pause or skip forward. If the movie is transmitted on a different channel every 15 minutes, then a subscriber starts with the show time best for him. If he wishes to pause, he will be shifted to another channel that started later. He can rewind 15 minutes or fast forward 15 minutes by moving to another channel. Of course he doesn't know that he is changing channels. He only knows that he is taken backward or forward in time, as if he had paused, rewound or fast forwarded his VCR. This feature should allow the cable industry to compete more effectively with video stores.

True video-on-demand

Many people are counting on the ability to offer video-on-demand (VOD), allowing the subscriber to request a program when he wants it. This is the electronic answer to the video rental store. Digital compression converters are assumed to be justified based on offerings of many channels of VOD. However, before the compression converters are deployed widely, a long and costly process, it is possible to do a lot of VOD using analog converters. This is because cable systems are being built in fiber-to-node architectures. The cable operator has an individual pipe from the headend serving typically 1,500 subscribers today, dropping to 500 in the near future. This allows some channels to be set aside for VOD applications with subscribers in each node having use of the same frequencies but for different programs. The technique has been shown to be viable in the analog converter world with easy expansion to the digital compression world at the appropriate time.

Look for video file servers in the next year that will allow local systems to provide automated VOD and commercial insertion, without relying on videotape recorders and the physical transport of programming material from one headend to another.

Bandwidth expansion

These new services will require more bandwidth than can be provided by even 550 MHz cable systems. Some are hoping that compression is right around the corner as a solution but this may take longer than expected. Many systems now are planning to build upgrades to 750 MHz, which appears to be the next plateau. Next-generation converters will support this. Systems built to 1 GHz do not appear to be around the corner except in special and experimental applications.

Physical expansion

Besides the expansion port, several manufacturers are planning some sort of expansion capability into which the consumer can plug in a card or something that will allow additional features. Some manufacturers are planning for this to be a Smart Card, and some are planning proprietary expansion slots, which they feel will be more versatile and cost-effective. Smart Cards are a European development used for all sorts of applications there. They look like credit cards but contain sophisticated electronic circuitry. A connector embedded in the card allows them to be attached to other systems. For example, they are used as telephone credit cards. Within limits, any circuitry may be imbedded in the plastic.

These can be used, for example, for more memory. The EPG described might carry information for all the programs on in the next week or two. Because of the time required to transmit all of this information, if a subscriber is to enjoy the full benefit without encountering a long access delay (while waiting for the information to come around again), the data must be stored in the converter. To store this much data is a rather expensive process, even at the cost of memory today. Therefore, some may choose to offer a converter that can only display the next hour or two of programs. If a subscriber wants to be able to look out further in the program data base, and doesn't want to encounter delay, he can purchase (rent?) additional memory that can be plugged in.

Other uses include adding features such as interactive TV, games or improved scrambling systems. It is conceivable that if a scrambling system is compromised in the future that the system could recover by supplying a new plug-in descrambler for the port, which would upgrade the box to a new scrambling system. I emphasize the word conceivable, because the existence of such a port does not necessarily guarantee that useful upgraded scrambling could be added.

Digital audio

Some manufacturers are planning to offer digital audio integrated into advanced converters. Such integration could allow sharing of some components, reducing the standalone cost of offering the service. This also would allow more of a seamless simulcast for the subscriber having such a box.

Data streams

A lot more data will be transmitted to advanced converters. This will be needed for EPG and other advanced services. Data transmission to the converters is a somewhat troubling issue for manufacturers. It can be accomplished in any of several ways. One way is to use an out-of-band (meaning out of any TV channel) carrier dedicated to data. Usually FSK modulation is employed. Data rates of up to 19.2 kb/s have been employed in the past, and rates up to 2 Mb/s are being designed for use in the near future. The disadvantages of out-of-band data include the cost of incorporating a data receiver in the converter and the need for spectrum on the cable. About 12 years ago I spent a lot of time trying to define a universal frequency for data. Such was impossible then, and the problem is worse now.

Another way to transmit data is in the vertical blanking interval (VBI) of one or more TV signals. This is being done a lot now. An FCC decision several years ago was that the VBI was the property of the cable operator, and the operator could either pass incoming VBI data, remove it or replace it with something else. This ruling has not been of great significance until now. However, with the increase in data in the VBI, some operators are now getting aggressive at protecting this space by removing VBI data from providers with whom they don't have carriage contracts.

It is possible for converter manufacturers to use the VBI, but they will have to make systems versatile, in that any line(s) on any channel(s) can be used, but there cannot be a specified place for the VBI data. Some manufacturers are planning to use both in-band and out-of-band data. Others plan to concentrate on one or the other, with provisions to change easily if a system has such a need.

In-band data is claimed by proponents to be more secure in that scrambling and addressing data are carried in the same data channel. If the subscriber tries to cheat by removing addressing data (preventing his converter from getting a downgrade instruction), the descrambling data also will be removed. Others believe that this security issue can be addressed with a combination of in-band and out-of-band transmission, and prefer out-of-band data transmission for operational reasons. One can assume that all active converters are listening to an out-of-band data carrier, but one cannot assume that all converters are listening to in-band data because the converter could be tuned to a channel without data. **CT**

The terminal of tomorrow: Building the ubiquinetwork — Part 4

By George Lawton
West Coast Correspondent

I remember back in my early teens when I saw cable TV for the first time. Someone I knew had just gotten a box with a slider bar that could tune about 30 channels. He showed me how he could even get HBO by sliding a butter knife into the edge of the box at just the right angle. (I don't think he told his mom about this because she didn't want him watching HBO's late night "erotic" movies.)

The set-tops installed in homes today are only a minor improvement over these, compared to what will be rolling out within the next few years. They have gotten a few more channels, remote controls, and even addressability. These features have enabled operators to add new revenue streams like pay-per-view (PPV) or those $3/month remote controls. But the remote control has lost its value, thanks to the Federal Communications Commission, and impulse PPV (IPPV) is only taking a small percentage of the dollars going to movie rentals.

Basic set-top evolution

There are different components of the set-top box that are evolving: tuner, descrambler, modem, graphics display and digital decoder. Tuners are approaching the limit offered by the cable systems. Descramblers are always changing, for good reason. Key ingredients for offering interactive services will be based on new communications capabilities made possible by modems, large channel capacities made possible by digital and new services that utilize the graphics capabilities of the next-generation set-tops.

The latest generation of set-tops from all the big manufacturers (including Scientific-Atlanta, General Instrument, Zenith, Pioneer and Philips) include some graphics capabilities. These will evolve over time to higher resolutions and more colors. Many of the newer set-top boxes on the market today enable the cable operator to send customer information to each terminal. In the simplest case, the operator can send text to the user's screen. This could be used to remind the customer about late bills, announcing yard sales in the neighborhood, or for creative marketing strategies.

Once direct broadcast satellite (DBS), multichannel multipoint distribution service (MMDS or wireless cable) and the telcos have gotten into the game, cable operators will need to distinguish themselves from the competition through branding. Michael Ares, marketing manager at Scientific-Atlanta, said that set-top boxes of tomorrow will be used for creatively branding and marketing the cable service.

Scientific-Atlanta's new 8600 terminals let the box display a message when it is turned on, such as the local cable company's logo. Alternatively it could say, "Thanks for buying three PPV movies this month. Have a free one on us."

The display also could hold news and information about the cable system, such as new services and free service trials.

Electronic program guides (EPGs) also could be displayed on these terminals. These enable consumers to scan through a listing of this week's programming. Some EPGs will even be able to program the consumer's VCR to automatically record a desired program, but these will require some kind of infrared output port on the set-top, or TV set.

These boxes open up a whole new type of programming to cable operators as well. Hundreds of virtual data channels can be placed onto a single TV signal. The bandwidth is so great that hundreds of customers could be doing things simultaneously. GTE has begun

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offering Main Street, a programming package of hundreds of text-based services that can be placed on a cable network with addressable set-top boxes with graphics display. The services range from simple games like solitaire to home banking.

If the cable operator had two-way capabilities built into the network, consumers could even use such a system for ordering pizza. Once the graphics get good enough, people will begin to use new multimedia applications such as pick-and-choose home shopping with still pictures to show the merchandise.

"The remote control has lost its value, thanks to the Federal Communications Commission, and impulse PPV (IPPV) is only taking a small percentage of the dollars going to movie rentals."

Tomorrow's set-top operating system

One of the interesting issues in the next-generation cable network will involve the operating system used to run the set-top boxes. This will have to manage the consumer's relationship with services and communicate with the headend. Ideally it should be well-developed with few bugs.

In addition, there should be a wealth of third-party development tools to create new applications. This will enable cable operators to offer a wide variety of new services.

There are a number of contenders in this field. DAVID (digital audio video interactive decoder), based on OS-9 from Microware of Des Moines, IA, seems poised to become the dominant operating system at the moment. A number of manufacturers have agreed to support it including Zenith, IBM, Philips Consumer Electronics, Compression Labs, ICTV, Adaptive Microware, DiviCom, EURODEC of France, Goldstar, Kyocera and Samsung.

Companies are flocking to DAVID because it is powerful, compact and works in real-time. It was originally developed in 1982. This has given Microware over a decade to iron out most of the bugs. The operating system itself can be squeezed into a half megabyte of memory.

Steve Smith, director of marketing at Microware, said, "These set-tops are very high-end computers. We are at an advantage because we have a proven operating system. OS-9 has been used in the telecommunications industry for digital switches, routers and line cards."

Philips chose to use DAVID for its MPEG video CD-I players. Consequently it already has an installed based in the millions. It also created the need for software development tools for all those CD-I titles. Smith said that set-top software development tools will be leveraged off the existing CD-I tools. For example, Optimage developed Media Mogul for the CD-I player and now plans to extend that to support set-top boxes.

One important characteristic of DAVID is interoperability. An application developed for DAVID will run on any set-top with the DAVID operating system, even if they come from different vendors. Cable operators who standardize on DAVID will no longer be locked into a single vendor per cable system. Microware also has started working with IBM, Oracle and Digital Equipment Corp. to ensure compatibility between DAVID and their video servers.

Philips' next-generation box will come with CD-I compatible graphics, enabling cable operators to offer hundreds of CD-I titles to consumers. Brian Smith, vice president of market development at Philips Digital Video Communications Systems, envisions putting CD-I applications on a server in the headend.

Microsoft also is working on an operating system LinX module that will enable digital capabilities in set-tops. GI has agreed to use it on the LinX module that will be used to upgrade GI's CFT line of set-tops. However, Bruce Jones, project leader for multimedia at GI, pointed out that the firm has not ruled out the possibility of working with others.

Jones said, "LinX is an open platform. The specs will be available to anyone who wants them. In order to sell set-tops that are not expensive, we need to show the network operator how to make money from this equipment. We cannot say 'pick an operating system.' I have to focus a project to get one good set of applications ready for the market."

According to Jones, GI picked Microsoft because it has a pretty good brand name and a company commitment to being a big force in this business. He said, "In this business, we are all just figuring this out on the fly, so you have got to have the commitment and resources to be able to hitch up your overalls and move onward."

The development tools for Microsoft's operating system are not done yet. Microsoft says they will be based on C++ and Visual Basic, both common development tools today.

LinX is scheduled for a major test by the third quarter of 1995, which will provide the first true glimpse of Microsoft in action.

Other vendors seem to be further behind at the moment. 3DO has signed up to develop an operating system for US West's Omaha, NE, trial. However, one questions the ultimate cost of the boxes when 3DO is selling a video system that costs over twice that of its competition. The video game has nice graphics, but the hardware to support it is probably too much for the consumer electronics industry today.

Other potential set-top operating system contenders include Oracle, Sybase and Silicon Graphics. Only time will tell if any of these rise to prominence.

The government factor

At the most recent Society of Cable Television Engineers Cable-Tec Expo in St. Louis, Wendell Bailey (vice president of science and technology for the National Cable Television Association) said, "I have never lost sight of the fact that whenever Congress or the FCC does anything, the likelihood that it affects some technical component is high."

The FCC has forced a number of stipulations on set-top box evolution. One of the thorniest issues is the interface between the set-top box and consumer electronics appliances like TV sets and VCRs. The set-top will descramble the video and pass it to the TV set via this interface. As well, infrared remote commands sent to the TV set will be passed to the set-top. One of the largest unsettled issues in this interface is the complexity of the infrared commands that can be passed to the set-top.

Zenith has an interesting perspective on this debate as both a set-top and consumer electronics manufacturer. Vito Brugliera, vice president of technology market planning at Zenith, said, "We have been aware of the consumer interface problem for some time and now we are seeing the regulatory impact of electropolitics."

Several years ago, the industry was exploring the development of a MultiPort interface that could connect TV sets to set-tops. However it never took off. Brugliera said, remote control revenue would have been gone. Remote controls were a sizable revenue stream, consequently it did not have a lot of cable support."

The remote control issue has fallen by the wayside in light of the new FCC regulations. The upside of this interface is that it could reduce the cost of the set-top box, as more functionality is moved to the TV set.

Congress has started making noise about controlling violence on cable TV systems. To pre-empt the government from sticking its clumsy hands into the issue, the NCTA has started working with the consumer industry to create a "violence control chip." This could be embedded in TV sets or set-tops or sold as a stand-alone device.

Bailey suggested that Line 21 of TV transmissions have Field 2 open, which could be used for program rationing. Violent or sexually explicit programming could transmit a special signal. The control chip would monitor these signals and block out undesired programs, unless the password is entered.

Marketing tests

No one is really sure yet which services are going to take off. It is all a matter of testing the waters until someone finds that service that delivers far more revenue than it costs to implement.

In the Full Service Network trial in Orlando, FL, Time Warner is paying about $5,000 per set-top.

S-A's Ares said, "There is not even an effort to build these based on cost. We are taking a Silicon Graphics Indy workstation and we are putting that in a set-top and tossing in communications capability. We are saying, 'If you could get anything you wanted, what would you do with it?' We are not making any money on this. We are going to learn. This will help us get information about our customers' customers."

Scientific-Atlanta is only building 4,000 boxes for the trial. That is nothing for a company that produces millions of boxes.

For anyone who remembers the grand old days of videotex, there is a wide margin between a cool new service and a profitable one. Only time and numerous trials will tell which set-top features can generate a profit. **CT**

Video testing step by step — Part 3

The new Federal Communications Commission-required "video tests" are less than 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 covered FCC reporting requirements and baseband video basics. Part 2 focused on two specific recommended tests — in-channel frequency response and percent modulation. This part will tackle signal-to-noise ratio (S/N) and hum modulation. Following installments will continue to detail each of the FCC-required tests, plus include information on a few tests that may benefit picture quality and system troubleshooting.

By Jack Webb
Product Manager, Sencore

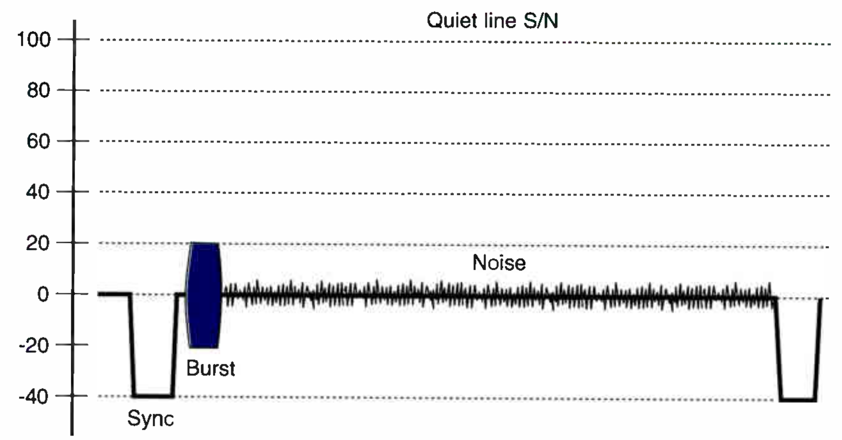
The following information is taken from various reliable sources and is believed to be accurate at the time of printing. Please refer to the FCC Rules and Regulations Part 76.601 through 76.605 to be sure that you fulfill the legal requirements. Listed with each recommended test and the FCC-required tests is information on the FCC regs, a definition of the test, a description of the picture effect, a measurement procedure and many helpful hints and precautions when making and interpreting these measurements.

Signal-to-noise ratio

No S/N specification is set by the FCC. However, the S/N of the video signal is important to the picture quality. Like carrier-to-noise (C/N), the S/N cannot be improved. (*Editor's note: Some sophisticated and very expensive digital signal processing equipment is available to improve baseband video S/N, but it is impractical for CATV use.*) If you start with a poor S/N, you will deliver a poor picture quality to the customer. Since most systems measure C/N using a procedure that measures the noise outside the channel's video bandwidth, the actual picture quality with respect to noise is still unclear. You can have a good C/N and still have a poor picture quality because of a poor S/N.

S/N is typically not a problem for most channels taken from one of the satellites using quality equipment. Problems are usually the result of poor video source material, an equipment failure, or when very distant off-air signals are brought in via marginal means. While most system sources of noise are flat across the spectrum, noise generated by imaging devices, microwave transmitters and satellite transponders is not flat. Generally, noise increases as the square of the frequency. This is a good reason to insert your own test signals using a VITS insertion generator.

Figure 15: Signal-to-noise ratio



Definition: S/N is the ratio of the peak-to-peak signal level to the level of the noise added to the signal. Since the effect of noise on picture quality depends on the level of the picture signal, the most meaningful measurement is the ratio between the noise and the signal level. S/N is the ratio of the luminance signal level from the black level to the white reference amplitude compared to the RMS amplitude of the noise signals after weighting the noise for perceived picture degradation according to EIA 250C or CCIR 567. The recommended performance objective in the National Cable Television Association recommended practices suggests that a 53 dB S/N be maintained for good system operation. S/N can be computed by the following formula:

$$S/N = 20\log(V_{\text{blanking to white}}/V_{\text{NRMS}})$$

Picture Effect: Picture quality will be degraded much like a C/N problem. Pictures containing high levels of noise will be grainy or snowy with "sparkles." Sharpness and resolution may be poor at high noise levels.

Measurement procedure: Low-level noise is very difficult to measure. Quality video equipment found in the typical headend will have S/N performance in the 55 to 60 dB weighted range (excluding the contribution of program source noise.)

Weighting refers to use of a weighting filter, such as the EIA 250C or CCIR 567 filter, to shape the noise frequency response similarly to the way a human eye would perceive the noise. Higher frequency noise is less perceivable to the human eye. To measure a 52 dB weighted S/N we should expect to measure ~4 mV RMS of noise in a 1 V video signal.

$$S/N \text{ weighted} = 20\log(4 \text{ mV}/0.714 \text{ V}) + 6.8 \text{ dB} = 51.8 \text{ dB}$$

To make an S/N measurement, no test signal is required. Any quiet line may be used. A quiet line is a horizontal line in the VBI with a continuous signal level between sync pulses as shown in Figure 15. Automated measurements available on newer CATV instruments are more accurate than typical manual measurements. Manual measurements can be made by comparing the amount of noise riding on the blanking signal to the overall signal level of the signal. The peak-to-peak noise measurement must

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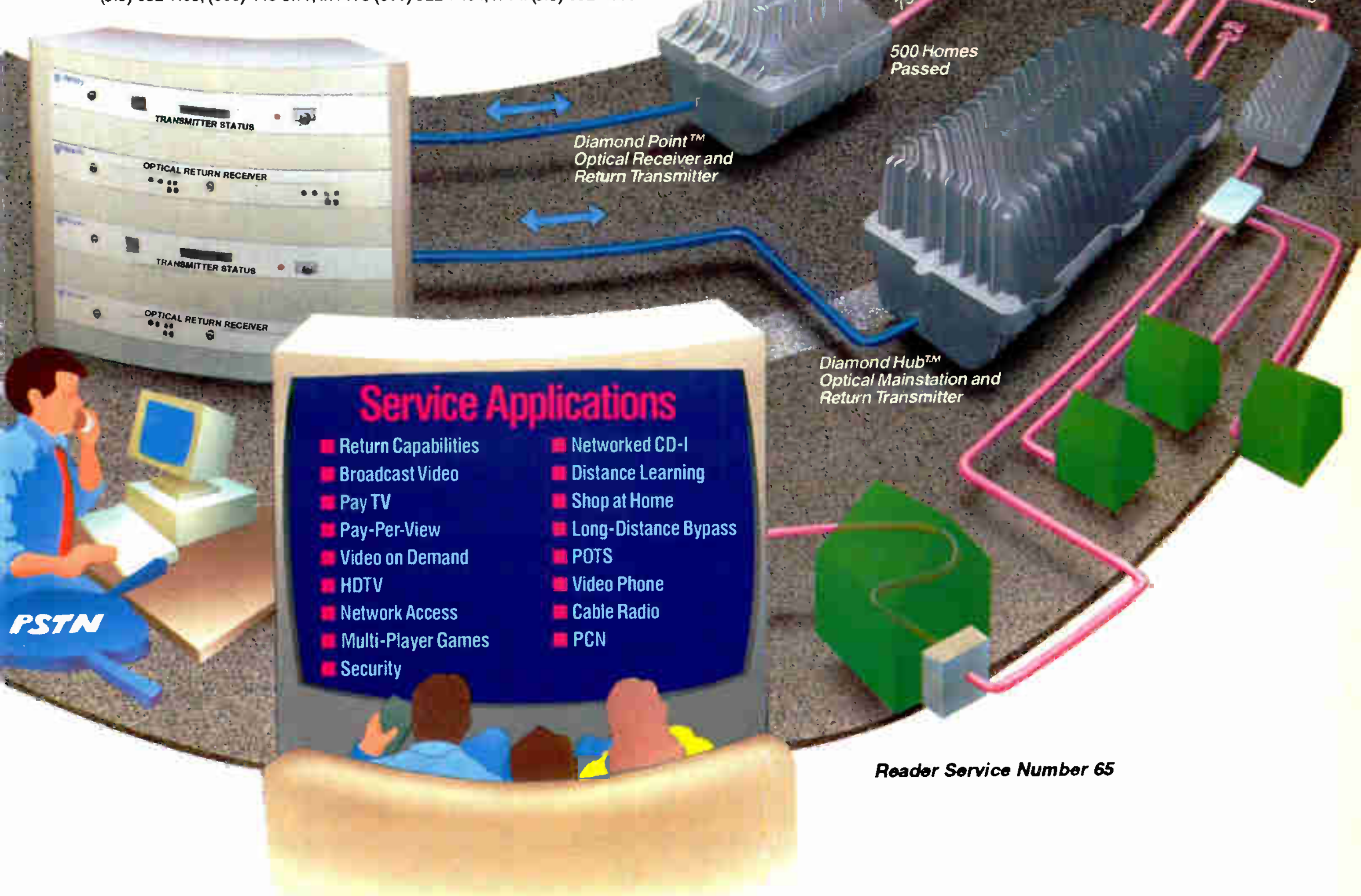

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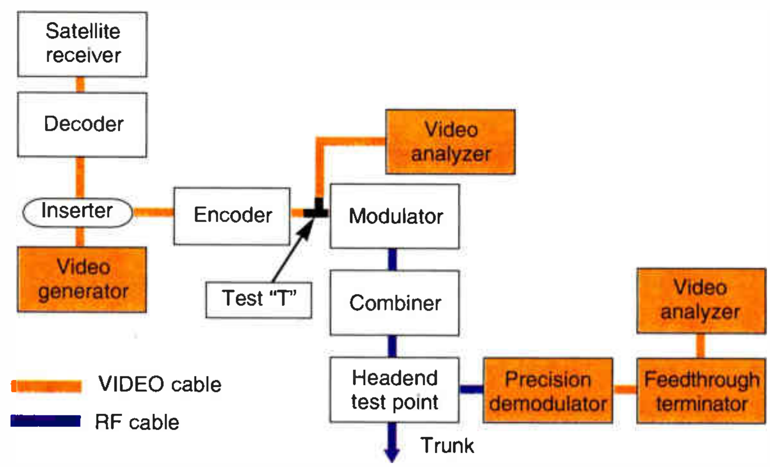
PHILIPS

"Although the FCC only requires hum to be measured on the distribution system and in a manner that will only measure hum caused by problems in the distribution system, it is good engineering practice to measure the hum contribution from the headend components."

Figure 16: S/N measurement



be multiplied by 0.35 to get the RMS value of the noise. A test signal may be used that contains a black reference or significant blanking level signal.

Procedure:

1) Connect the test equipment as shown in Figure 16.

2) Test signal generator setup:

a) Connect the signal insertion device or loopthrough as required.

b) Select the VITS insertion mode.

c) Select the desired test signal.

d) Connect to the insertion device, enable the generator output.

e) Using the CATV video signal analyzer, verify the test signal insertion.

3) Demodulator setup:

a) Tune to the channel to be tested.

b) Use the synchronous detector mode.

c) Be sure the "zero carrier reference" mode is turned off.

4) CATV video signal analyzer setup:

a) Check the Cal signal and be sure the display gain and vertical position controls are properly set.

b) Set the line select to the line and field containing a quiet line.

c) Select the 1 H sweep mode so that one horizontal line is displayed.

d) Measure the % modulation to be sure that the % mod is set at 87.5%, or slightly under. Overmodulation will create excessive differential phase and gain distortion.

5) Press the S/N key and read the LCD for the S/N in dB.

Or, for manual measurements (Figure 17):

a) Adjust the vertical gain until the bar just reaches the 100 IRE graticule and the sync is positioned for the - 40 IRE position.

b) Measure the peak-to-peak noise riding on the blanking signal and apply the values to the previous formula.

Precautions:

1) Permanently install an insertion device in each channel's video path at the output of the satellite receiver so that test signals may be injected without interrupting the channel. Be sure that only a single 75 ohm termination exists on each video line.

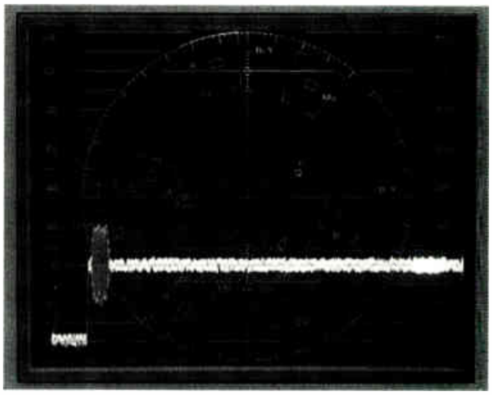
2) Also, install a "T" at the input to any device in the video path of each channel. This will provide troubleshooting test points without interrupting the channel. Be sure that only a single 75 ohm termination exists on each video line.

3) Before connecting the CATV video signal analyzer to any test point, be sure that it is in the high impedance mode (not using the feedthrough terminator).

4) Remember whether you are looking for weighted or unweighted S/N and remember that the 6.8 dB correction factor is only good if the noise measured is relatively flat across the frequency spectrum.

5) Distortions that fall in the video bandwidth also may be perceived as noise using this measurement technique. Be sure that your X-mod, second and third order distortions (generally not a problem in the headend), as well as any video linear distortions are lower than the noise level you are attempting to measure.

Figure 17: Measuring S/N



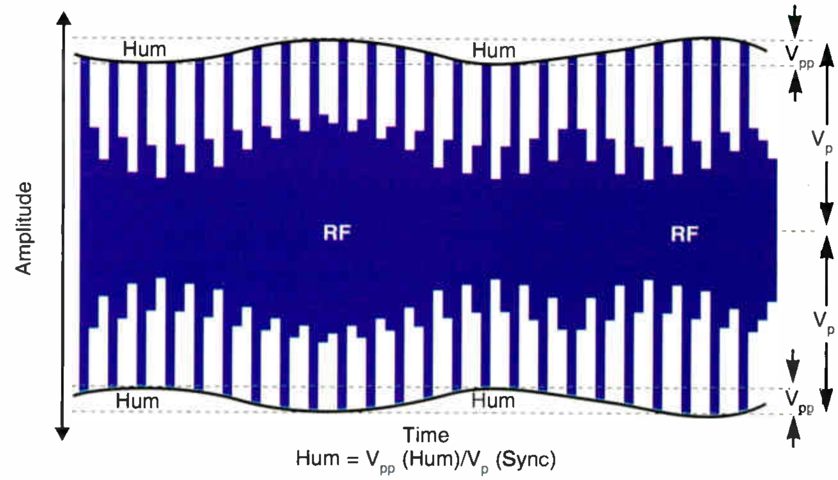
Hum modulation

Hum modulation is an FCC test that was reinstituted in July 1992. It is a measurement of the low frequency AM distortion of an RF carrier. Hum distortion will generate horizontal bars in the TV picture. A DC restorer or AGC must be turned off in order to make hum measurements. The following sections provide detailed information on FCC rules and regulations, a definition of the test, a measurement procedure and many helpful hints and precautions.

- 76.605 (a)(10): The peak-to-peak variation in visual signal level caused by undesired low frequency disturbances (hum or repetitive transients) generated within the system, or by inadequate low frequency response, shall not exceed 3% of the visual carrier level. Measurements may be made on a single channel using a single unmodulated carrier. →

• 76.601 (c)(1): For cable systems with 1,000 or more subscribers, but with 12,500 subscribers or less, proof-of-performance tests conducted pursuant to this section shall include measurements taken at six widely separated points within each mechanically continuous set of cables within the cable TV system. Within the cable system, one additional test point shall be added for every additional 12,500 subscribers or fraction thereof. Such proof-of-performance test points shall be balanced to represent all geographic areas served by the cable system. ... at least one third of the test points shall be representative of subscriber terminals most distant from the system input in terms of cable length ... An identification of the instruments, including the make, model number, most recent date of calibration, a description of the procedure utilized, and statement of the qualifications of the person performing the test shall be set forth.

Figure 18: Hum modulation on the RF envelope



Although the FCC only requires hum to be measured on the distribution system and in a manner that will only measure hum caused by problems in the distribution system, it is good engineering practice to measure the hum contribution from the headend components, since this will represent the picture quality that will be delivered to the customer. This also is a good method of preventive maintenance — finding problems before they become large enough to affect noticeable system performance.

Definition: Hum is the low frequency AM distortion of the video signal, generally considered < 400 Hz to 1 kHz, and is the percentage of peak-to-peak distortion to the peak signal level. This is approximately 2 times the percentage of the % modulation of the low frequency distortion. Note the hum illustrated in Figure 18.

Picture effect: Hum distortion produces horizontal bars slowly rolling through the picture. One or two bars is

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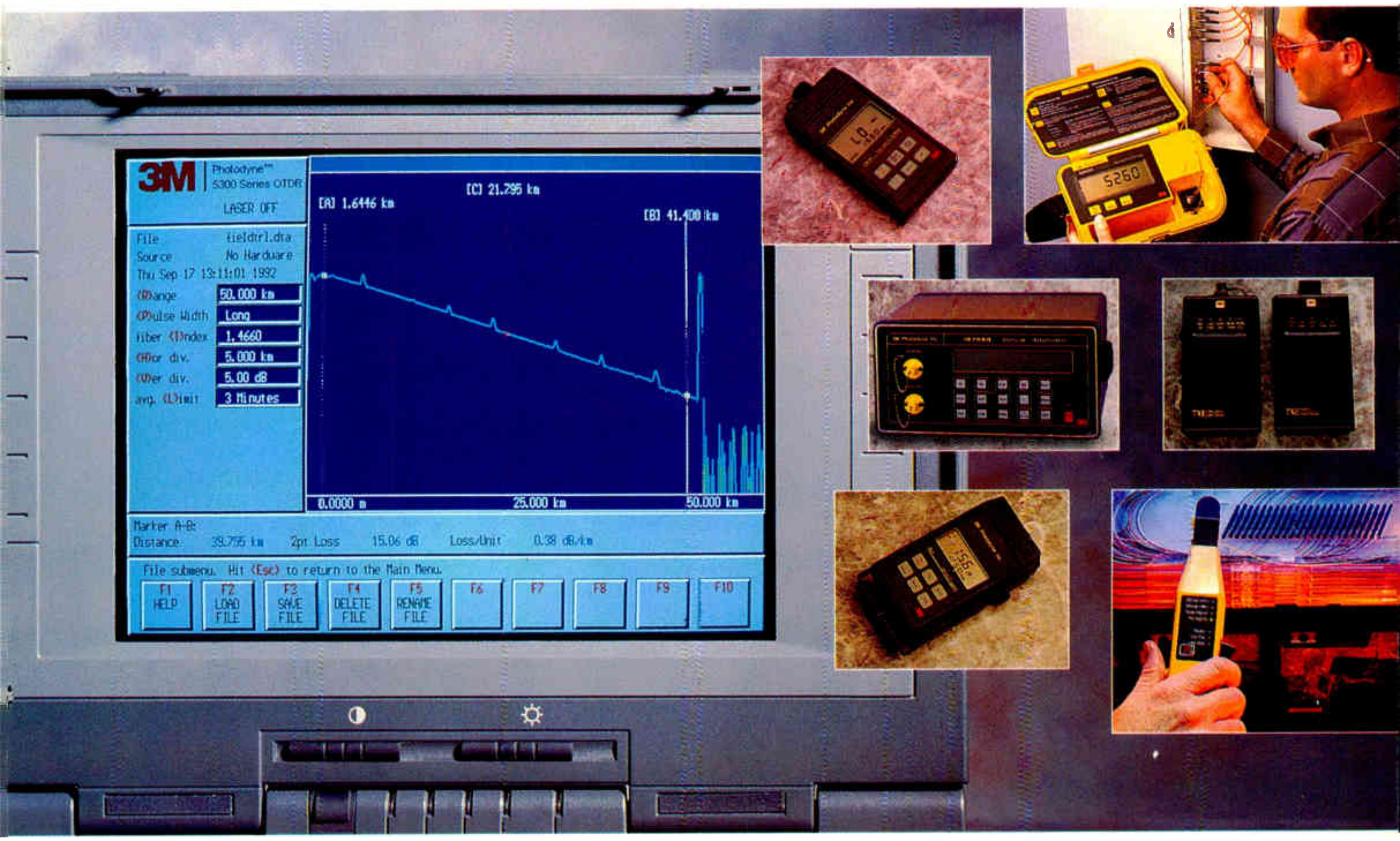

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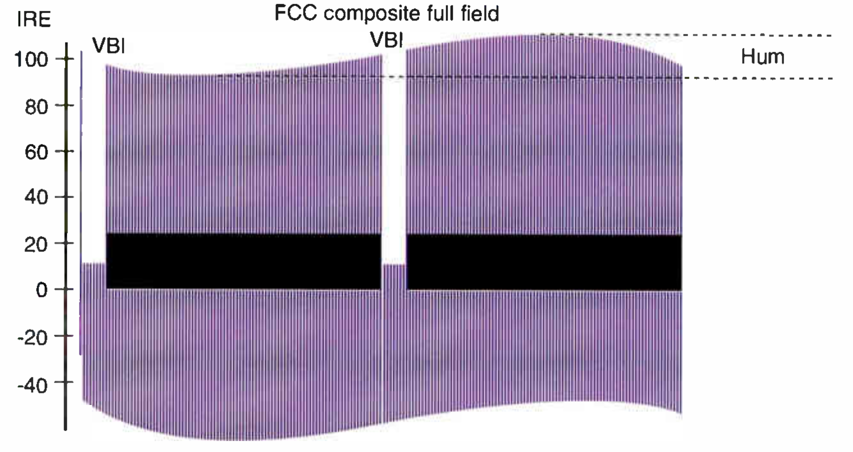
common to hum related to the AC power. The intensity of the bars will be proportional to the level of the hum signal. Other low frequency distortions also occur. Ground loops are the most common cause of small hum distortions in the headend. Hum of 0.5 to 1% is typical performance in the headend. Hum created in the headend will add to the hum distortions caused by the distribution system. This addition may be in or out of phase, creating distortions that may not appear to be the expected sine wave or "clipped sine wave" form.

Measurement procedure: For hum measurements to meet the FCC performance tests follow the procedures outlined in NCTA recommended practices or use a field strength meter or spectrum analyzer that has the built in measurement.

To measure the hum distortion generated in the headend you may use any full field or test signal. Automated CATV video analyzers automatically switch off the DC restorer and AGCs and compare the amount of hum riding on the top of the sync pulses to the overall signal level of the video signal. Hum measurements cannot be made if the DC restorer or AGC cannot be turned off (Figure 19).

Figure 19: 2 V horizontal sweep



Procedure:

1) Connect the test equipment as previously shown.

2) Test signal generator setup:

a) Connect the signal insertion device or loopthrough as required.

b) Select the VITS insertion mode.

c) Select the desired test signal.

d) Connect to the insertion device and enable the generator output.

e) Using the CATV video signal analyzer, verify the test signal insertion.

3) Demodulator setup:

a) Tune to the channel to be tested.

b) Use the synchronous detector mode.

c) Be sure the "zero carrier reference" mode is turned off.

4) CATV video signal analyzer setup:

a) Check the Cal signal and be sure the display gain and vertical position controls are properly set.

b) Set the line select to the desired test signal or to the off (full field) position.

c) Select the 2 V sweep mode so that two fields are displayed.

d) Turn off the DC restorer and AGC if appropriate.

e) Measure the % modulation to be sure that the % mod is set at 87.5%, or slightly under. Overmodulation will create excessive differential phase and gain distortion.

5) Press the hum key and read the LCD for the hum in percent.

Or, for manual measurements (Figure 20):

a) A test signal with a white reference must be used. Adjust the vertical gain until the white reference just reaches the 100 IRE graticule and the sync is positioned for the - 40 IRE position.

b) Measure the peak-to-peak hum riding on the sync pulses and apply the measurements to the following formula. (See Figure 20.)

Hum = V_{Humpp} IRE/140 IRE

Precautions:

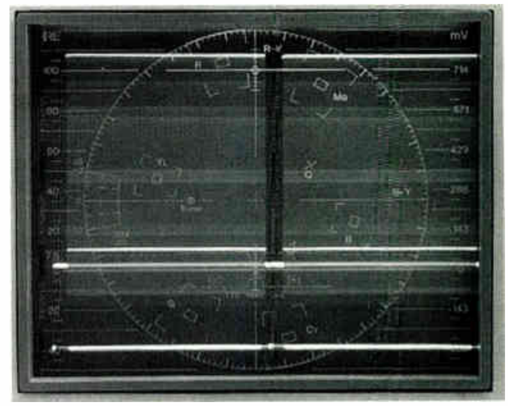
1) Permanently install an insertion device in each channel's video path at the output of the satellite receiver so that test signals may be injected without interrupting the channel. Be sure that only a single 75 ohm termination exists on each video line.

2) Also, install a "T" at the input to any device in the video path of each channel. This will provide troubleshooting test points without interrupting the channel. Be sure that only a single 75 ohm termination exists at the end of each video line.

3) Before connecting the CATV video signal analyzer to any test point, be sure that it is in the high impedance mode (not using the feedthrough terminator).

4) Distortions that fall in the video bandwidth also will be perceived as noise or signal distortions using this measurement technique. Be sure that X-mod, second and third order distortions (generally not a problem in the headend), as well as any video linear distortions are lower than the hum level you are attempting to measure. Hum distortion will commonly be a sinusoidal distortion at some low frequency (i.e., field or 2X field rate).

Figure 20: Measuring hum

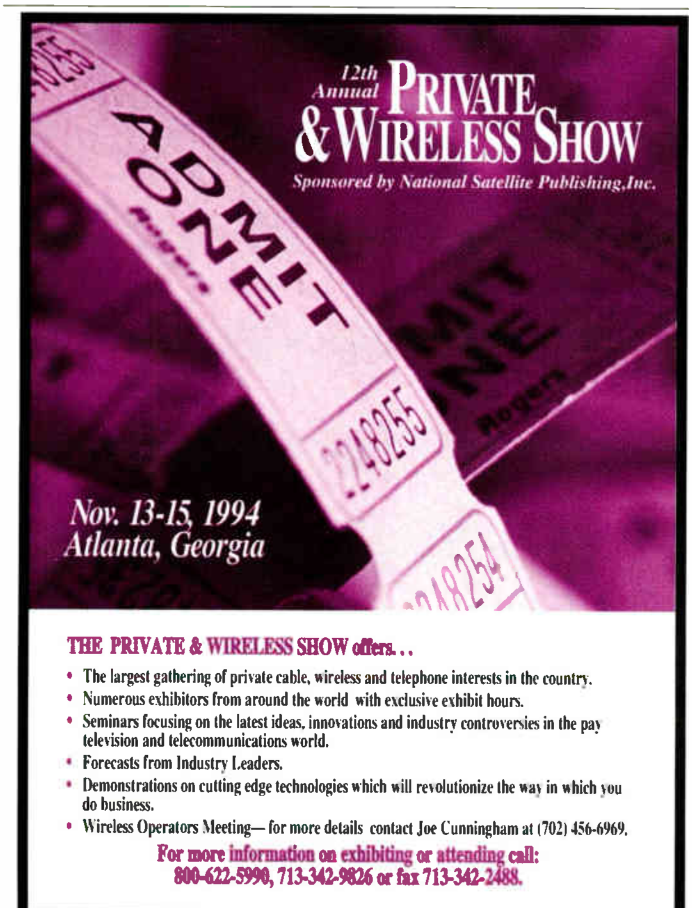


5) Some waveform monitors use a DC restorer and/or a fast AGC that will hide all or part of the hum signal you are attempting to measure. Similarly, some headend equipment with DC restorers or AGC may eliminate or reduce the hum distortion in your video signal. **CT**

Ham radio operators in the cable TV industry — Part 2

The following is the second part of a list (in alphabetical order) of amateur radio operators employed in the CATV industry. The first part ran in August. It was compiled by Steve Johnson, N0AYE, who is in the process of adding a new category to include packet addresses for each of the hams. Please send any additions or corrections to Steve Johnson, Time Warner Cable, 160 Inverness Dr. W., P.O. Box 6659, Englewood, CO 80155-6659; fax (303) 799-5651.

Name	Call	Company	Location
Phelps, Alan	KA4DXM	Jones	St. Leonard, MD
Piccolo, Tony	WD9GCJ	Texscan	El Paso, TX
Pience, Roger	KA4ATI	NCTA	Washington, DC
Pike, Dan	N5TLM	Prime	Austin, TX
Pincombe, Scott	2NNR	Philips	Manlius, NY
Potter, Greg	NM2L	New Channels	Syracuse, NY
Preston, Charles	N4SXM	N. Georgia Comm.	Norcross, GA
Prince, Bradley	N3GMT	Adelphia Cable	Plymouth Meeting, PA
Pringle Jr., J. Leon	W5NA	Pine Belt	Hattiesburg, MS
Proctor, Ken	N2DQD	Mobile Diagnostic	Bricktown, NJ
Pruitt, Michael	KC4FMJ	Cablevision Ind.	Danville, VA
Radicke, Chris	N7TWW	Westec	Scottsdale, AZ
Radicke, Ingo	WA7KUM	Post-Newsweek	Miami/Globe, AZ
Radicke, Lora	N7TWY	ComSonics	Chandler, AZ
Radzik, Jack	N2RK	LRC	Horseheads, NY
Raimondi, Steve	W2QUU		Englewood, CO
Raue, Martin	WB5LJO	Texscan	El Paso, TX
Reed Jr., Oscar	W3FFQ	Reed Assoc.	Silver Springs, MD
Reed-Nickerson, Linc	W2HIE	Tektronix	Blue Bell, PA
Reihs, Warren A.	WB6QKA	CaLan	Thousand Oaks, CA
Reno, Larry	N0NPM	Mile Hi	Denver, CO
Ressler, Bryan	N8BFC	Cable Link	Columbus, OH
Reynard, Rand	N0DYQ	ANTEC	Englewood, CO



Name	Call	Company	Location
Rice, Charles	KD4SS	Glasgow EPB	Glasgow, KY
Rice, Milton	KC4YOT	Time Warner Cable	Gastonia, NC
Richards, Dallas	WA0CFZ	TCI	Junction City, KS
Richardson, Earl	W1NIC	Moosehead	Greenville, ME
Rios, Edgar	XE2SHL	Jerrold	Nogales, Mexico
Rivera, Phil	KM4OP	Gold Coast	Miami Beach, FL
Robertson, Bill	N6VLR	Continental	Lakewood, CA
Rocci, Joseph	WA3CMQ	AM Communication	Quakertown, PA
Rodgers, Gregg	KJ9X	Trilithic	Indianapolis, IN
Roman, Geoff	WA2DTL	Jerrold	Hatboro, PA
Rosenberg, Eric	WA6YBT	C-SPAN	Washington, DC
Roush, Sam	KA8OOT	Rifkin	Point Pleasant, WV
Runkle, Fred	K4KAZ	Scientific-Atlanta	Atlanta, GA
Rupert, J. Scott	N3DDZ	TCI	Apollo, PA
Sabraw, Martin F.	N8IWQ	Starion	Ada, MI
Salas, Gustavo	LU3DNM	Video Cable Comm.	Buenos Aires, Argentina
Salyards, Todd	W5VUX	Siecor	Raleigh, NC
Sambol, Don	K7CS	Time Warner Cable	Englewood, CO
Sanchez, Nestor	N4UJZ	Storer	Miami, CA
Sandgathe, Michael	WB9VTX	CableLabs	Boulder, CO
Sanford, Mark	KF8KY	Time Warner Cable	Canton, OH
	Packet address: @KA8Z.#NEOH.OH.USA.NA		
Scherer, Mike	N8OCA	Continental	Lansing, MI
Schmidt, Bill	KF4CQ	Superior Tele.	Atlanta, GA
Schmidt, Jim	WB9EPW	Time Warner Cable	Appleton, WI
Schmidt, Wally	KD6EZE	Loma Linda U. Med.	Loma Linda, CA
	Packet address: @KC6LHA.#SOCA.CA.USA.NA		
Schmig, Gene	KQ4AV	Time Warner Cable	Greensboro, NC
	Packet address: @WB4WOR		
Schwarz, Guillermo	KP4DDB	Century Comm.	San Juan, PR
	Packet address: @KP4TW.#SJ.PR.USA.NA		
Scott, Noel	KA0TWQ	Time Warner Cable	Kansas City, MO
Seal, Thale	WB7CWB	TCI	Billings, MT
Seale, Richard	VE2FEL	Infinity	LaSalle, QB
Sell, Bob	WB4OEZ	Time Warner Cable	Melbourne, FL
Sellers, Mike	KI6ED	Comcast	Fullerton, CA
Selwa, Paul	NB9K	Trilithic	Indianapolis, IN
Serafin, Neil	KE0XL	Peregrine Comm.	Golden, CO
Sexton, Burl	KO4V	Scientific-Atlanta	Atlanta, GA
Seymour, Andy	N0JPD	Telecable	Springfield, MO
Shaw, Bob	KB8BIY	Pioneer Comm.	Columbus, OH
Sherman, Craig	KC4QZD	Altam Electronics	Fort Lauderdale, FL
	Packet address: @WB4TEM.#BCRFL.FL.USA		
Shine, Daniel	K1NJX	M/A-COM-MAC	Chelmsford, MA
Sicard, Don	K1OSG	CommSpec	Haverhill, MA
Siebring, Gary	KA0DWE	Siebring	George, IA
Sigler, Glenn E.	N8IJY	NaCom	Columbus, OH
Simmons, Marc	KD4JAZ	Spectradyne	Orlando, FL
Simoneau, Wayne	WA1WSM	Aero-Trac	West Warwick, RI
Skinner, Russ	WA8EQX	US West	Boulder, CO
Smith, Bill	W5USM	Cadco	Garland, TX
Smith, Melton	W4GOL	Lincoln CATV	Lincoln, AL
Smith, Tom	W4YJU	Alpha Resources	Plant City, FL
Snopko, Paul	K9VUD	Zenith	Chicago, IL
Snyder, Mike	KB0MJW	Jones	Englewood, CO
Sokola, Ray	K9RS	Wavetek	Indianapolis, IN
Souci, Roland	N6WQ	Standard Comm.	Los Angeles, CA
Spence, Jeff	KA0QEJ	US Cable	Merrillville, IN
Spencer, Ron	N4VOS	Spencer Const.	Stanton, KY
Spilka, Jesse	N2HYR	BQ Cable	Flushing, NY
Squires, Steve	WB9LKT	TCI	Galesburg, IL
Stader, Jim	KF0FL	MO Telephone CATV	Bolivar, MO
Stahlman, Greg	KJ6KO	King Video	Placerville, CA
Staiger, Jay G.	KA2HYA	Philips	Manlius, NY
Standridge, Jim	KB2PH	Jerrold	Lakeland, FL
Stanek, Matt	N0OBE	Time Warner Cable	Denver, CO
Stannard, Chris	KB4GAA	Storer	Miami, CA
Star, Danny	N8KRZ	Dimension	Heath, OH
	Packet address: @KB8GVW.#CENT.OH.USA.NA		
Stelle, Raleigh	NY0Y	Philips	Manlius, NY
Stephens, Bill	N9HEP	ALM	McHenry, IL
Stewart, Columbus	KF8AN	TCI	Grand Rapids, MI
Stewart, Neville	KB5YKN	Time Warner Cable	Austin, TX
Stigberg, Chuck	NT4U	E Tech Comm.	Richmond, VA
Stofer, Ray	K7JNK	Columbia Cable	Gardnerville, NV
Strahan, Dave	N7LSD	TCI	Seattle, WA

Name	Call	Company	Location
Strebel, Rich	KA3ANO	Adelphia Cable	Macedonia, OH
Styblo, Milo	OK2VA	Cable Plus	Ostrava, Czech
Surkiss, Arie	4X6UO	Intermil Ltd.	Azor, Israel
Sutton, Dave	WA9J	TCI	Galesburg, IL
	Packet address: @N9GQR.#WCIL.IL.USA.NA		
Sutton, Steve	KC4ZTH	Time Warner Cable	Gastonia, NC
Swanson, Pete	KA2IAY	Cable Exchange	Liverpool, NY
Tash, Gill	WB6WNN	PTK	Gdansk, Poland
Tauiliili, Sumatala	WH6CDN	Time Warner Cable	Honolulu, HI
Taxdahl, Tax	W7KCZ	Telecomm Assoc.	Ferndale, WA
Taylor, Jim	K9JT	The Video Term	Milwaukee, WI
Taylor, Tim	N7PQZ	TCI	Rawlins, WY
	Packet address: @WD4MYL.WY.USA.NA		
Templeton, Tim	KB0LDV	Time Warner Cable	Kansas City, MO
Thomas, John	VE3BVX	Lindsay	Lindsay, ON
Thomas, Ray	N0NNX	Cablevision Syst.	Richmond, MO
Thompson, Mike	KA0WJQ	Time Warner Cable	Kansas City, MO
Timberlake, Herb	W5TQI	Sammons	Fort Worth, TX
Tinggaard, Neil	WA0HJI	TCI	Englewood, CO
Tobin, Greg	WA2SFT	Paragon	Torrance, CA
Todd, Stephen	WB6ELD	Multivision	Lemoore, CA
Tonge, Tim	KA0MWA	Time Warner Cable	Englewood, CO
Troutman, Edwin L.	WA3TFX	Adelphia Cable	Winchester, VA
Tschirner, Alan	KA0TQH	Time Warner Cable	Kansas City, MO
Turner, John	WB5IRM	TCI	Muskogee, OK
Tyler, Mike	N5OLP	Weather Scan	Olney, TX
Tyrrell, George	K0CPT	HP	Englewood, CO
Ulrich, Dale	N4BZZ	Multivision	Rohnert Park, IL
Unverzagt Jr., John R.	N8MCQ	Pioneer Comm.	Columbus, OH
Van de Mosselaer, Wim	ON1BMV	Electro Service	Mechelen, Belgium
VanBuren, R.H.	W5ILH	Cablecom	Kirksville, MO
VanDamme, Michael	N6MOF	Heritage	San Jose, CA
VanDyke, Dave	KF2DT	Cable TV of Jersey City	Jersey City, NJ
Vaughan, Jim	K4TXJ	Storer	Louisville, KY
Vaughan, Ray	KD4BBM	Dynamic Cable	Hialeah, FL
	Packet address: @W7LUS.#HWDFL.FL.USA.NA		
Venne, Peter	N1PGG	White Mtn. Cable	Colebrook, NH
Voiles, Art	N5BZL	Texscan	Fort Dodge, IA
Voorman, Jim	WA2GSX		
Vyverberg, Chuck	WB7NNF	Cox Cable	Spokane, WA
	Packet address: @WB7NNF.WA.USA.NA		
Wagenblast, Rich	WA2BWP	Falcon Cable	Big Bear Lake, CA
Wager, Rich	N2UPX	C-Tec Cable	Carmel, NY
Wagner, John S.	N3IYN	Service Electric	Pottsville, PA
Walker, Dane	WB6JNP	Hughes Aircraft	Torrance, CA
	Packet address: @KJ6VV.#LACCA.#SOCA.CA.US		
Wallpole, Bill	VE3WNW	Maclean Hunter	Owen Sound, ON
Walters, Dave	KD4FZN	Paragon	Jamestown, NY
Wanderer, Bob	AA0CY		Denver, CO
Warburton, Peter	G8UGK	ARCOM	Syracuse, NY
Warren, Larry	N4ZE	ANTEC	Bensenville, IL
Wasleske, Bruce	WB9YVT	Jones	Mosinee, WI
Watt, Philip	KB7IQO	TCI	Anaconda, MT
Weber, Scott	KD4SHZ	Columbia Cable	Woodbridge, VA
Weeks, Randy	KB9BFZ	DH Satellite	Prairie duChien, WI
Whelan, Daniel	WB2WHD	NY Cable Comm.	Albany, NY
White, Thomas	KB9ACX	Heritage	South Bend, IN
Wicks, Wayne	WA2KEC		Littleton, CO
Wightman, Gary	WA8MCD	Cablevision MI	Kalamazoo, MI
Wilke, Allen	KE0EN	Time Warner Cable	Kansas City, MO
Williams, Billy	KB5ZFD	TCA Cable	Clovis, NM
Williams, Paul	WB4GVY	John Weeks	Beauford, GA
Williams, Robert T.	K5BFT	Century Comm.	Johnstown, PA
Williams, Steve	KA1WAM	Continental	Beverly, MA
Williams, Thomas	KD9KR	Continental	Centerville, OH
Williamson, Mike	KA5DVR	TCI	Englewood, CO
Wiltshire, Dan	KB8BKF	Pioneer Comm.	Columbus, OH
Winn, Al	KA9CAS	Time Warner Cable	Terre Haute, IN
Witherspoon, Brian K.	KB4RAB	Alert Cable TV	Clayton, NC
Witt, Scot	N9AZI	Col. of Dupage	Glen Ellyn, IL
Wolcott, Mike	WB4OEX	Scientific-Atlanta	Atlanta, GA
	Packet address: WB4OEX@WB4HUO		
Wolford, James	WB8FAX	Texscan	El Paso, TX
Wonn, Jim	W3GCZ	Trilogy	Jackson, MS
Woods, Emmitte	KA7NEH	Cooke Cablevision	Cle Elum, WA
Wouw, Tony	VE7CCI	ComLink	N. Vancouver, BC
Wyatt, Tim	KA0TYE	Time Warner Cable	Kansas City, MO
Yorks, Sal	WD4NZX	Philips	Manlius, NY
Young, Mark	N2MTT	Philips	Manlius, NY
Young, Scott	N4HLA	Time Warner Cable	Memphis, TN
Younker, Dennis	NE6I	Cox	Spring Valley, CA
Zeidler Sr., David H.	WB6TBT	LucasFilm	San Rafael, CA
Zerrenner, Robert	WA2RDH	Cox	Santa Barbara, CA
Zhorne, Brent	WB9FHI	TCI	Galesburg, IL
	Packet address: @N9GQR.#WCIL.IL.USA.NA		

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Differential gain, differential phase, chrominance-to-luminance delay

The following is adapted from a paper that ran in the "1994 NCTA Technical Papers."

By Rex Bullinger
Development Engineer, Hewlett-Packard

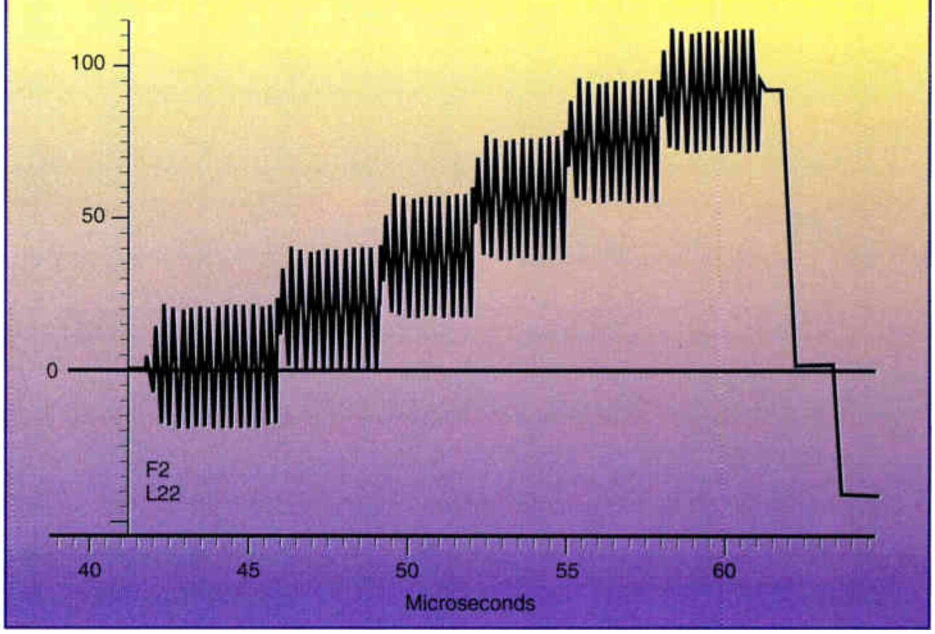
Beginning in mid-1995 cable TV operators must measure the quality of the color signals they are delivering to subscribers. The measurements chosen to judge color quality are differential gain, differential phase and chrominance-to-luminance delay.

Local insertion of full-field signals allows the operator to test the performance of the system but requires program interruption. Local vertical interval test signal (VITS) insertion allows in-service testing without program interruption or picture impairment.

Another in-service approach utilizes programmer-supplied VITS. In addition to lower cost, this is an end-to-end test that more closely links the test result to the actual subscriber picture quality. This approach, however, risks the signal not being present when needed or that the signal, if present, is already impaired enough to call its value into question.

A great deal has been written on the three "color" tests selected by the Federal Communications Commission to be performed by cable TV operators.[1,2,3,4,5,6] Rather than repeat work already accomplished in describing how to do the measurements, this article will look at some of the issues in getting set up to make these measurements. After reviewing the law we will look at the test signals used. Then we will describe the differences in measurement techniques between satellite and over-the-air channels. Finally, we will describe some considerations for selection of test modulators and demodulators.

Figure 1: Modulated stairstep signal (NTC)



Legal requirements

As of June 30, 1995, the color rules will apply. Chroma delay shall be within 170 nanoseconds, differential gain shall not exceed ±20%, and differential phase shall not exceed ±10°. Generally, the number of channels that must be tested are four plus one for every 100 MHz of spectrum use. (See the rules for the specific requirements.[7]) However, since a consultant or FCC auditor can check any channel, and since all channels must comply, few operators will feel comfortable unless all channels are tested. Thereafter, these tests must be done once every three years.

The FCC requires these tests of the headend-related signal processing equipment only. Since the trunk and feeder system components are all broadband, their contribution to color signal impairment is minimal. Not having to test outdoors in the system should be good news especially during bad weather.

A look at test signals

The differential gain and differential phase measurements are done using a modulated stairstep signal (Figure 1). The modulation on each step is the color frequency at an amplitude of ±20 IRE on each step. What is being measured are changes in amplitude and phase of that color signal as the luminance signal is stepped through its range of operation. Ideally there would be no changes at all in the chroma amplitude and phase as the luminance staircase goes from black to white.

The third test, chrominance-luminance delay inequality (CLDI — also called relative chroma time or RCT) uses a different test signal called variously the modulated 12.5T $\sin^2$ pulse or chrominance pulse. This cleverly designed signal consists of both luminance (Figure 2) and chrominance (Figure 3) components, which occur simultaneously. Figure 4 illustrates the 12.5T pulse as it appears after the low and high frequency components are added together. As the two components, which are at different frequencies, travel with the TV signal,

Figure 2: Low frequency portion

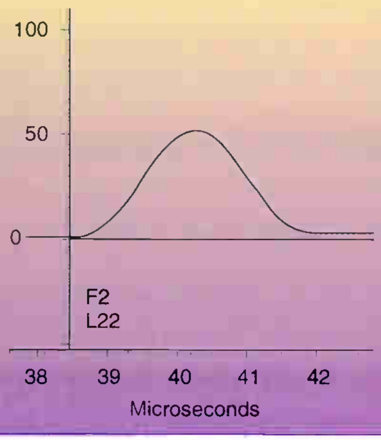


Figure 3: High frequency portion

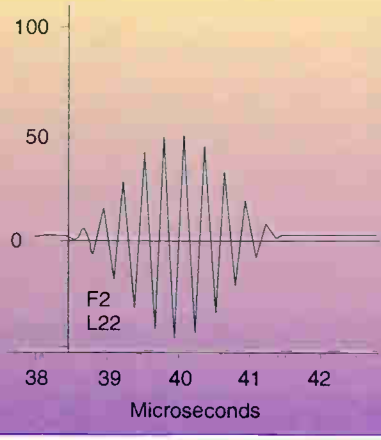


Figure 4: 12.5T chrominance pulse

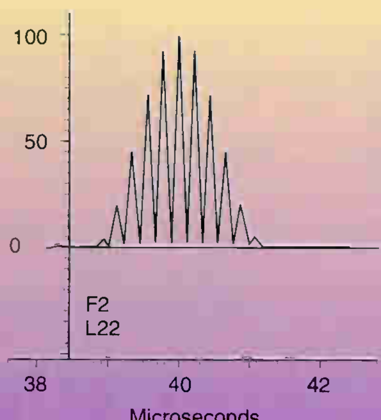


Figure 5: FCC composite signal

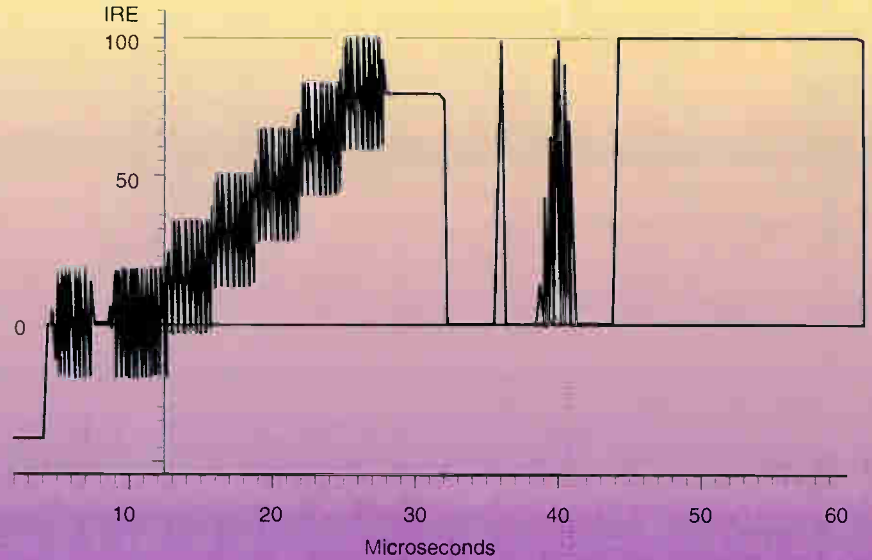
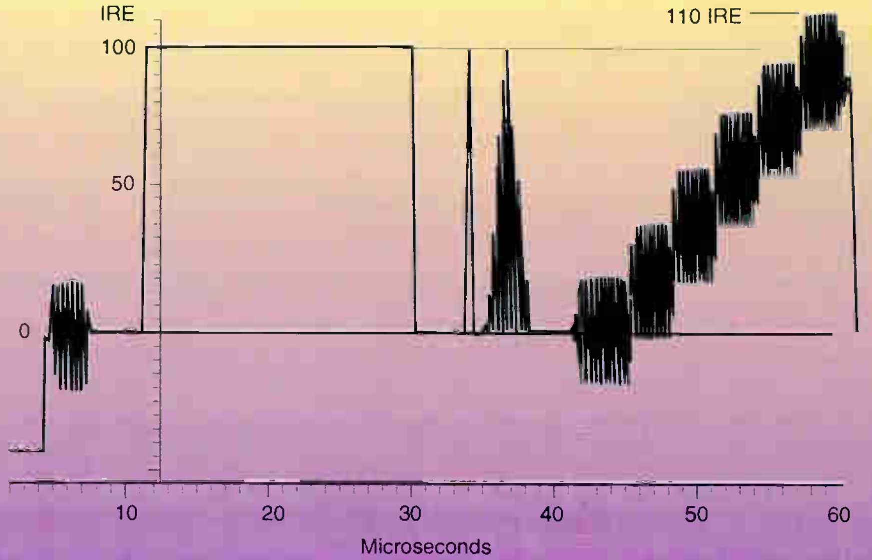


Figure 6: NTC-7 composite signal



any speed differences encountered because of being at different frequencies become readily visible through predictable distortions of the 12.5T $\sin^2$ pulse. Generally, the higher chroma frequency will encounter more delay than the luminance signal so the test is probably named for this. However, negative delay, where the chroma component arrives first is not uncommon.

These test waveforms (the modulated stairstep and the 12.5T $\sin^2$ pulse) have both been incorporated into two common test signals called the FCC composite (Figure 5) and the NTC-7 (Figure 6 — hereafter just NTC) composite signals. (Note that it is easy to confuse the name "composite" signal with that of the NTC-7 "combination" signal, which is quite different. Fortunately, there is no "FCC combination" signal.)

The 12.5T $\sin^2$ pulse is identical in both signals, but the modulated stairstep is slightly different. In the FCC composite signal the fifth stairstep has a DC level such that the color signal at peak excursion is exactly 100 IRE. However, in the NTC version the DC level of the fifth step is already at 90 IRE so the color signal's peaks extend to 110 IRE. This has implications for the cable TV operator that will be explored later. Compare Figures 5 and 6. Figure 1 (page 58) is the NTC modulated stairstep in more detail.

The reason there are two such similar test signals seems related to differences in their application. The NTC

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is intended for network video transmission to affiliate broadcasters and the FCC is for the terrestrial broadcast environment. The NTC composite signal is explicitly intended for testing "video facilities leased by the major TV networks from the Bell systems." For this purpose, Johnston[9] writes that the NTC members preferred having the line bar occur first because it gave a more valid reading on line-time distortion. In addition, the author suspects the excursion of the fifth stairstep's modulation in the NTC composite signal to 110 IRE is good for testing marginal network capability but would put broadcast transmitters under unduly harsh treatment.

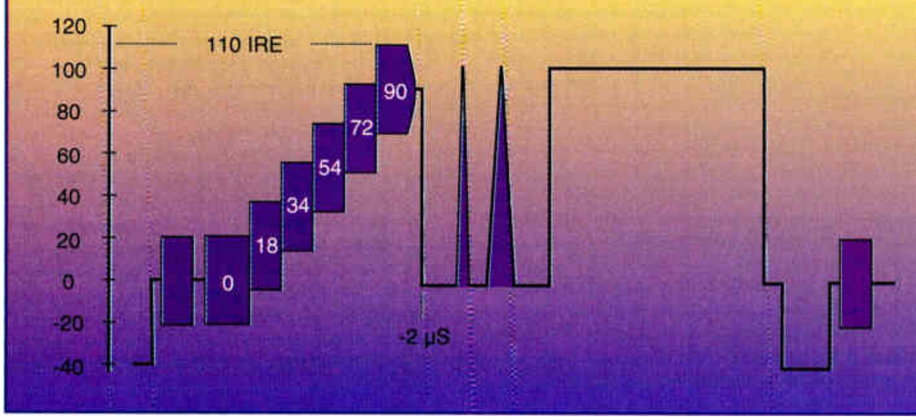
The FCC composite signal, on the other hand, seems intended for terrestrial broadcast. Indeed, it's called the "composite *radiated* signal" in the *NAB Engineering Handbook*.[10]

Other differences between the FCC and NTC composite signals are the order of occurrence of the test signal elements. In the FCC composite signal the modulated stairstep comes first, while in the NTC composite signal it comes last. The 12.5T $\sin^2$ pulse occurs in the middle of the signal for both, but the timing of the center of the pulse after the leading edge of the sync pulse is 39.2 µs for the FCC composite and 37 µs for NTC composite signal. In general, these timing differences should not matter to the cable TV operator. However, the amplitude differences of the fifth modulated stairstep does matter. This issue will be covered later.

Both composite test signals also include two other features called the bar and the 2T pulse. The 2T pulse is the short pulse occurring just before the 12.5T $\sin^2$ pulse. It is used for measuring short-time waveform distortion. The bar is a relatively long period of time with the signal at the white level. Both of these features are used in other video tests not called for in cable TV by the FCC. However, the bar is useful in cable TV for measuring depth of modulation.

Figure 7 illustrates a now rare but not completely absent test signal developed by the Satellite Technical Operational Committee and reported on in the early 1970s.[11] This reference says its purpose was to "test microwave radio relay systems." Another reference[12] says it was for "testing satellite NTSC transmission." It is strikingly similar to the FCC composite signal and can be easily mistaken for it. The differences, however, between the STOC and FCC composite signals are the chroma peak amplitude in the fifth stairstep, and a 2 µs shift forward in time of the rest of the signal components after the fifth stairstep.

Figure 7: STOC composite signal



The main reasons to bring this up here are that the chroma level on the fifth stairstep, like the NTC composite, reaches 110 IRE. The other reason is that I recently saw this signal, or something very similar to it, on an over-the-air signal in Arkansas. As will be discussed later, chroma at 110 IRE can lead to overmodulation and clipping, thus compromising the differential gain and phase tests. And the fact it has been seen means it's lurking out there threatening to confuse the situation.

A bit of test signal history

Taylor[13] writes that in the 1950s and 1960s TV network video feeds carried by the Bell system to TV broadcasters sometimes became impaired. Attempts to locate the source of the impairment could lead to finger-pointing between Bell system and TV broadcaster personnel. To help resolve this problem the National Transmission Committee was formed. This committee consisted of engineers from ABC, CBS, NBC, PBS and AT&T and produced the well-known *NTC-7 Engineering Report*.[14]

Jenkins[15] wrote that in 1966 the NTC was considering using both fields of Lines 18 and 19 for vertical interval test signals (VITS). Field 1 of Line 19 was to carry a "sine-squared signal" defined as a 2T pulse and bar. (No 12.5T pulse yet.) Field 2 was to carry a modulated stairstep. These two signals were later combined with the 12.5T pulse onto a single line.

Rhodes[16] wrote that in 1965 P. Wolf introduced the 20T modulated $\sin^2$ pulse in Munich, Germany. Rhodes then proposed that a 12.5T pulse was more appropriate for NTSC. He also developed a number of nomographs for determining CLDI from the amplitudes of the distortion of the pulse baseline.

Using the composite test signal

Figure 8 on page 66 shows measurement setups. The three color tests can be measured at the output of the final headend combiner using a directional coupler. They also can be obtained from the input test point of the first trunk amp.

The traditional equipment needed is a precision demodulator, waveform monitor or TV triggered oscilloscope for the CLDI tests and a vectorscope for the differential tests. The previous pieces of test equipment are available in a wide range of performances and costs. Alternatively, a new spectrum analyzer has recently come to market that combines these three color tests with the traditional cable TV test capabilities in one portable unit.

VITS testing

VITS, as opposed to full-field, allows measurements to be made on the equipment in service. This minimizes service disruption and when programmer-supplied VITS are used, the result is an indication of the actual signal quality delivered to the subscriber.

Substitution full-field testing

Another option for doing the color tests is to substitute temporary headend signal processing equipment into

"As of June 30, 1995, the color rules will apply. Chroma delay shall be within 170 nanoseconds, differential gain shall not exceed ±20%, and differential phase shall not exceed ±10°."

the signal path of the channel to be tested. The equipment substituted for would include channel filters, processors, modulators and any other components in the signal path that would have narrowband enough amplitude and/or phase characteristics to affect the color measurements. As with trunk and feeder equipment, headend switching and combining equipment generally should not affect the color tests.

This method would limit service interruption to the time to change cable connections. This would allow bench testing using a full-field test signal. Other advantages of this method are not needing a VITS inserter in order to maintain service and because of full-field testing, having the ability to test over the full range of average picture level (APL) as recommended in the *NAB Engineering Handbook.*

The actual processes for making these measurements have been well explained by other authors. The purpose of this article is to explore the in-service options available to the cable operator for obtaining the composite test signal and analyze the merits of each option.

Satellite, LO channels

The first point at which the cable TV operator has any control over a satellite or local origination (LO) signal is as it is delivered as baseband either from a satellite receiver or from another source such as a VTR or text generator. If a composite signal is present in the signal it may or may not be usable. If not, a VITS inserter can be placed in the baseband video path at this point. (See Figure 9 on page 68.)

Recently a VITS survey was done

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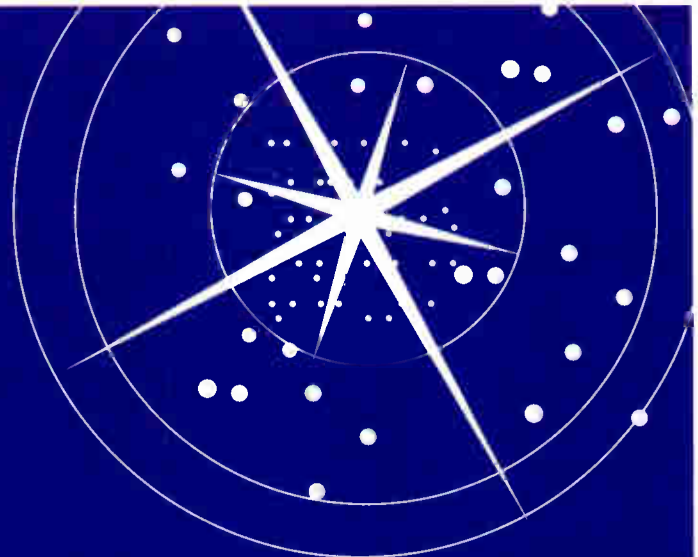

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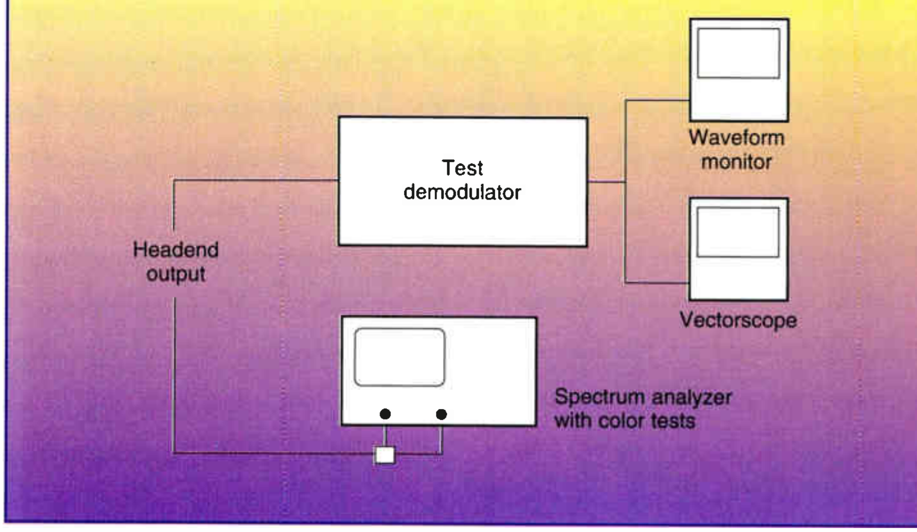
Reader Service Number 30

for the NCTA of 118 satellite services by Reed-Nickerson.[17] It was found that 33% had the FCC composite signal, 33% carried the NTC-7 composite signal and 40% had no composite signal at all. (There were some that carried both composite signals.)

It is attractive to use the satellite programmer-supplied test signal because it is convenient and does a complete end-to-end test. If the result is within test limits, not only are the FCC requirements met, but the cable operator can have greater confidence in the final quality of the product at the subscriber terminal (ignoring the effects of a converter). A potential inconvenience, though, is that the test signal can be interrupted or changed because of programmer or local signal switching. Local ad insertion is a prime example.

Since initial indications are that satellite programmer-provided composite VITS can be a usable (if not always continuous) signal source for the cable color tests, one hopes that more satellite programmers will carry the composite VITS.

Figure 8: Measurement setups



Over-the-air channels

Channels using processors present a bit more of a challenge. While broadcasters are more likely than other sources to have a composite signal, VITS derived from over-the-air channels tend to be more impaired than when delivered by satellite. This may mostly result from impairments in broadcast transmitters multiplexers and/or effects of multipath. This increases the likelihood that VITS will have to be inserted. But the composite VITS will have to be inserted at RF at the input to the processor in order to do the test properly. This requires the use of a test modulator in addition to the VITS signal generator. See Figure 10 on page 70.

To insert VITS into an RF signal it must first be demodulated, VITS inserted, then the signal is remodulated to RF and connected to the processor input. In this case the demodulator does not need to be precision. It merely needs to supply a good enough signal to carry the inserted VITS and keep the channel in service during the period of the test. An agile demodulator is the best choice because the audio path is most easily managed. In a pinch, a VCR or TV set with a baseband video output could be used. However, the audio would most likely be available as left and right and not a composite audio signal at 600 ohms.

Modulators

To my knowledge, one cannot buy a "precision" video modulator specifically designed for testing. Precision demodulators for testing are available, but not their reverse function. Therefore, the operator must make do by buying a modulator with good specifications then verifying its performance with a precision demodulator.

However, at least a couple of cautions must be observed. Bowick[18] reports that many modulators used in cable TV may not have CLDI predistortion circuitry. If the measurement assumes predistortion is present, the results can be off by 170 ns. Since the FCC requires this predistortion of broadcasters, it almost certainly is as-

suming that predistortion will be present in the signal delivered to cable subscribers. It may be hard to justify use of modulators without it.

What we are considering here is defining a modulator to be used for testing. But what about headends now populated with modulators without CLDI predistortion? This issue (and how it relates to the concept that the cable TV operator is not to change CLDI by more than 170 ns nor is the operator charged with fixing a bad signal) is beyond the scope of this article.

Another modulator issue is peak clipping. Some modulators used in cable TV limit modulation to 90-95% to avoid overmodulation. Recall that the NTC and STOC fifth stairsteps have chroma amplitudes at 110 IRE. Even when depth of modulation is correctly set to 87.5%, this fifth stairstep could cause the modulator with modulation limiting to reduce the chroma amplitude. This will significantly affect the differential gain measurement. The NCTA recommended practices document addresses this by stating: "If the modulator under test contains a clipping circuit (90% modulation) ignore the fifth step in a five-step signal." Using the FCC composite test signal and making sure depth of modulation is properly set minimizes the effect of this problem.

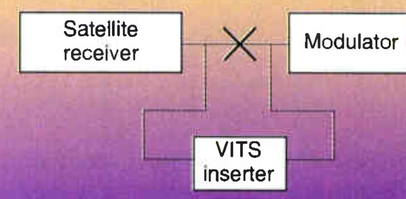
A last caution is that if using a precision test demodulator, the test modulator must have a stable enough carrier for the precision demodulator to be able to phase-lock to it. It has been seen that at least one state-of-the-art agile modulator is not stable enough for a top-of-the-line precision demodulator to phase-lock to it. *(Editor's note: The problem is common in many agile demodulators.)* As noted later, phase-lock is needed for synchronous detection, which is required for some tests. (At this time, I have no data on the potential extent or seriousness of this issue.)

In summary, when choosing a modulator to be used as a reference test modulator, chroma-luminance predistortion must be present, white clipping would ideally not be functioning, and it would have a stable carrier output.

Demodulators

Synchronous vs. envelope detection is an issue that deserves attention. Rhodes[20] writes that synchronous detection can be used for all video measurements as long as incidental carrier phase modulation (ICPM) and static phase error are known to be negligible on the signal to be tested. Excessive ICPM can make differential phase measurements read artificially high with true synchronous detection. In this case envelope detection may help. Static phase error can affect CLDI, however, it still must be measured using synchronous detection.

Figure 9: Satellite channel VITS insertion



Rhodes goes on to say that depth of modulation when measured at baseband with synchronous detection can be strongly affected by ICPM. He suggests envelope detection here but cautions that envelope detectors are usually quite nonlinear at low (white) carrier levels. I suggest that since depth of modulation is such an important setup parameter for the color tests, that it be measured at RF using a spectrum analyzer. This relatively narrowband technique uses envelope detection and a calibrated linear scale to avoid problems with ICPM and linearity.

In summary, when making color measurements with a test demodulator, it must be capable of synchronous detection that must be used for all tests except for differential phase and depth of modulation, which may use envelope detection if the signal under test is impaired by ICPM. Additionally, the test demodulator must be capable of phase-locking in synchronos mode to the test visual carrier signal.

Conclusions

The intent of this article was to identify the assumed few subtle issues that might arise when doing the color tests in the cable TV environment. Unfortunately, a search of the available literature uncovered more subtleties than anticipated. It is hoped that most if not all of the issues raised here will prove to be minor in practice. Until experience proves otherwise, though, here is a summary of some of the things to watch out for:

1) Depth of modulation has to be set to 87.5%. Broadcasters shoot for 85-90%.

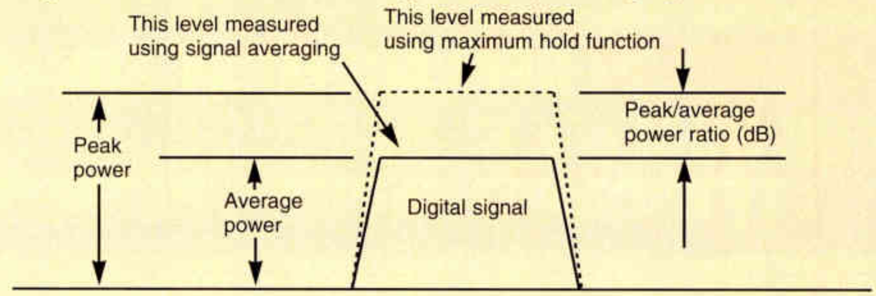
yields results that are within 1 dB of each other.

Although one need not correct for analyzer bandwidth when measuring digital C/N, it is still important to correct for errors caused by the analyzer noise floor. When making this measurement, it is necessary either to apply a correction for the analyzer noise floor or to make certain that the system noise floor is sufficiently above the noise floor of the analyzer so as not to require a correction. For most analyzers, if the difference between system and analyzer noise floors is on the order of 10 dB or more, no correction is required.

Peak-to-average power ratio

All of the measurement techniques discussed in the previous paragraphs have dealt with the average power of the digital signal. However, the digital signal can have peak excursions that exceed the average power level by 6 or 7 dB. When setting the power level of a digital signal, it is desirable to know the peak power as well as the average power so as to avoid signal distortions that could create intersymbol interference in the demodulated data.

Figure 3: Measurement of digital peak/average power ratio



This measurement can be made rather easily if the analyzer incorporates both signal averaging and "max hold" functions. A number of analyzers have these features built into the instrument. If the analyzer is equipped with these, peak-to-average power ratios can be measured using the following procedure:

- Use the signal averaging capability of the analyzer to obtain an average value of the digital signal power. Note this value.
- Disable the signal averaging function and enable the max hold function. Note the peak value of the digital signal.

The difference between these two readings is the peak-to-average power ratio. This method also yields results that are quite close to those obtained using more sophisticated techniques. The technique is illustrated in Figure 3. When making this measurement, the averaging and max hold functions should be applied for a sufficient time duration to assure accurate results.

The spectrum analyzer has been a useful tool for analog signal measurements for many years. When digital signals appear on cable, there is no reason why the same equipment cannot be equally useful for measurement of digital signal characteristics. **BTB**

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Reader Service Number 63

A survivor's guide to BCT/E exams

By Robert E. Baker
Chief Technician, TCA Cable TV

Back in June 1993, the call went out for volunteers to serve on working groups to review and rewrite the Society of Cable Television Engineers Broadband Communications Technician/Engineer (BCT/E) examinations. I answered the call and got involved. The goals are:

- To review and edit the outline for each category to remove or add subject areas as thought necessary due to changes in our technology.
- To review all existing exam questions with a view to updating if required, removing if no longer applicable and assuring that each question fits into the examination outline.
- To create an additional pool of new test questions appropriate to both the outline and today's technology. It is hoped that we will be able to generate a pool of at least 250 questions for each level of each test category (with Category VII being the only exception). A quick calculation would disclose that a pool of some 3,000 questions covering both levels in the first six categories will be created. You can easily see that these questions will thoroughly cover our field of endeavor.

Before you start

Every individual who is planning on taking examinations should first recognize the BCT/E program for what it is. This is not a simple "certification" program. It is really intended to do more. This program will force every BCT/E candidate to learn about all of the things that go into a broadband communications system and about all the applications for which the system may be used.

I hesitate to venture a guess of just what percentage of our technical population has worked in systems having all the bells and whistles, but you can bet if there are any, that percentage will be in the single digits. What I am trying to say is that most of us have a very limited exposure to broadband communications and that exposure is usually limited to the system you are in. (I have over 12 years CATV experience with four major MSOs, but all in one city.)

"I sincerely would advise anyone to start at the technician level even if your goal is to become certified at the engineer level."

So then, just how does one prepare to sit for the examinations with a hope of successfully completing all of them? Here's my recommendations based on my experiences. (I have taken all exams successfully at both levels, proctored exams for several years and have seen what can result from not being fully prepared. I am currently on the Category I Working Group.)

Step 1 — Get organized

Decide which level best suits your needs and experiences. I sincerely would advise anyone to start at the technician level even if your goal is to become certified at the engineer level.

Once you have decided, get a copy of the examination outline that will tell you what areas are covered on the exam and also provide you a bibliography of the sources used in creating the questions. Use these as your study guides and don't assume you know all you need to about any of the topics in the outline.

Step 2 — Gather material

Gather all or as much as you can of the reference materials listed in the bibliography for the exam you plan on taking. It is very important that wherever possible you use these books or articles. Every book or article in the bibliography will have information telling you the source from which you may obtain copies. (Please refer to the June 1992 issue of the SCTE monthly membership newsletter, *Interval*, for the most recent outlines and bibliographies. You must be a national member of the SCTE to receive the newsletter.) As our tests are updated, look for the SCTE to publish an updated guide, also in *Interval*.

Step 3 — Read all you can

Using the outline, starting at the beginning and using the reference material, begin reading all you can find on the first topic. Make sure you have a thorough understanding of the topic before moving on to the next. (Don't pile snow on top of snow.)

Never assume that since you have the reference materials, you are ready for the test. I know what you're thinking. You're probably saying, "Why do I have to study all of this? It's an open book exam isn't it?" Trust me! Open book exams are probably the hardest of all. The intent here is that you learn the material and apply it to answer the questions. In most cases, that is how your answer will be found, by applying the material learned. So again, learn the material.

Step 4 — Familiarize yourself with references

Once you have familiarized yourself with the topics, be sure to familiarize yourself with the reference materials. Know your way around them. Some have a table of contents in the front and an index in the back. Not all have indexes, but if they do these are usually more detailed and helpful in finding a topic than the table of contents, which is usually limited to chapter headings or title of major subject areas.

It was not intended for the entire contents of each book listed in the bibliography to be "digested" before sitting for the examinations, only that the topics in the outline be learned. Most books cover much more information than will be referred to in the outline and can cover information applicable to several test categories. Zero in on one category at a time. One suggestion may

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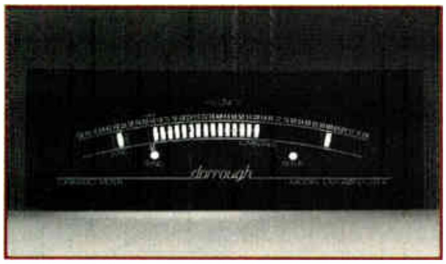


Video level meter

The new 40-N video level meter from Dorrough Electronics performs fast evaluation of picture luminance levels and features a 40 segment LED bar graph. Thirty LEDs represent 0 to 120 IRE on which an operator can read a mathematical computation of the waveform translated into peak and average luminance. The 10 remaining LEDs indicate sync level. There are sync and setup violation LEDs.

Like the waveform monitor, the peak/average feature allows evaluation of lighting conditions, contrast, dropouts and general picture quality, but with the ease of interpretation of a single meter scale. Several alarm closure functions are available. Additionally, the Model 40-P/S is scaled in volts and displays blanking.

Reader service #209

Buried closure

A new easy-to-install closure for protecting buried cables featuring a flexible end cap system and force-tilled encapsulation is now available from the 3M Telecom Systems Division. The re-enterable and reusable 900 Series buried closure protects in-line, tap and butt splices, sheath repair and buried service wire installations against harsh environmental conditions including water and back filling damage, frost heaves, soil shifts, oil, ground chemicals and extreme temperature changes.

The unit features a unique variable closure body that adjusts to fit the diameter of any type of buried splice, and its simple design has fewer loose parts than other models on the market. Both factors contribute to time and money saved by reducing inventory, simplifying installation and requiring less fill compound than other systems. Further, connectors can be identified through the translucent body and encapsulant, making re-entry fast and easy.

Other features include: raised fill-ports on the body that ensure moisture-tight encapsulation; adjustable closure diameter, reducing compound usage; gel end seals that tightly secure the closure system and allow for multiple cable port configuration with a single end seal; strain relief bond bars that provide a continuous current path and cable stress relief across the splice opening; spacer mesh that centers splice connectors in the closure, ensuring that compound flows around the complete bundle; unique variable diameter design that accommodates splice bundles ranging in size from 2 to 7 inches, simplifying inventory and installation; and a buried closure kit that simplifies stocking by having all necessary parts in one package.

Reader service #206

Demodulator

Tektronix Inc. announced the TV1350 TV demodulator, designed for precision test and measurement in high-performance cable TV applications. The unit is manufactured by Rohde & Schwarz GmbH & Co. KG and will be sold under joint company labeling. Tektronix provides service and support.

The unit is one of three new TV1300 Series products. They replace Tektronix 1450 Series demodulators, which are being phased out of the company's product line. The new TV1350, available for a range of worldwide TV standards, features switchable envelope and synchronous detection, quadrature output for ICPM measurement, zero carrier reference pulse and selectable sound trap.

The unit is continuously tunable from 54 to 880 MHz and offers an optional GPIB interface. It is designed for cable and off-air measurements and can be used as a tunable relay receiver.

Reader service #180

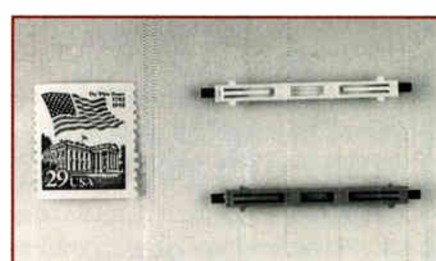
OTDR test platform

EXFO announced the OTDR kit universal test platform, a toolbox of fiber-optic test equipment, configurable to fit almost any fiber testing need. Combine any three of the following test cards: single-mode OTDR, multimode OTDR, automatic attenuation meter and fiber-optic talk set. A CW light source or visual fault locator plus a power meter also can be added. The entire platform is run by a compact, notebook computer that can run other computer applications.

The card-based unit has all the features of a conventional OTDR: full fiber analysis, real-time averaging, event zooming, signature overlay, two-point analysis and splice loss measurement. All our test cards are powered by user-friendly, intuitive software designed with the user in mind.

Other features include: trace management software (DocuNet), mass storage capability, large display, easy mouse or keyboard operation, files and batch printing, and complimentary software upgrades.

Reader service #205



Splice

Advanced Custom Applications Inc. has developed a mechanical splice used mainly for testing fibers in a controlled environment. The LABsplice is available for single-mode or multimode applications and comes preloaded with index

matching gel. The user may add index matching gel and disassemble the splice in case of fiber breakage. The unit requires no special tools or fixtures to operate and accepts any combination of buffer sizes 250-900 microns.
Reader service #204

RF wattmeter

The new Telewave RF wattmeter from Jensen Tools Inc. introduces an improvement in the efficiency of communications field testing. It offers the same test features as the Model 43 Bird wattmeter, but needs no additional slugs or inserts for different power levels and applications. It requires no band switching.

The unit specializes in 25 to 1,000 MHz broadband. It has five scale ranges (5, 15, 50, 150 and 500 W) and provides direct measurement of forward and reflected power with type N in-line connection. The instrument makes an excellent tool for any two-way communications testing, from low-power handheld units to powerful mobiles and bases. It covers cellular bands and most remote and control links. Basic meter accuracy is ±5%. The unit is offered with optional carrying case and 60 W dry load cell.
Reader service #194

Threshold extension

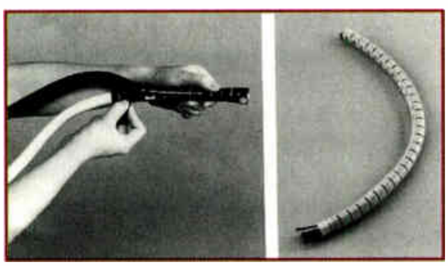
The R.L. Drake Co. announced an enhancement to its ESR300e receiver: programmable threshold extension providing less than 4 dB carrier-to-noise. The company has enhanced the receiver's performance to improve reception of weak or noisy signals. Adjustable threshold extension permits programming the effective dynamic IF bandwidth of the receiver, thereby improving the minimum signal quality threshold of the receiver.

The extension can be programmed into memory of desired channels or adjusted from the normal operating mode, and is independently adjustable from one channel to the next. The operator can choose the setting that reduces any noise in the picture. Picture quality is maximized with the least video distortion for the available signal strength. The extension is available for either 18 or 27 MHz IF bandwidth setting.

The ESR300e is a versatile, 225 programmable channel remote-controlled receiver capable of multistandard operation. While the unit features less than 4 dB C/N typical at maximum threshold extension, the receiver boasts less than 6 dB C/N typical with no threshold extension.

Features include stereo audio with advanced audio noise reduction and companding circuitry compatible with Wegener audio transmissions, dual input tuner for multiple LNB connections, expanded input frequency range from 950 to 2,050 MHz, multi-voltage AC input (220 V, 240 V), two SCART connections for multiple decoder operation, a video recorder timer and a built-in antenna positioner for motorized installation.

Programming and operation of the receiver is made simple through a series of selectable, multilingual on-screen menus. In addition, the receiver features programmable video invert selection via the remote control, allowing the operator to select, and program into memory proper operating parameters on a channel by channel basis.
Reader service #203



Harness wrap

Richco Plastic Co. introduced the Slit Harness Wrap, designed to wrap wires, rubber hoses, cables or any tubular device in a protective enclosure. It is easy to install with a specially designed tool for the particular size wrap. The slits in the wrap allow for flexible installation and maintenance. The black version is reusable and manufactured in Nylon 6, RMS-63.
Reader service #192

Underground tape reel

CableTek Wiring Products introduced Tape Tender, a lightweight rugged reel that securely holds 1,000-foot rolls of 2- or 3-inch underground tape. Durable and easy to use, the unit is self-storing and has a built-in, quick cutter. The reel virtually eliminates tangled, twisted and wasted tape, and is economically priced to allow equipping every truck and saving costs. The unit can be customized to order.
Reader service #202

Portable printer

Fotec Inc.'s new P310 portable printer allows the company's FM300 Series fiber-optic power meters to print hard copy results of measurements. The meters are used to measure optical power and loss in fiber-optic networks.

The printer prints out the meter reading a form for the operator to record other pertinent data, such as the identification of the components being measured. The record can be kept for proof of testing, as is often required by customers.
Reader service #193

Visual fault locator

Photon Kinetics announced the 7800 visual fault locator, part of a new line of rugged hand-held fiber-optic test and measurement equipment. The unit is simple to operate, designed to quickly locate breaks or bends in jacketed or unjacketed fiber-optic cables. It is pulsed at a 1 Hz rate that allows the operator to easily find the cable damage even in the brightest light conditions. This makes it ideal for troubleshooting fiber in splice cabinets/enclosures where breaks are typically within an OTDR's dead zone, simplifying fiber continuity checks in the field: just connect the fiber, turn on the 7800 and follow the red light. The unit can operate either with

standard rechargeable batteries, alkaline batteries or the AC charger/adapter.
Reader service #201

Optical fiber identifier

Wilcom Inc., a subsidiary of NAI Technologies, is now offering the F6222C hand-held optical fiber identifier, a rugged, easy-to-use installation and maintenance instrument designed to identify a specific optical fiber by detecting one of three frequency modulated optical signals being transmitted from a separate source. The unit is clamped on an optical fiber instead of cutting in. This eliminates costly service interruption and downtime.

Also, the unit is able to perform core power measurement and has a dynamic range of 20 to -20 dBm. By simplifying fiber-optic communications link testing, the unit allows fiber installers to reduce the amount of test equipment necessary to do the job.
Reader service #200

Router

LANcity Corp. has designed and manufactured the LANcity Router (LCR) data communications router to provide citywide Internet access using standard, existing cable TV infrastructure. It is the first technology enabling cable TV connectivity to the Internet, according to the company, and creates a 70-mile, high-speed path to the information superhighway, delivering a full symmetrical 10 Mbps of data transmission utilizing any nationwide Internet service provider at the cable TV headend. The unit offers connectivity six to 1,000 times the capacity provided by most telephone companies through which Internet data transmission currently takes place.

It migrates cable TV from the entertainment industry to the information industry and expands local area networks (LANs) from their 2-mile limit to 70 miles and provides connectivity between the lowest cost computing LAN — Ethernet — and the highest possible bandwidth pipeline — cable TV.

Dual IP routing and bridging functionality makes the product ideally suited to citywide connectivity for educational facilities, corporations and government-installation networks requiring routing and bridging capabilities.

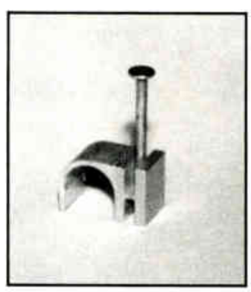
LCR is supported by industry standard protocols, including IP standards, the simple network managed protocol (SNMP) and the IEEE 802.1(d) Spanning Tree. It will forward IP protocols based on IP addressing and will transparently bridge all other protocols. Simple hardware installation and user-friendly, Windows-based software upgrades are facilitated by established protocols.

The unit supports both single and dual cable plants providing 10 Mbps of symmetrical data transmission. Because it is frequency agile, LCR operates in any of 83 available, standard 6 MHz channels over a frequency range of 10-174 MHz TX and 54-550 MHz RX.

Similar in size to a cable TV converter, the unit is installed at each site between cable TV lines and Ethernet connections to LANs.
Reader service #199

Power supply enclosures

Performance Cable TV Products introduced a series of power supply enclosures for both aerial and ground mounting. The pole-mounted cabinets are built of heavy gauge aluminum while the pedestal units are made of high-security steel to discourage illegal entry.



The aluminum and steel units are identical and may be used interchangeably depending upon circumstances. The units are shipped with pole-mounting brackets that also fit the steel version and may be ordered as an option, if needed. The cabinets come complete with wiring harness and hardware and are simple to install. Power supply modules are located in the upper half of the enclosure while the batteries are in the lower compartment. Generous ventilating louvers provide optimum cooling so the power supply modules normally do not require fans.
Reader service #198

Fiber-optic laser source

The new LightScan model LST 2135 stabilized laser source features a single port design for testing at both 1,310 and 1,550 nm without the need to change connections. The output power is stabilized to provide accurate, repeatable performance for all applications. Versatile power options include an AC wall cube, rechargeable NiCads or alkaline batteries.

The unit can transmit a continuous wave, a modulated wave at 270 Hz, 1 kHz or 2 kHz, or automatically scan the modulated frequencies. A built-in stand allows hands-free operation and continuous self-testing assures accuracy. The unit has a 24-month warranty.
Reader service #191

Microwave signal generators

Anritsu Wiltron unveiled the 68200B and 68300B synthesized signal generators that combine high performance and economy. The 68200B delivers precise CW and internally or externally driven AM, FM and pulse-modulated signals for complex receiver testing applications. Output frequencies may be digitally or manually swept. The 68300B adds analog sweep capability for high-speed network analysis. Both synthesizers feature 1 kHz frequency resolution (0.1 Hz optional), low SSB phase noise, wide dynamic range and fast switching times.

Both units are available in six models covering different frequency ranges. Units installed with Option 15 deliver higher leveled output power over the 2-26.5 GHz bands than available from the standard units.
Reader service #195

Digital video

Wegener announced a real-time, compressed, digital video product family. Ideal for point-of-use transmissions such as video conferencing and distance learning, the DVR Series product family uses MPEG-1 encoding to achieve exceptional picture quality while minimizing transmission cost. When couples with the company's MPEG-2 digital audio encoders and decoders, DVR Series products represent a powerful and efficient means to transmit combined video, audio and data at T1 rates.

The series will deliver full-motion SIF

resolution video with associated CD-quality audio and multiple auxiliary data channels within a T1 channel (1.544 Mbps). The series consists of encoders, decoders and single-channel-per-carrier integrated receiver decoders (SCPC IRDs). Compatible with the company's Addressable Network Control System (ANCS), these products provide flexibility and control unavailable in conventional broadcast networks. Addressability combines the precision of point-to-point communications with the economies of a point-to-multipoint broadcast.

The DVR Series digital video encoder converts NTSC or PAL composite video, Super VHS or component video (YUV) to compressed video format. Other user inputs include a synchronous data channel and an RS232 asynchronous data channel. The unit also accepts digitized audio from a company MPEG digital audio encoder and a second asynchronous control channel from the company's ANCS. All digital signals are multiplexed into a single data stream for transmission.

For transmission over satellite, a modulator applies forward error correction before modulating the data on a QPSK carrier. This carrier is then ready for final upconversion and amplification by the satellite transmission system.

The digital video decoder reconstructs digitized video and associated audio into an analog format. The unit may be ordered with NTSC, PAL, Super VHS or component (YUV) outputs, as well as CD-quality audio. Auxiliary outputs include a 16 kpbs synchronous data channel and two asynchronous data channels.

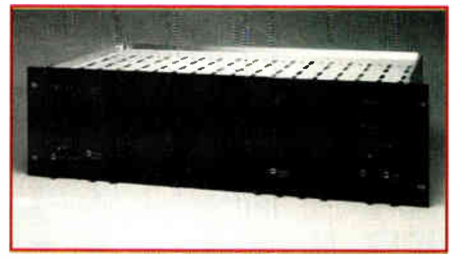
The digital video SCPC IRD integrates the digital video and audio decoders into an L-band SCPC receiver to allow direct reception from C- or Ku-band satellite networks with full function addressability. Also, it provides an external interface allowing extensive diagnostics and control.

Reader service #196

Fiber-optic closure

The new Keptel LG-500 72-fiber aerial weather-tight fiber-optic closure offers a low-cost, lightweight splicing system that provides fiber routing, protection and security for up to a 72-fiber splice with all ancillary drop cables. The outer case provides self-supporting aerial strand hangers and weather protection utilizing the company's back-to-back sealing grommets. A unique "wick-away" tongue-in-groove case channels water down, out and away from case joints. The integrated mini frame and tray holder assembly accommodate from one to three fusion splice trays and provide cable strain relief clamps and central strength member tie-downs for up to four cables.

Reader service #178



Fiber-optic links

Fiber Options Inc. announced its Series 1240B fiber-optic links for transmitting video and stereo audio signals incorporating 18-bit digital audio signal processing technology. Systems in this series utilize state-of-the-art technology to convert video and two channels of stereo audio to reliable broadcast-quality digital signals that are transmitted over a single optical fiber. The signals are then reconstructed without degradation. Employing

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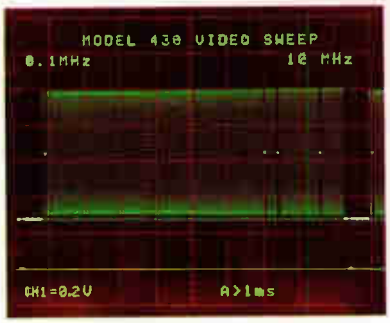

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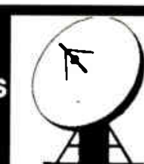

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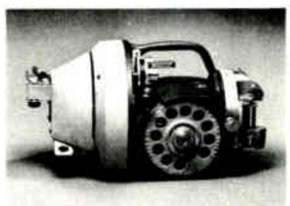

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A. Are you a member of the SCTE (Society of Cable Television Engineers)?
01. ___ yes
02. ___ no

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 expenditure?
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 Meters
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

COMMUNICATIONS
TECHNOLOGY

September 1994 HJ2

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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	282	308
23	49	75	101	127	153	179	205	231	257	283	309
24	50	76	102	128	154	180	206	232	258	264	310
25	51	77	103	129	155	181	207	233	259	285	311
26	52	78	104	130	156	182	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 expenditure?
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

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BOOKSHELF

The following is a listing of some of the 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.

☛ *Video Waveform Measurements* — Using actual equipment setups, various measurements are discussed. Topics include baseband video, demodulators, envelope-type detection, synchronous detection, depth of modulation on radio frequency (RF) signals and zero choppers. Full-field video waveform testing includes multiburst, depth of modulation, sine pulse, 2T window, field rate square wave and tilt. Includes information on use of vectorscope, average picture levels and video signal-to-noise. (30 min.) Order #T-1008, $35. **(This video is a reference for BCT/E Category II.)**

☛ *Safety Awareness Around Electrical Conductors* — Using slides, movies and demonstrations, this videotape provides information about the hazards of working around power. It reviews amperage and its effects and graphically depicts the results of injuries and burns. Clearances and dangers of energized conductors are discussed. Power line handling techniques, clothing, flashes and insulators, wire, aerial and underground cable and wire, conductors and their hazards are included. This program was produced by the New Jersey Cable Television Association with the cooperation of the Office of Cable Television of New Jersey, New Jersey Bell, Public Electric and Gas, Suburban TV-3 and Maclean Hunter. (30 min.) T-1016, $35.

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. 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 March 1994 issue of the Society newsletter, "Interval."

CALENDAR

September

8: Society of Cable Television Engineers Satellite Tele-Seminar Program, *An Overview of the Society's BCT/E Program (Part 1)*, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. EDT. Contact SCTE national headquarters, (610) 363-6888.

8: SCTE Gateway Chapter seminar, headend in the sky and digital compression, Overland Community Center, St. Louis. Contact Duane Johnson, (314) 272-2020.

8: SCTE New Jersey Chapter seminar, cable competition, Wayne, NJ. Contact Linda Lotti, (908) 446-3612.

11-12: SCTE Old Dominion Chapter seminar, BCT/E Category IV, Distribution Systems and tour of Media General's facilities, Installer and BCT/E exams to be administered, Continental's Anniston office, Richmond, VA. Contact Maggie Fitzgerald, (703) 248-3400.

12-13: First Annual Cable Television Conference, The Carlton Hotel, Washington, DC. Contact Frost & Sullivan, (800) 256-1076.

12-14: The Telco-Cable VI Conference, Washington, DC. Contact (202) 842-3022.

12-15: Philips Mobile Training Center, Minneapolis. Contact (800) 448-5171.

13: SCTE Cascade Range Chapter meeting. Contact Cynthia Stokes, (503) 230-2099.

13: SCTE Desert Chapter seminar, data networking and architecture, San Goronio Inn, Banning, CA. Contact Greg Williams, (619) 340-1312, ext. 277.

13: SCTE Magnolia Chapter meeting, BCT/E and Installer exams to be administered, Ramada Coliseum, Jackson, MS. Contact Robert Marsh, (601) 932-3172.

13: SCTE Sierra Chapter seminar, SONET and ATM, ANTEC, Sacramento, CA. Contact Michael Meade, (209) 943-3256.

14: SCTE Great Lakes Chapter seminar, data networks, Holiday Inn, Livonia, MI. Contact Mary Gilliland, (810) 578-9445.

14: SCTE San Diego Chapter seminar, BCT/E Category V, Data Networking and Architecture, San Diego. Contact Kathleen Horst, (310) 715-6518.

14: SCTE Snake River Chapter seminar, system construction. Contact Mike Dudley, (208) 377-2491.

14: SCTE South Jersey Chapter seminar, CSR training/plant maintenance, Ramada Inn, Vineland, NJ. Contact Mike Pieson, (609) 967-3011.

15: SCTE Greater Chicago Chapter annual Cable-Tec Games and elections of new board of directors, Willowbrook Holiday Inn, Chicago. Contact Bill Whicher, (708) 362-6110.

15: SCTE Lake Michigan Chapter seminar, data/telephony, Days Inn, Grand Rapids, MI. Contact Karen Briggs, (616) 941-3783.

15: SCTE Penn-Ohio Chapter seminar, headend design and maintenance, Pittsburgh. Contact Marianne McClain, (412) 531-5710.

15: SCTE Wheat State Chapter seminar, Wichita, KS. Contact Jim Fronk, (316) 792-2574.

Planning ahead

Oct. 4-6: Atlantic Cable Show, Atlantic City, NJ. Contact (609) 848-1000.
Oct. 5-7: Pacific Northwest Cable Show, Spokane, WA. Contact (612) 641-0268.
Nov. 13-15: Private Cable Show, Atlanta. Contact (713) 342-9826.
Nov. 30-Dec. 2: Western Cable Show, Anaheim, CA. Contact (510) 428-2225.
Jan. 4-6, 1995: Society of Cable Television Engineers Emerging Technologies conference, Orlando, FL. Contact (610) 363-6888.

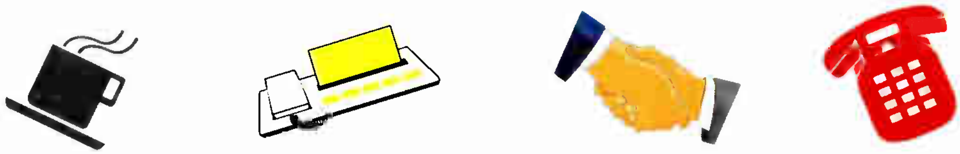
16: SCTE North Country Chapter seminar, Sheraton Midway Hotel, St. Paul, MN. Contact Bill Davis, (612) 646-8755.
17: SCTE Cascade Range Chapter seminar, BCT/E exams to be administered, Portland, OR. Contact Cynthia Stokes, (503) 230-2099.
17: SCTE Chaparral Chapter seminar, fiber demonstration. Contact Scott Phillips, (505) 761-6253.
19-21: Great Lakes Cable Expo, Indiana Convention Center, Indianapolis. Contact (317) 845-8100.
19-21: Society of Cable Television Engineers Technology for Technicians II hands-on technical training program for broadband industry technicians and system engineers, Chicago. Contact SCTE national headquarters, (610) 363-6888.
19-22: Philips Mobile Training Center, Madison, WI. Contact (800) 448-5171.
20: Hewlett-Packard CATV Measurements Course, St. Paul, MN. Contact (800) 472-5277.
20: SCTE Dakota Territories Chapter seminar, transportation systems, Custer, SD. Contact Michael Schmit, (605) 229-1775.
20: SCTE Floribama Meeting Group seminar, Holiday Inn, Crestview, FL. Contact Rylan Bishop, (205) 476-2190.
20: SCTE Oklahoma Chapter seminar, Oklahoma City. Contact Rick Martin, (405) 525-2771.
20: SCTE Pocono Mountain Chapter seminar, Holiday Inn, Hazelton, PA. Contact Anthony Brophy, (717) 462-1911.
20-21: Society of Cable Television Engineers Great Lakes Cable Expo technical sessions, BCT/E and Installer exams to be administered, Indianapolis. Contact (317) 845-8100.
21: SCTE Appalachian Mid-Atlantic Chapter seminar, fiber-optics update, Chambersburg Holiday Inn, Chambersburg, PA. Contact Ron Mountain, (717) 684-8607.
21: SCTE Dixie Chapter seminar, Montgomery, AL. Contact Charles Hill, (205) 880-1673.
21: SCTE Golden Gate Chapter seminar. Contact Mark Harrigan, (415) 358-6950.
21: SCTE Piedmont Chapter seminar, cable systems of the future, BCT/E and Installer exams to be administered, Hickory, NC. Contact Mark Eagle (919) 477-3599.
22: Society of Cable Television Engineers OSHA/safety seminar for system managers and safety coordinators on maintaining records and developing safety training programs, Chicago. Contact SCTE national headquarters, (610) 363-6888.
22: SCTE Chesapeake Chapter seminar, PCS/ wiring, Chantilly, VA. Contact Scott Shelley, (703) 358-2788.
22: SCTE Mount Rainier Chapter seminar, Bremerton, WA. Contact Bruce Gladner, (206) 869-4116.
23: Hewlett-Packard CATV measurements course, Cleveland. Contact (800) 472-5277.

The International Lounge at The Western Cable Show '94
November 30 through December 2, 1994
Anaheim Hilton Hotel, Anaheim, California

WELCOME INTERNATIONAL DELEGATES!

International Cable magazine and the California Cable Television Association cordially invite you to join us in "The International Lounge" to be held in the Anaheim Hilton Hotel during the Western Cable Show. The Western Show is one of the largest cable shows in the U.S. drawing more than 15,000 attendees and over 250 exhibitors.

The lounge will offer business center services, phones and fax machines, convenient meeting and relaxing space, special events, translation services and complimentary food and beverages throughout each day to international delegates at the show.



INTERNATIONAL LOUNGE SPONSORSHIPS

A limited number of sponsorships are available for the International Lounge. A lounge sponsorship offers companies that are involved in, or developing, international business a wide variety of benefits including the opportunity to meet international delegates face-to-face off the show floor, the services of the lounge, convenient space for conducting business meetings, access to translation and secretarial services and much more.

Sponsorship increases your visibility at this important show in a number of ways. Your company logo is prominently displayed on international delegate registration bags, advertising, promotions and signage for the International Lounge. Additionally, special events in the lounge are hosted by sponsor companies.

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FASTEN YOUR BELTS SEAT
94
THE WESTERN SHOW

Fundamentals of fiber

In previous issues, this column has answered questions on everything from fiber geometry to stimulated brillouin scattering. This month our fiber expert will go back to the basics and answer some commonly asked questions about the fundamentals of fiber — different types, how it works, etc.

By Don C. Vassel
Senior Applications Engineer, Corning Inc.

☛ I've heard about the long-term potential of deploying optical fiber, but with the Federal Communications Commission rate rollback, isn't it cost-prohibitive to install fiber right now?

No. Just the opposite. The cost of installing a fiber-optic system has dropped significantly over the past few years. And since transmission over fiber results in lower signal loss, cable TV operators can install fiber and eliminate the need for amplifiers and other active devices in cable TV systems.

Factor in fiber's other inherent advantages, including the potential for increased channel capacity and lower maintenance costs, and fiber deployment (in conjunction with existing coaxial cable at the drop) emerges as a very cost-effective way to accommodate existing services. For the consumer, that means better picture quality, more channels and fewer outages.

As a result, optical fiber is a very practical option today and for the future as cable TV systems evolve into full-service communications providers.

☛ What's the difference between single-mode fiber and multimode fiber? Which one will do the best job of optimizing system performance?

There are two types of optical fiber — single-mode and multimode. Both types of fiber consist of a core and cladding glass surrounded by a protective acrylate coating. The difference lies in their core sizes (the light-carrying region that runs down the center of the fiber). The cladding surrounds the core and keeps the light signal within the core. The acrylate coating is applied to the fiber to protect the surface of the glass from becoming scratched or flawed. The coating also shields the fiber from environmental factors that can result in microbending losses.

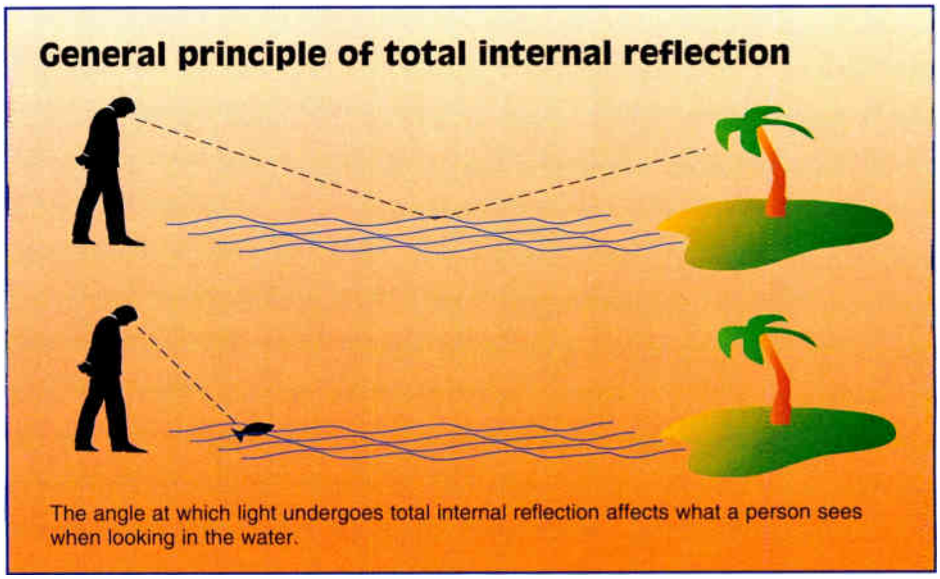
Multimode fiber comes in several core sizes and has a larger core, which allows hundreds of light rays or modes to propagate down the length of the fiber. Single-mode fiber has a much smaller core and as the name suggests, allows only one mode of light at a time to travel through the core. Additionally, single-mode fiber is optimized for 1,310 nanometers (nm) and has near-zero dispersion at this wavelength.

Despite its smaller core, standard single-mode fiber has a much higher information carrying capacity than multimode fiber. With only one mode traveling through the core, single-mode fiber can maintain better signal quality over longer distances. Multimode fiber, however, is subject to modal dispersion, which occurs when multiple modes traveling through the fiber arrive at different times.

These attributes make single-mode fiber extremely attractive for most cable TV applications. With virtually unlimited bandwidth, fiber will provide the basis for a wide array of future services and will offer solutions for cost-effective upgrades.

Since multimode fiber is subject to modal dispersion over long distances, it is best suited for shorter distance (<2 km), lower data rate applications such as local area networks (LANs) and fiber-to-the-desk.

☛ How exactly does optical fiber work?



The angle at which light undergoes total internal reflection affects what a person sees when looking in the water.

Optical fiber works on the principle of total internal reflection (see the accompanying figure), which occurs when light is reflected at an interface between two materials with different indices of refraction. Think of looking at a body of water. Looking down at a steep angle, one can see fish, the rocky bottom and other objects in the water. Glancing across the water at a less steep angle, one can see the reflection of trees and other objects located on the opposite side.

Since air and water have different indices of refraction, the angle at which a person looks at the surface of water influences what is seen. In some cases the surface acts like a mirror. The same principle applies to optical fiber.

Since the fiber's core and cladding glasses have different indices of refraction, light waves are guided through the core of the fiber by being reflected back and forth within the core to allow for total internal reflection. **CT**

Readers with fiber-related questions can send them to: Ask a Fiber Expert, c/o Communications Technology, 1900 Grant St., Suite 720, Denver, CO 80203; fax (303) 839-1564.

The impacts of cable regulation

If you would like to speak to the author of this column, he can be reached at (202) 728-0001.

By Thomas K. Crowe, Esq.
Communications Attorney
Irwin, Campbell & Crowe

The technical changes in the provision of cable service wrought by the regulations promulgated by the Federal Communications Commission, under authority of the Cable Consumer Protection and Competition Act of 1992, may have the most lasting and far reaching impact of that congressional action. Unfortunately, these regulations are not always consistent and will force cable operators to make difficult technology investment choices at a time when uncertainty and constant change are the watchwords of the day.

Restricting options

The effect of the FCC's cable rate regulations on cable operators' ability to make system upgrades is presently the subject of intense debate and examination by the FCC and the industry. At stake is the ability to meaningfully enter the market for telecommunications services with any hope of wresting away market share from existing, and well-entrenched, service providers.

However, the ability of cable operators to make an unfettered choice as to the delivery technology and mix of services best suited to an increasingly competitive marketplace becomes more restricted with each new rule promulgated by the FCC.

Consumer electronics

For example, the rate rules restrict income available for upgrades, while the program carriage rules restrict exclusive access to programming. The most recent example is the interaction of the FCC's tier buy-through regulations with the new consumer electronics compatibility rules, which, as explained more fully later, will likely serve to further restrict cable operators' ability to freely implement the most competitive delivery technology.

The FCC's consumer electronics compatibility rules require as a short-term solution the provision of supplementary equipment such as set-top devices with multiple descramblers and/or timers and bypass switches to enable the operation of extended features and functions of consumer equipment that make simultaneous use of multiple signals. Moreover, subscribers must have the option of having all signals not requiring a converter passed through directly to the TV receiver or VCR through the use of bypass switches or similar equipment, without passing through the set-top device. Cable operators are prohibited from scrambling basic tier signals, which would allow subscribers to receive basic tier service without the need for a set-top device. Finally, to provide more efficient and effective long-run compatibility, the FCC's rules require the use of decoder interface connectors in consumer equipment and associated component descrambler/decoders in cable systems, and establish a standard cable channel plan for new "cable-ready" consumer equipment and new or rebuilt cable systems.

Thus, the consumer electronic compatibility rules dictate a shift in cable technology away from encrypted signals and set-top converters, and toward "in the clear" transmission and little or no consumer-site equipment. Regardless of how a system is presently configured, significant expenditures may be required to allow consumers to use their electronic equipment to their full potential.

Buy-through

The FCC's tier buy-through rules add a significant regulatory and public relations concern to the mix. Under Section 76.900 of the FCC's rules, cable operators are prohibited from requiring subscription to any tier of service, other than the basic tier, as a condition of subscription to video programming offered on an per-channel or per-program charge basis. This prohibition applies to any system that

is technically capable of controlling subscriber access to nonbasic channels of service either: 1) through addressable equipment electronically controlled from a central point, or 2) through the installation, noninstallation or removal of frequency filters at subscriber premises without other alteration in system configuration or design and without causing degradation in the technical quality of service provided. Systems that are incapable of complying with this requirement are exempted for a 10-year period, until Oct. 5, 2002, at which time all systems will be required to comply. However, where a system becomes capable of complying with the rules within the 10-year exemption, it will be required to comply.

Of the two choices posited under the tier buy-through rule — addressability or traps and filters — addressability is usually the most attractive to cable operators because it is generally less labor-intensive, provides better system security (by allowing the encryption of signals) and carries less risk of signal degradation (a common problem associated with filters). Thus, the tier buy-through rule would seem to encourage operators to implement system modifications allowing the use of encryption and addressable converters. However, the consumer electronics compatibility rules force cable operators to move away from set-top

"The ultimate irony is that with practically every new rule, the FCC seems to close another door for cable, at a time when Congress, the courts and the public want competition in video services."

converters and signal encryption, thereby placing cable operators in a technological catch-22.

To be fair, the FCC took pains to indicate that the tier buy-through rule does not mandate addressability and that cable operators should be free to pursue creative solutions to providing effective subscriber choice. However, the reality of the situation is that a system upgrade that calls for set-top converters and signal encryption would be a wasted investment in light of the consumer electronics compatibility rules. Operators that do not currently employ signal encryption and set-top converters will not be able to justify the investment, and will therefore be stuck adding and removing traps to comply with the tier buy-through rules — all the while foregoing revenues associated with pay-per-view services and suffering the risk of signal theft with little recourse. Operators that have addressable plant in place are no better off, facing significant compatibility costs in the short run and the forced obsolescence of their delivery technology in the long run — all at a time when the rate regulations cut into a system's cash flow by as much as 17%.

The end result is that cable operators are faced with increasingly restricted choices as to present or future delivery technology, and therefore must be even more creative to proactively position for a future characterized by meaningful competition. The ultimate irony is that with practically every new rule, the FCC seems to close another door for cable, at a time when Congress, the courts and the public want competition in video services. **CT**

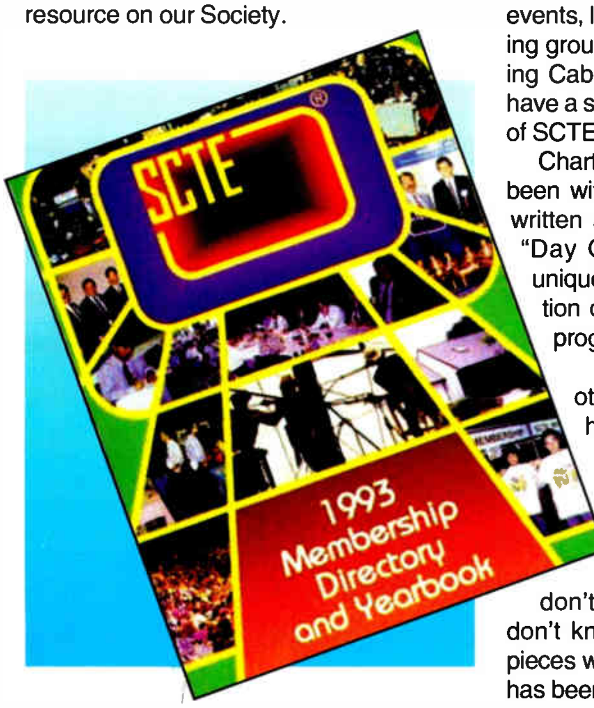
Twenty-five years in the making

By Bill Riker
President, Society of Cable Television Engineers

Last month in this column, I wrote about SCTE's 1994 Cable-Tec Expo, which represented the official celebration of the Society's 25th anniversary. Now, I would like to tell you all about another way we are going to celebrate the anniversary of the formation of our organization in 1969: The special 1994 anniversary edition of SCTE's *Membership Directory and Yearbook.*

Book of firsts

The 1993 edition of the SCTE *Membership Directory and Yearbook* marked a number of firsts for the Society. It was the first time the SCTE national headquarters staff produced this annual publication completely in-house. All production, typesetting, advertising and design tasks were executed by staff members. For previous editions, SCTE had contracted with professional publishers to handle these duties, supplying raw text, membership data and photos to the publisher and serving in more of a hands-off, supervisory manner. With the advent of desktop publishing computer hardware and software, we were able in 1993 to fulfill a goal by producing in its entirety the publication that has become the ultimate reference resource on our Society.



Other firsts achieved with last year's edition included the appearance for the first time of color photos (over 100) in its pages. In addition, we improved the quality of the paper stock and book binding. And one of the most well-received innovations of the 1993 *Membership Directory and Yearbook* was the inclusion of a list of all SCTE members categorized by local region (city, state and, if necessary, country). This provided members with the welcome opportunity to locate members in their area, encouraging greater interaction among members for the exchange of technical information.

This year, we will take this idea one step further. In addition to the regional listing, the 1994 edition will include a list of SCTE members who also are amateur radio operators. They will be categorized by name and call letters, enabling hams across the country to speak with fellow members using a communication medium that is favored by many members. This list was compiled and supplied by Steve Johnson of Time Warner Cable, who himself is a longtime SCTE member and a ham.

As stated in the title of this column, the 1994 edition has been "25 years in the making." Besides containing regular directory features such as a complete member list, material on SCTE programs and events, listings of local chapters and meeting groups and the year in photos (including Cable-Tec Expo '94), this edition will have a special focus on the 25-year history of SCTE.

Charter member Rex Porter, who has been with SCTE since its beginning, has written an article for this edition entitled "Day One" that documents from his unique personal perspective the formation of the Society and its subsequent progress.

We are soliciting comments from other CATV industry veterans who have been involved with SCTE since its early days and continue to do so to this day. Their insights will help paint the picture of SCTE over the years. To paraphrase an old saying, "If you don't know where you've been, you don't know where you're going." These pieces will enlighten us as to where SCTE has been as we chart the Society's future.

Even the cover of the 1994 directory will be something special. In the style of "before and after" photo spreads that offer a contrast of two versions of the same scene, the cover will portray the Society yesterday and today. It will include a photo from the first SCTE meeting held June 22, 1969, in conjunction with that year's NCTA convention at the San Francisco Hilton (the site of SCTE's Cable-Tec Expo '88.) It also will contain a photo taken at this year's Cable-Tec Expo showing many of the charter members who were present at that first meeting. By the way, this photo was taken the evening of June 17, 1994, nearly 25 years to the day from that historic first meeting.

As of this writing, the 1994 SCTE *Membership Directory and Yearbook* is currently in production by the national headquarters staff, headed up for this project by Editor Howard Whitman and Sales Manager Anna Riker. We hope to have the book printed in September and shipped to members for delivery some time in October. As we currently have over 12,000 members, producing and mailing a book of this magnitude is a large but not insurmountable task. But, barring any complications, all SCTE members should soon see their copies of the 1994 *Membership Directory and Yearbook.* I'm sure it will be the best edition yet, a fitting tribute to 25 years of training, certification and standards. I couldn't think of any better way to celebrate this important milestone. **CT**

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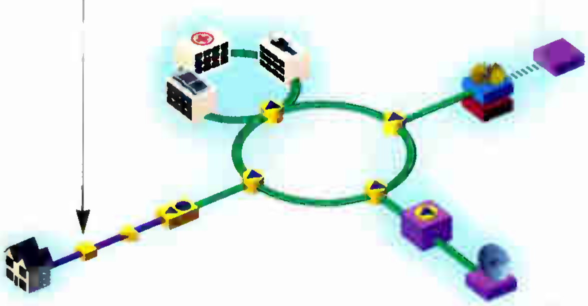

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