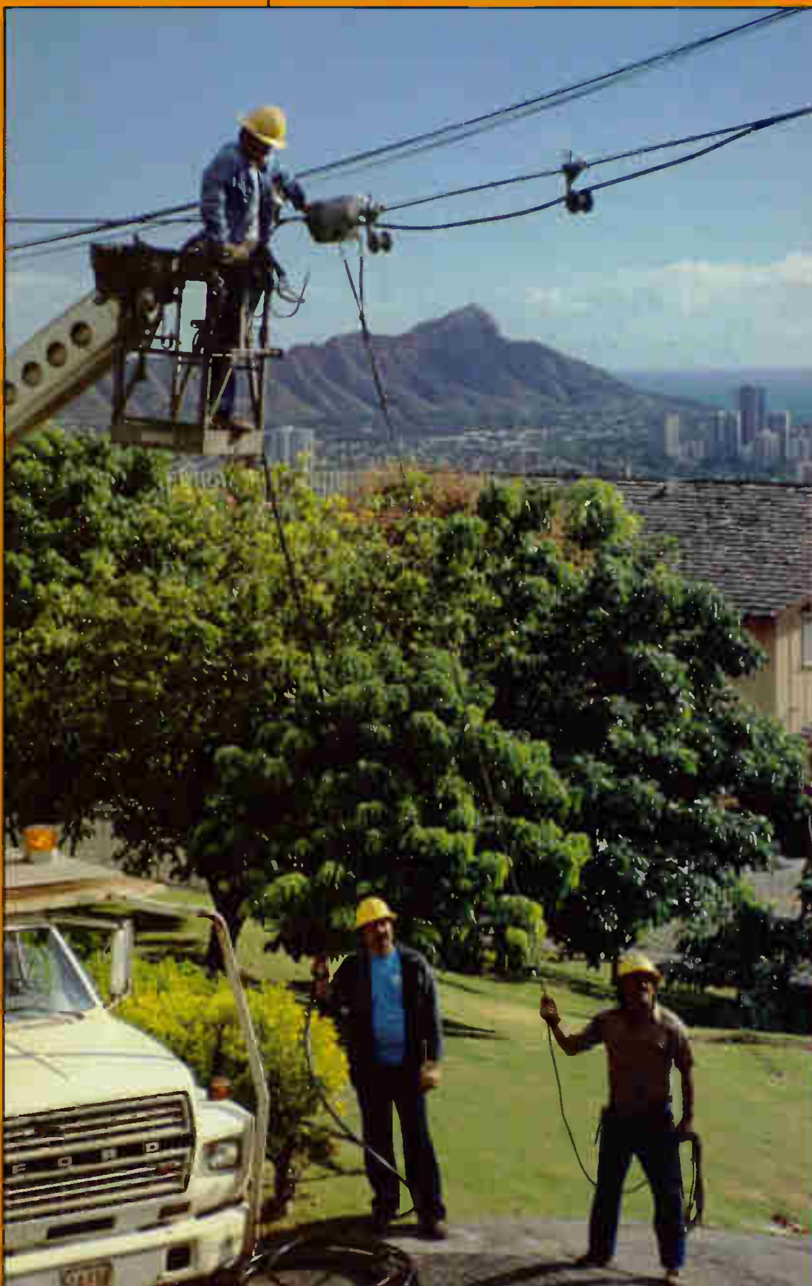
COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers



Fiber optics: For today, for the future

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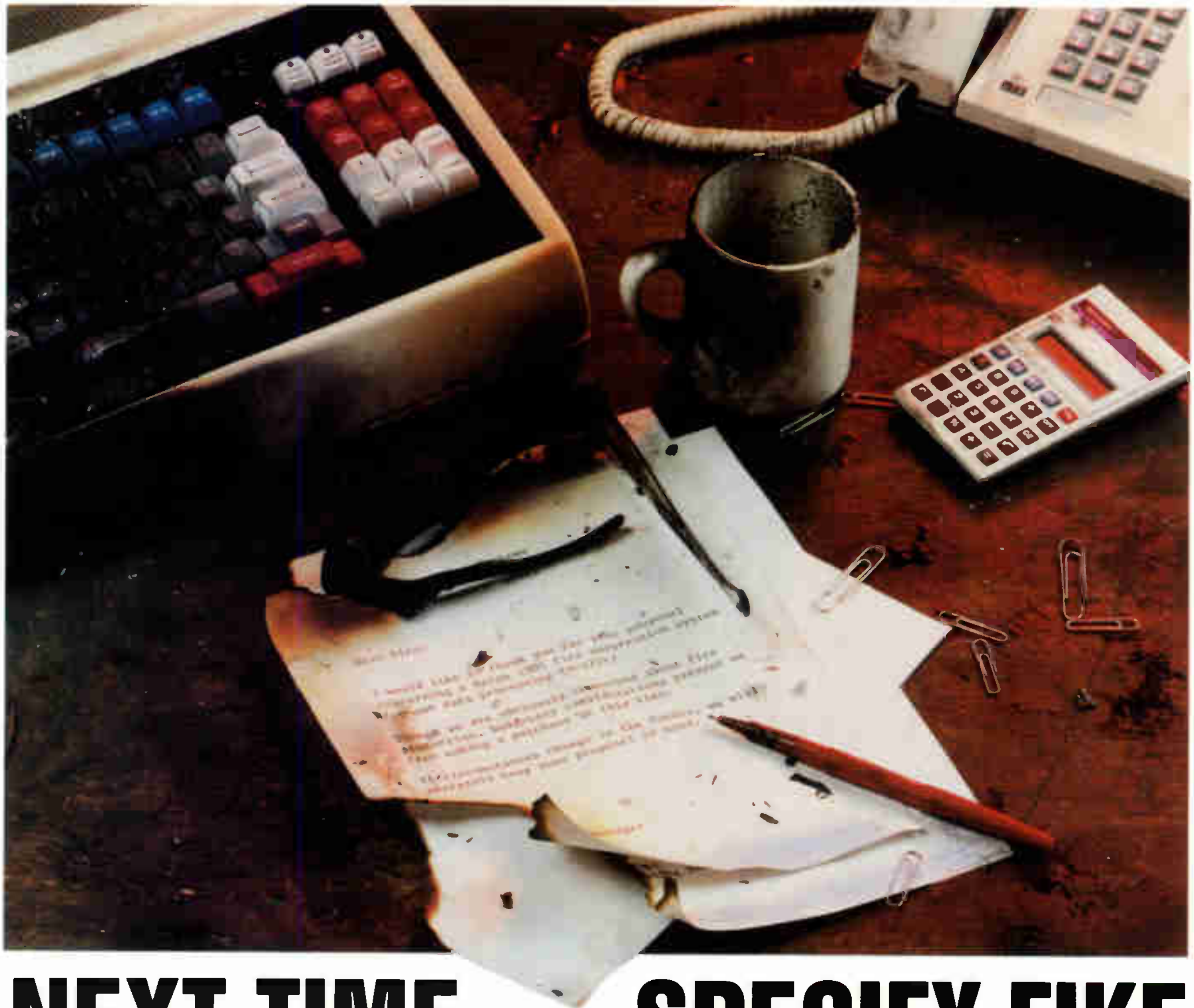
makin' waves

Making waves in Atlantic City

October 1987

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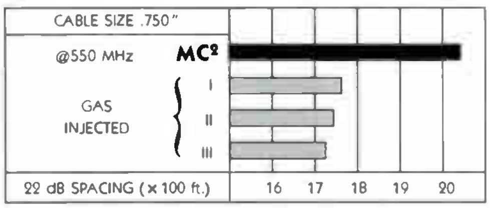

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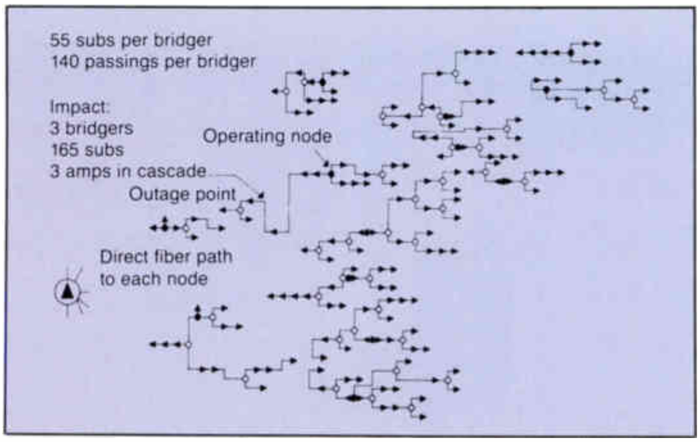

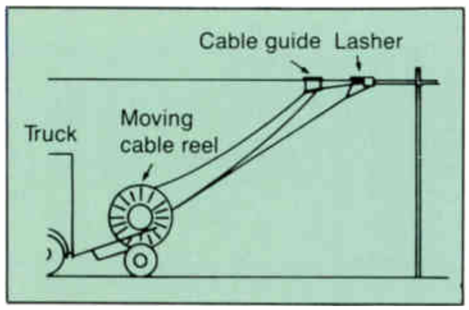

Drop audit update

System name (one pay trapped)	Date 8-11-87
Homes passed	
Homes audited	4,744
Disconnected drops	1,774
Basic-only illegals	45
Basic & pay illegals	451
Total basic illegals	496
% of disconnected drops	28
% of homes audited	10
Pay-only illegals	390
Total pay illegals	841
Total drops illegal	866
% of homes audited	18
Total potential illegals	1,337
% of homes audited	28
Sales conversions update	
Basic cable conversion	218
% of contact	
% of basic illegals	44
Pay cable conversions	
% basic	

Features

Cover
Photo by Dennis Callan, courtesy Oceanic Cablevision; Atlantic Show logo courtesy Slack Inc.

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See the Cable Video Store, Booth 239.
Reader Service Number 4.

GENERAL INSTRUMENT

The cable/telco war

The editor's letter is usually a forum to bring to the forefront certain issues concerning the cable industry—or a particular soapbox I might be on at the moment. This month, however, I am reprinting an editorial from Dick Kirn of Wire Tele-View Corp. and secretary/treasurer of the Society of Cable Television Engineers' Florida Chapter. Kirn's letter is titled "The Cable/Telco War," and I strongly advise our readers to take the issues to heart.

"The cable industry has already lost the first battle of this war by being a no-show. The telephone companies have installed or are installing a number of fiber-optic cable systems (see accompanying table). These cable systems provide cable TV, movie rentals, security, data banks, telephone and energy management service.

"Enhanced telephone service using integrated services digital networks (ISDNs) will allow features such as multilines to single phones, simultaneous data and voice operation, call tracing, sophisticated answering and redial systems. All this in addition to delivering full video.

"Granted, these are demonstration projects and are not expected to earn a monetary profit. However, they will repay a bounty of information concerning system design, component reliability and operational techniques. One day in the not-too-distant future, the cable industry will wake up and find that the war has been lost and we will be left holding our analog RF systems with all their distortions and noise. Guess where our subscribers will be?"

To drive this point home, the SCTE Florida Chapter will co-sponsor a three-day seminar on fiber optics at the Hyatt Orlando Hotel in Orlando, Fla., on Jan. 18-20. The sessions will include presentations by AT&T, Bell Labs, Ortel, AMP, Stromberg-Carlson, BellSouth, ATC and Synchronous. Because of the many misconceptions about fiber-optic technology, the basics as well as the future of fiber optics will be discussed. A tentative agenda of topics is as follows:

Monday, Jan. 18
8:30-9:45 a.m.—Fiber basics: An overview (AT&T)
9:45-10:45 a.m.—Fiber cable (AT&T)
11 A.M.-noon—Interconnect technology/loss balance (AMP)
2-3 p.m.—Splicing (AT&T)
3:15-4:30 p.m.—Aerial and underground construction techniques (AT&T)
4:30-5:30 p.m.—Questions and answers (panel)

Tuesday, Jan. 19
8:30-10:30 a.m.—FM modulation techniques (Synchronous)
10:45 a.m.-noon—Digital modulation techniques (Stromberg-Carlson)
1-2 p.m.—AM modulation techniques (ATC)
2-4 p.m.—Hands-on demonstrations
4-4:30 p.m.—Safety
4:30-5:30 p.m.—Questions and answers (panel)

Wednesday, Jan. 20
8:30-10 a.m.—User view (ATC)
10-11 a.m.—Future technology (Bell Labs)
11:15 a.m.-noon—Training (AT&T)
Noon-1 p.m.—Hunter Creek, operating leaseback fiber system (BellSouth)

For more information on this valuable seminar, please contact Dick Kirn, (813) 924-8541; Pat Luckett, (305) 660-5524; or write the Florida Chapter at P.O. Box 7835, Sarasota, Fla. 34278.

More on the SCTE front

A sincere congratulations to SCTE Tip-O-Tex Chapter Secretary/Treasurer Arnold Cisneros on becoming a senior member of the SCTE. He is recognized by the Society as having demonstrated and documented significant performance as a professional in the CATV industry. Cisneros joins the ranks of 165 SCTE members who have been elevated to senior member status—the highest professional grade given by the SCTE.

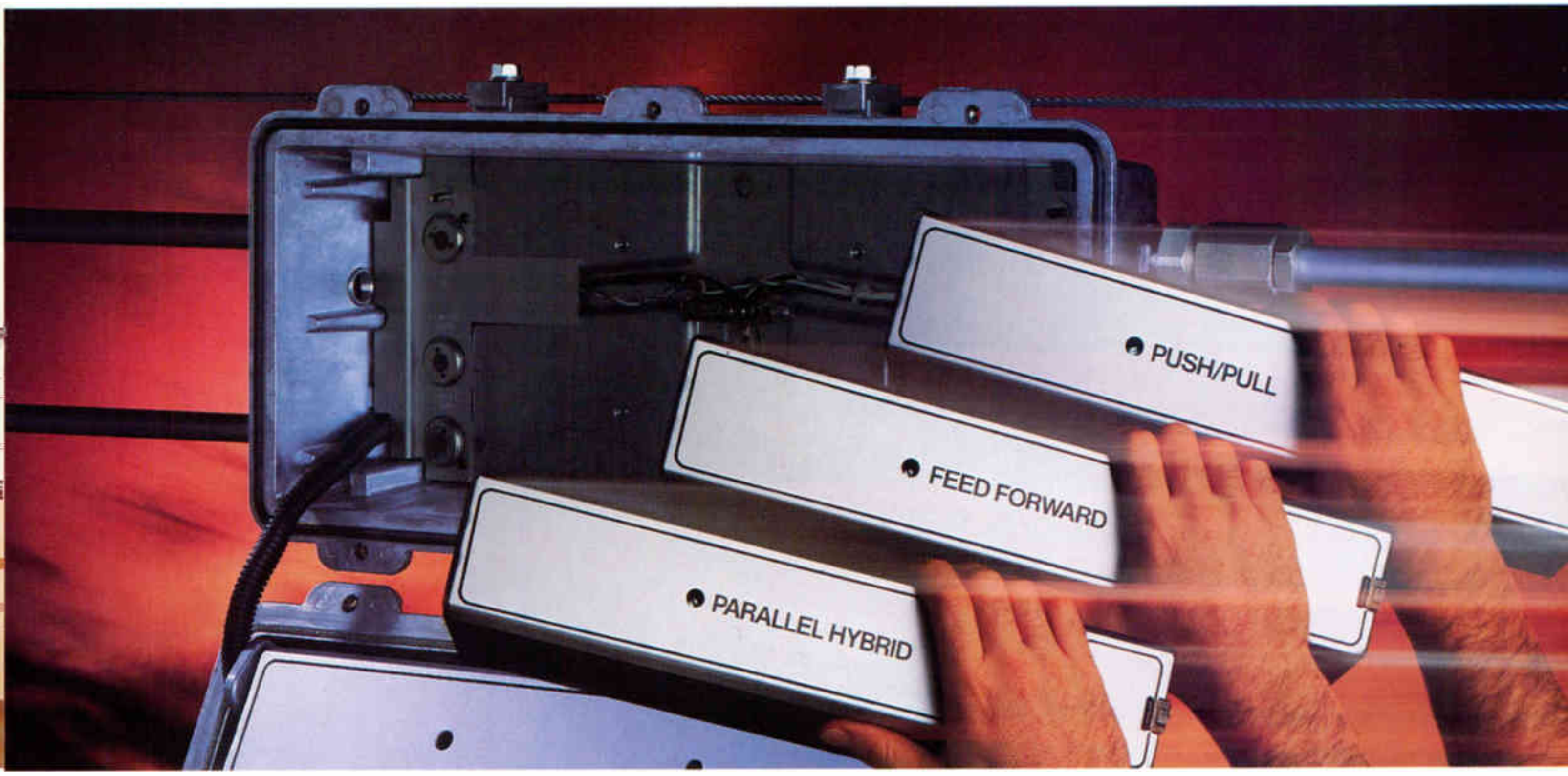
Many thanks to Microwave Filter for offering to support the printing and postage costs for the SCTE's new Upstate NY Meeting Group's mailing.

The SCTE, a driving force behind cable TV technicians and engineers, now boasts a total of 40 chapters and meeting groups nationwide. The two most recent organizations are the Four States and Upstate NY meeting groups. For more SCTE happenings, don't miss this issue's *Interval*—and join the Society.

Toni I. Barnett

Telco fiber-optic systems

Community	Location	Status	Installer
Cerritus	Los Angeles	Waiting approval	GTE
Heathrow	Orlando, Fla.	Under construction	BellSouth/ Northern Telecom
Hunter Creek	Fort Lauderdale, Fla.	Operating	BellSouth
Leewood	Leewood, Kan.	Under construction	Southwestern Bell



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Yes ☐ No ☐

2. In the performance of my job, I authorize, specify or purchase products and/or services.
Yes ☐ No ☐

3. Please check the category that best describes your firm's primary business (please check only one).

1. Cable TV Systems Operations
- ☐ a. Independent Cable TV Systems
- ☐ b. MSO (two or more Cable TV Systems)
- ☐ 2. Cable TV Contractor
- ☐ 3. Cable TV Program Network
- ☐ 4. SMATV or DBS Operator
- ☐ 5. MDS, STV or LPTV Operator
- ☐ 6. Microwave or Telephone Company
- ☐ 7. Commercial Television Broadcaster
- ☐ 8. Cable TV Component Manufacturer
- ☐ 9. Cable TV Investor
- ☐ 10. Financial Institution, Broker, Consultant
- ☐ 11. Law Firm or Government Agency
- ☐ 12. Program Producer or Distributor
- ☐ 13. Advertising Agency
- ☐ 14. Educational TV Station, School or Library
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For more information on how you can streamline your microwave needs, contact M/A-COM MAC, Inc., 5 Omni Way, Chelmsford, MA 01824, (617) 272-3100.

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Atlantic Show '87: 'Making waves'

ATLANTIC CITY, N.J.—With the theme "Making waves," the sixth annual Atlantic Show, sponsored by the Maryland/Delaware/District of Columbia, New Jersey, New York and Pennsylvania cable TV associations, is scheduled to get under way Oct. 6-8 in the East Hall of the city's convention center. In addition to the show's marketing, management and legal sessions, the Society of Cable Television Engineers is coordinating several of the technical sessions for the event.

A special one-day registration fee has been made available to SCTE national members.

The show's agenda, featuring technical sessions, is as follows:

Tuesday, Oct. 6
11-11:15 a.m.—Ribbon cutting ceremony
11:15 a.m.-1 p.m.—Keynote speaker Ted Turner, chairman of the board and president of Turner Broadcasting System
1-3 p.m.—Lunch
1-6:30 p.m.—Exhibits open
2-3:30 p.m.—"Carrying BTSC stereo and other special services," moderated by Brian James, director of engineering, NCTA

3:30-4 p.m.—Coffee break
4-5:30 p.m.—"Signal leakage and the FCC," moderated by Cliff Paul Sr., consultant, RTK
5:30-6:30 p.m.—Cocktail party

Wednesday, Oct. 7
9-10 a.m.—Associates meeting
10 a.m.-5:30 p.m.—Exhibits open
10-11:30 a.m.—"Open forum: BCT/E Certification," moderated by John Kurpinski, consultant
11 a.m.-3 p.m.—Lunch
1:30-5 p.m.—BCT/E Certification examinations, administered by William Riker, executive vice president, SCTE
3-3:30 p.m.—Coffee break

Thursday, Oct. 8
9:30 a.m.-noon—Exhibits open
10 a.m.-noon—"A demonstration of high-definition television," moderated by James Stilwell, president, TeleResources.

NCTA, SCTE issue call for papers

WASHINGTON, D.C.—Proposals for technical papers to be presented during the 1988 National Cable Television Association convention April 30-May 3 in Los Angeles are due Jan. 5 at the association's headquarters. Persons wishing to present original papers on communications engineering topics of interest to the cable TV industry should submit 250-word summaries to: Katherine Rutkowski, NCTA, 1724 Massachusetts Ave., N.W., Washington, D.C. 20036.

The Society of Cable Television Engineers also issued a call for technical papers to be presented at the SCTE's Annual Engineering Conference in San Francisco June 16, 1988. In addition, proposals for workshops are being solicited for the Cable-Tec Expo, which immediately follows on June 16-19. Workshops are hands-on sessions presented at both technician and engineer levels of subject depth. Submissions are due Nov. 15, should include an abstract of the paper or workshop, and must be sent to: SCTE, 669 Exton Commons, Exton, Pa. 19341.

● The Charles Machine Works Inc. announced that its Ditch Witch product line has been expanded to include Radiodetection tools

Study predicts future of fiber

AUSTIN, Texas—Technology Futures, a consulting, research and education firm based here, recently completed a forecast of near-earth communications from 1990 to 2010. As background for the study, industry data was gathered on the performance capacity (in bits per second) and the costs per mile (in 1975 dollars) of communication technologies since 1910. This data was plotted to indicate rates of change in performance and transmission costs due to both radical and incremental improvements in technology.

According to the report, the rate of improvement in performance of communications satellites from 1965 to 1975 resulted in reduction of further improvement in cable and microwave technology. Also, fiber-optic technology accelerated rapidly after 1977—surpassing satellite capacity even in its early development—and now exceeds coaxial cable, microwave and satellite capacities by a factor of five or more.

The report forecasts that even if the increase of fiber capacity slows in the near future, it will remain so far ahead of satellite capacity that all growth in fixed point-to-point communications of any magnitude can be handled by fiber-optic cable. This growth rate exceeds any projections of growth in voice, data, video and video-conferencing demands.

for locating buried pipes and cable. The equipment is available through most Ditch Witch dealerships in North America.

● ISS Communications was appointed as a manufacturer's representative for CaLan, and will be responsible for California, Nevada, Oregon and Washington. The company will represent CaLan's Model 1776/1777 integrated sweep system.

● North Coast Cable has secured financing for the construction and operation of the cable TV system in Cleveland, Ohio. The system has begun initial construction; its first customers are expected by the end of the year. Viacom will manage the system on a day-to-day basis. Catel Telecommunications recently announced receipt of an order from Ohio Bell to supply TV, video and audio processing equipment for the Cleveland system.

● Kanematsu-Gosho (USA) Inc. signed an agreement for the sale of a Sprucer 310 two-way interactive addressable converter system to United Cable Television of Eastern Shore Inc., Ocean City, Md. The converter allows subscribers to order and bill pay-per-view and pay-per-week events using a major credit card.

● Trilogy Communications announced that 1,650 miles of its MC2 coaxial cable will be supplied to Suburban Cablevision of East Orange, N.J., for a major rebuild scheduled to begin in January 1988. Trilogy also announced the production of an air-spaced dielectric coax cable for plenum installation, its .500 MIII.

● Scientific-Atlanta reported an increase in sales, earnings and new orders for the fourth quarter and the fiscal year ending June 30. Sales for the quarter were up 6 percent over the same quarter a year ago. Net earnings were $8.8 million, compared to $17.7 million last year. New orders booked during the quarter were 33 percent greater than those of the comparable quarter of last year.

● RCA American Communications recently changed its name to GE American Communications Inc. The company operates five C-band and two Ku-band Satcom satellites.

● Ross Communications of Allentown, Pa., received contract awards for five construction projects. The new contracts include multiple dwelling unit wiring in New York for Antenna and Communications Corp.; constructing a cable communications system for the University of Salsbury in Maryland; aerial construction for a Storer system in Groton, Conn.; an underground project for Thompson Cable Services, Laurel, Md.; and aerial construction for Contel/Executone in Allentown.

● With an initial order of $2.7 million, General Instrument's TOCOM Division was named addressable equipment supplier to the Philadelphia cable system being developed by Cablevision Industries and Wade Communications. Also, General Instrument's Jerrold Division recently celebrated the installation of its 500th addressable system, serving Sammons' southern New Jersey operation.

● Pioneer Communications announced an order for its BA-5000N addressable converters from Warner Cable for the MSO's systems in Kingsport, Tenn., and Olean, N.Y. Also, Pioneer announced the sale of addressable equipment to Sammons' McComb, Miss., system.

● Oak Industries announced that it has entered into a license agreement with M/A-COM and General Instrument Corp. Oak received total license fees of approximately $20 million and settled all litigation with the other two companies relating to Oak patents. In return, M/A-COM and General Instrument received paid-up, non-exclusive licenses to over 40 Oak patents in the communications, encryption and converter fields for their full term.

● AM Communications announced over $1 million in new orders for its new line of CATV and LAN products. Also, AM received $5 million in new cable and LAN construction contracts, which includes construction of the ATC/Queens, N.Y., cable system and the rebuild of the Wolverine Cable System in Battle Creek, Mich.

● Zenith Electronics reported its second-quarter earnings of $0.3 million or 2 cents per share, compared to its loss of $9.9 million or 43 cents per share in the same period of 1986. Sales rose 41 percent compared to last year's second quarter; computer product sales were a key factor in the increase.

Job hunting in the '30s

By Isaac S. Blonder
Chairman, Blonder-Tongue Laboratories Inc

The "terrible '30s," as the newly graduated scientists called that Depression-ridden era, featured high levels of unemployment, businesses barely surviving from day to day and a surplus of scientists for every vacancy. The abundance of job opportunities today and the high prevalent wage scales will cause you to luxuriate in your good fortune as compared to the difficult experiences faced by the job seekers then.

At that time, a laborer could earn as little as 25 cents per hour. Secretaries and office personnel were fortunate to find a steady job at $12 per week; $25 per week was above average for the working non-professional. Government jobs were eagerly pursued since they offered security and high pay. I was informed by my New York relatives that I should spend all of my time pursuing a license to teach in the New York City schools at the princely sum of $3,500 yearly! Unfortunately, I discovered quickly that not only were New York residents given preference over out-of-state applicants but one had to be sponsored by a politician with sticky fingers in order to enter the teaching profession.

Federal positions such as "Junior Observer in Meteorology" were favorite targets of the educated and I succumbed to the pressure and took the exam. Not having spent a minute of preparation in that field, I was delighted with my score of 94 only to be informed that enough applicants had scored 100 to fill the openings for the next century!

If you couldn't find a job on graduation, and I didn't, you regarded graduate education as a worthy alternative. Armed with wildly enthusiastic letters from my professors I applied to over 50 universities for a fellowship in physics and prepared to live an aesthetic lifestyle for the next several years. Alas for such optimism! Turns out that there were at least 10 applicants for every opening and the natural reaction of the administration was to set up standards and quotas that they were perfectly willing to expose to your scrutiny, knowing that the quantity of applicants and the picket fence of quotas would screen out anyone with whom they had the slightest qualms. I had to go on to graduate school at my own expense (no science-based job was offered to me for two years).

After spending four years during World War II in the signal corps as a radar officer (a science-based job at last), the drought was over. Good jobs at good pay were easy to secure (I hope you engineers find this scenario alive forever). Now, back to the "terrible '30s."

One summer, while an undergraduate, a friend with inside influence in a machine shop worked his magic and I spent a happy vacation as an unskilled lathe operator for 35 cents per hour rough cutting steel bars for the real machinists. As a novice they almost convinced me to ask the stockroom for a supply of "hen's teeth" for the final finishing polish to the steel bearings.

Once I thought I had a real job as a radio engineer. It was at a small company that had fled from Brooklyn to the Connecticut wilderness in order to lower space and people costs. The wage scale created for the highest paid employee was $25 because they could not find a local radio serviceman willing to take a job with unlimited calls on his time for the ever-present emergencies. Their principal products were versions of a basic five-tube radio wholesaling for $5. All, I repeat, all of the parts were rejects, and we spent as much time troubleshooting problems as building the radios. Here is one typical problem: The speakers usually emitted a *sshing* sound caused by the voice coil rubbing against the pole pieces. My despicable solution: a wad of tissue paper between the grill cloth and the cone! What do you want for $5? When the boss began to hand out paychecks with the caution to wait two weeks before cashing the check, it was time to move on.

Finally, my experiences in the heart of electronics America, the downtown area in NYC surrounding Courtland Street. Upstairs, in a dingy unpainted loft of the XYZ Capacitor Corp., the owner eyed me suspiciously; why would a physicist lower himself to work as an engineer in a capacitor factory? Grudgingly, he admitted there could be an opening, but I would have to work two weeks at no salary to prove I could hack it and then the salary would be $25 with increases as I produced new products to prove my value. This offer was repeated in similar language at a retail electronics store and a coil winder. At least a dozen more enterprises had no openings at any price. By the way, I also would have had janitorial duties at the store.

One could survive in those days at $25 since a full meal in a Bowery restaurant could be had for 25 cents and the Chinese restaurants offered half a hogshead of chop suey for 35 cents, sufficient for four engineers. Single-room lodgings were available at $6 weekly. Movie houses on 14th Street charged 10 cents and some even threw in a live striptease act for their patrons. Subway fare was 5 cents and crime was a statistic but not a personal concern. If you had a job, New York was perfection personified.

Count your blessings, you lucky employed scientists; it was not always thus.

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Part II: A fiber backbone system

This is the second part of a series on the use of fiber optics in a CATV system.

By Dave Pangrac
Director, Engineering and Technology
American Television and Communications Corp

In the last issue I provided some ideas on how to overcome the fear of a new learning experience; specifically, the use of fiber. In this article I will discuss a "fiber backbone" system, a new concept that refers to the application of fiber to a cable TV system. Note that while fiber backbone cannot presently be implemented, nevertheless, our expectations are high because of progress that is occurring. Learning and understanding should proceed now as a way of preparation and readiness for our industry.

Figure 1: Trunk layout (standard tree and branch architecture)

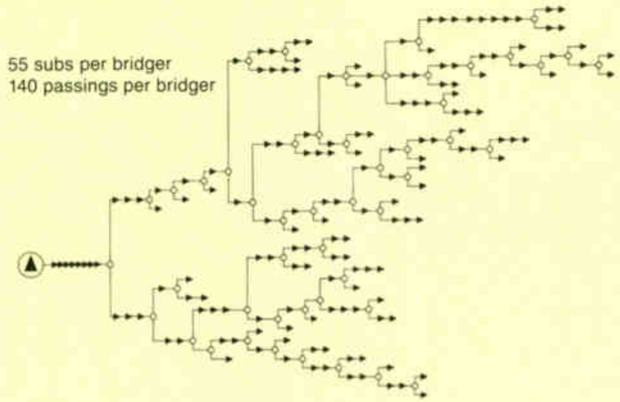

Figure 1 shows an actual trunk layout of a portion of a major cable system with standard cable tree and branch architecture. Amplified cascade lengths are up to 31 deep. The section of plant shown provides service to 8,525 subscribers and is made up of 155 bridgers. Figure 2 shows the system with an outage (indicated at the arrow); the system is 14 amplifiers deep at this point. The system failure has affected 89 amplifiers (those after the arrow), a total of 4,895 subscribers. (Note that the subscriber numbers are actual as they relate to this system.)

With this many customers out of service, it is not hard to predict events and problems. All incoming phone lines will be tied up with outage-related calls and many subscribers will be frustrated because of busy signals. Once the outage is repaired, the system will likely roll service trucks on problems generated from the plant failure; e.g., the TV set remaining on Channel 4 when the converter output is Channel 3, the outside antenna (or rabbit ears) hooked up during the problem and the subscriber forgetting to reinstall the cable once the service interruption is repaired, etc. CSRs and other staff also will be responding to an increased number of "nuisance" calls, i.e., where there are no real signal difficulties.

Fiber backbone reconfiguration

Now refer to Figure 3. This is the same trunk system but it has been reconfigured to accommodate the fiber backbone. The long cascades have been broken up into small operating clusters using a device called an "operating node," located at every other power supply. Some of the amplifiers are turned around so that they feed *out* from the operating node. As a result, there is a group of very small cable systems that have (in this example) no more than five amplifiers in cascade. (Refined designs have been able to accomplish as few as three amps in cascade, but four seems to be the most efficient.) Each node is fed *directly* from the headend with single-mode fiber. Photons generated at the headend are transmitted via the fiber to the node and then are converted to electrons. The output of

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Figure 2: Outage in cable plant (tree and branch architecture)

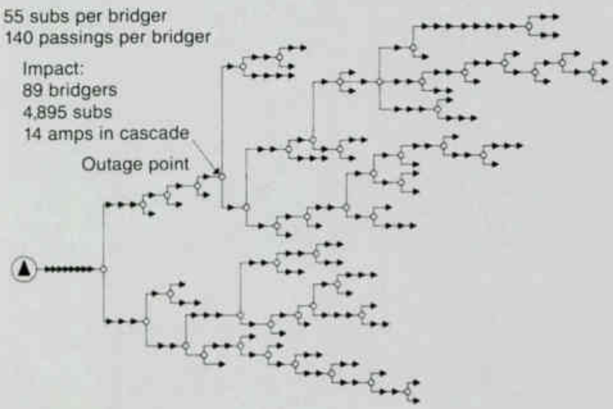
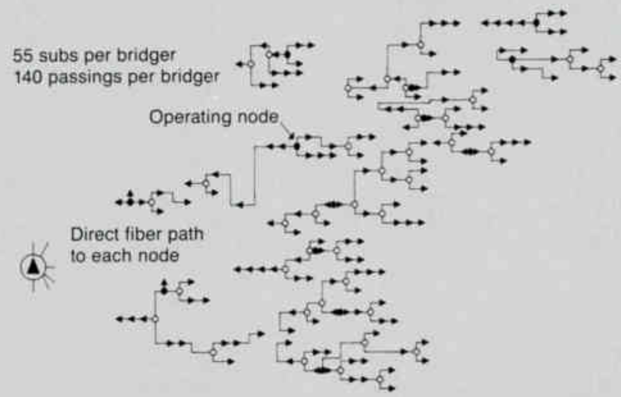


Figure 3: Same trunk system reconfigured with fiber backbone



the node is broadband RF and has the same capability as a trunk amplifier.

Figure 4 shows the system with the fiber backbone and an outage at the same location as in Figure 2. Its effect is quite different. Instead of 4,895 subscribers out of service, there are only 165. This is a significant decrease, so trouble calls should be manageable and operations less chaotic and, hence, less expensive. Also, the design of short cascades will change the need for sweeping the system and possibilities will arise for increased channel capacity using the same electronics.

Thus, the overall effects of using a fiber backbone system include improvements in subscribers' perception of reliability, reduction of incoming trouble calls (as a result of less outages), reduction in plant maintenance requirements and improvements in picture quality (as a result of shorter cascades). And all of this is achieved by using existing plant and simply reconfiguring and adding operating nodes and fiber.

There is another benefit for systems dealing with data transmission. With a fiber path running to every part of the system and since fiber is capable of operating bidirectionally, there is a very reliable path back to the headends to carry a large amount of data. How real is this plan? Consider a little history as well as present-day developments.

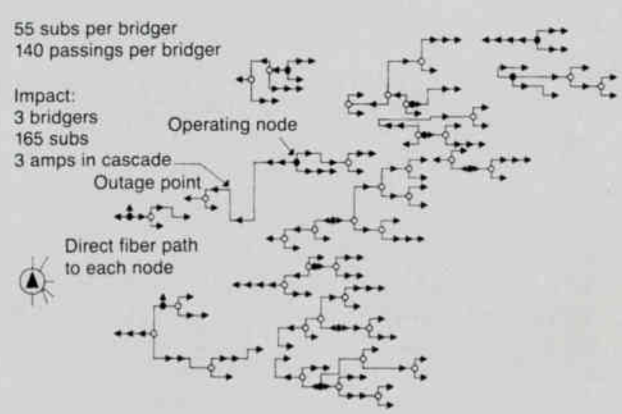
Back in the "good old days" frequency modulation (FM) was the only technology available if you needed to use microwave to move TV channels beyond your longest cascade lengths. This involved a transmitter/receiver (and associated mod/demod equipment) for each channel. Today, we have close to the same requirements for fiber transmission—a mod/demod for each channel and transmitter/receiver for each group of channels on a fiber.

In the "good old days" AML (amplitude modulated link) microwave was a fun idea but could not be done because of the noise problem and distortions generated by the system. Today we have the same situation with VSB-AM (vestigial sideband-amplitude modulated) transmission on fiber. Meanwhile, AML is a reality.

Only a few years ago, FM analog transmissions on fiber started with four to six channels per fiber. Now, we see companies producing equipment that will handle 16 to 24 channels on a fiber. Also, there are systems that can carry four to eight VSB-AM analog channels per fiber. At the same time, testing is continuing with the systems up to 42 channels. Keep in mind that because of the short cascades the system is feeding, the carrier-to-noise ratio and distortion numbers do not have to be as good at the headend.

The concept of the fiber backbone system has been accepted by enough people that it has stimulated development in both AM and FM transmission systems. There is no question in my mind that fiber is in our future. The winner will be the company that can produce a "light in, broadband RF out" operating node for a price of $5,000 or less per node.

Figure 4: Outage in cable plant (fiber backbone reconfiguration)



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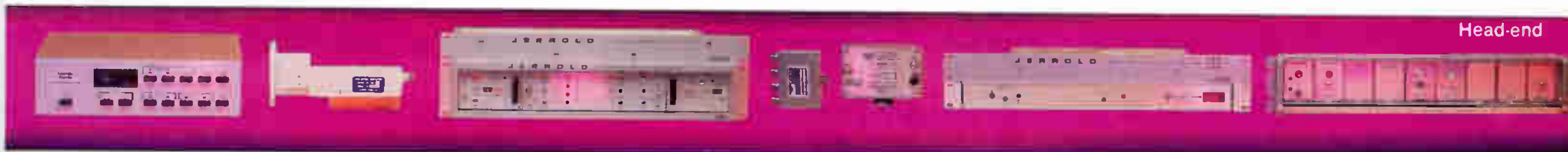

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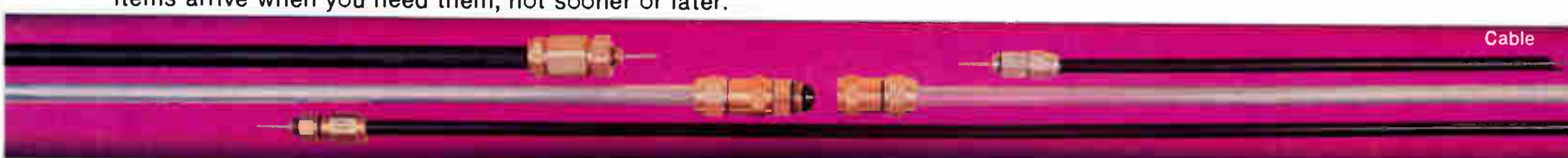

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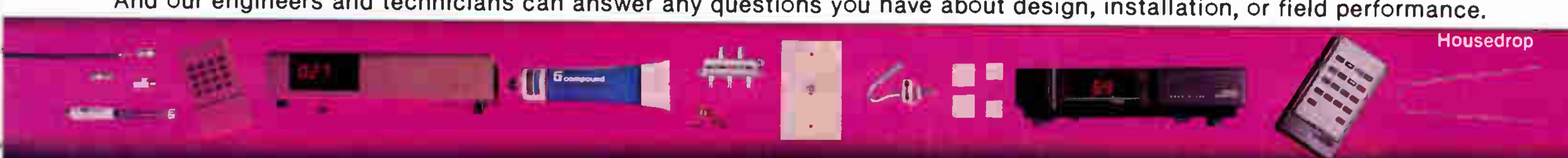

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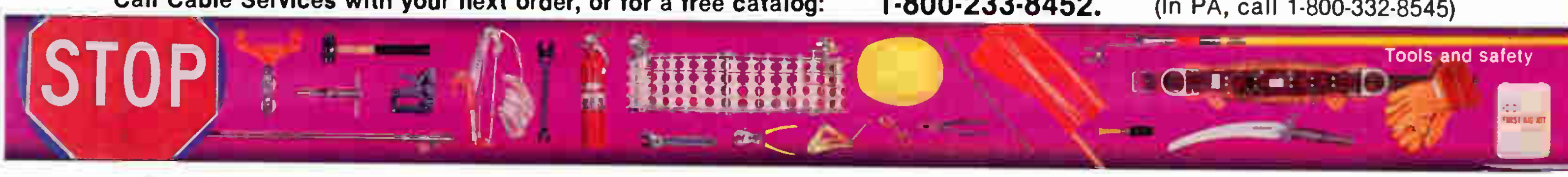

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Fiber-optic broadband systems

This is the first of a two-part series. Part II will cover optical sources, detectors and the future directions of fiber-optic systems.

By Mircho A. Davidov
Catel Telecommunications Inc.

Degradations in a typical CATV system are caused by the cable itself and the associated repeater amplifiers, which limit the number and the level of the transmitted carriers and the plant bandwidth. As a result, the performance of the signals delivered to the farthest subscriber suffers. Other limitations include the FCC-dictated frequency allocation aimed at minimizing the interference between signals and the system susceptibility to external noise and interference.

For broadband supertrunking signal transportation it is imperative to be able to deliver video *transparently* (with virtually no system-added degradation) from geographically separated locations to distant (tens of miles away) headends. Typical CATV delivery systems having repeater amplifiers every half mile cannot achieve this goal.

Some approaches that can be used to achieve a higher quality of delivered signals include the use of microwave links, different modulation over a coaxial cable, or both.

With the rapid development of cost-effective optical sources and fiber technology, an attractive and economical approach to the delivery of high quality signals would be to use fiber-optic links as the transmission media. It would allow the system designer to take full advantage of the wide bandwidth available and of the insensitivity to EMI. Also, no repeaters are required for fiber links less than 25 miles.

Why bother with fiber-based supertrunks?

The necessity for transparent transmission of video in supertrunks demands that the delivery system's performance be extremely high. (The performance specifications typically require that the overall video transmission system must meet or exceed the RS250B broadcast industry standards for short- or medium-haul video transmission.) To satisfy these stringent performance requirements economically, a careful system design is needed.

The topology of a supertrunk includes path lengths extending from several miles to several tens of miles with one or more branches along the way. The number of video channels and their associated audio channels that each supertrunk is required to carry can vary (depending on the signal-to-noise ratio required and the path length) with the maximum achievable (using wide deviation FM) being 16.

Coaxial cable-based supertrunks must use booster amplifiers in order to maintain the proper signal levels and carrier-to-noise ratio in all of the path sections. Although the coaxial cable itself has a wide bandwidth, a booster amplifier's bandwidth is limited to 500 - 600 MHz. To guarantee that after a cascade of booster amplifiers the required signal-to-noise ratio (S/N) can be maintained at the farthest receiver location, FM modulation is frequently selected. With the proper modulation index chosen for optimum S/N improvement vs. bandwidth expansion, large improvement factors can be achieved at the expense of the number of channels the system can support. If more channels would need to be added either now or in the future, more cables (and booster amplifiers) will be required and the system cost would tend to increase due to the added cost of the cable, additional amplifiers and the maintenance involved.

Microwave supertrunks use frequency-division multiplex methods to combine several FM video and audio carriers. The combined carriers (typically occupying up to 550 MHz of bandwidth) are then upconverted and transmitted at microwave frequencies. Although the microwave equipment costs more, it requires licensed frequencies to operate and tends to suffer from fading, but it is indispensable whenever it is very difficult or impossible to use a wired system.

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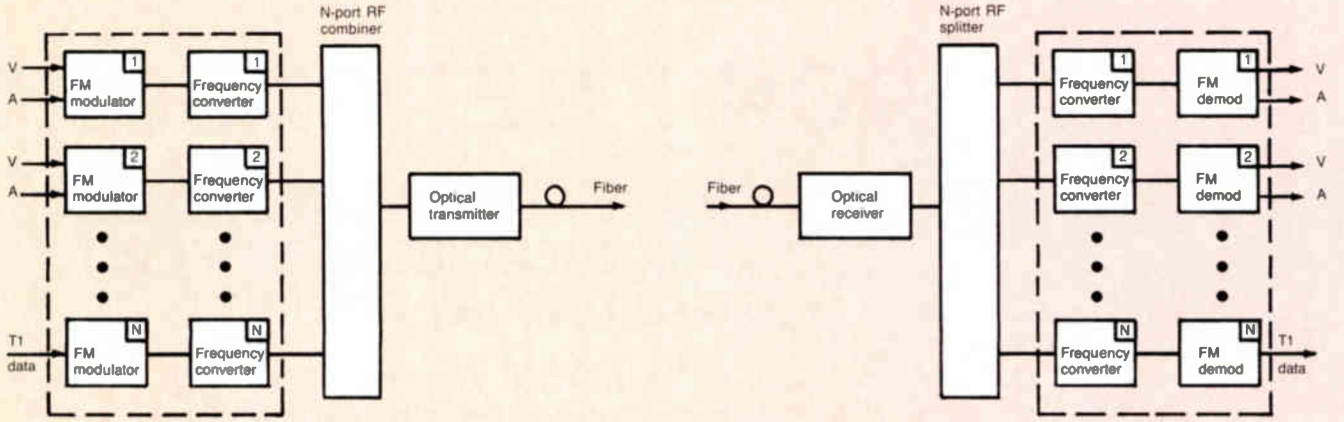
Figure 1: Fiber-optic supertrunking system



A fiber-optic supertrunk delivery system offers wide bandwidth, low losses, very small size and weight (and therefore many fibers can be packed into a small space), security of communications and rapidly dropping cost. Because of these factors the system designer can select the frequency plan, the modulation method and the number of fiber links offering the best and the most economical way of packing the number of required channels into a fiber-based supertrunking system.

For long-haul paths especially, the benefits derived from a broadband fiber-optic supertrunk delivery system can be substantial—both in up-front cost as well as in maintenance. Because FM can offer large S/N improvement factors and the bandwidth expansion associated with it can easily and inexpensively be accommodated in a fiber-optic link, a broadband fiber-optic supertrunk can carry a large number of high quality video channels inexpensively.

Figure 1 illustrates the basic components of a fiber-based supertrunk. It consists of RF and fiber-optic subsystem portions and a broadband single-mode fiber serving as the transmission medium.

The fiber medium

An optical fiber is a dielectric waveguide that operates at optical frequencies. It is cylindrical in form and it confines the electromagnetic energy in the form of light to within its surfaces and guides the light in a direction parallel to its axis.

One of the principal optical fiber characteristics is its attenuation as a function of wavelength. Early applications have made exclusive utilization of the 800-900 nm wavelength band, since the fibers made at this time exhibited a local minimum in the attenuation curve and optical sources and photodetectors operating at these wavelengths were available.

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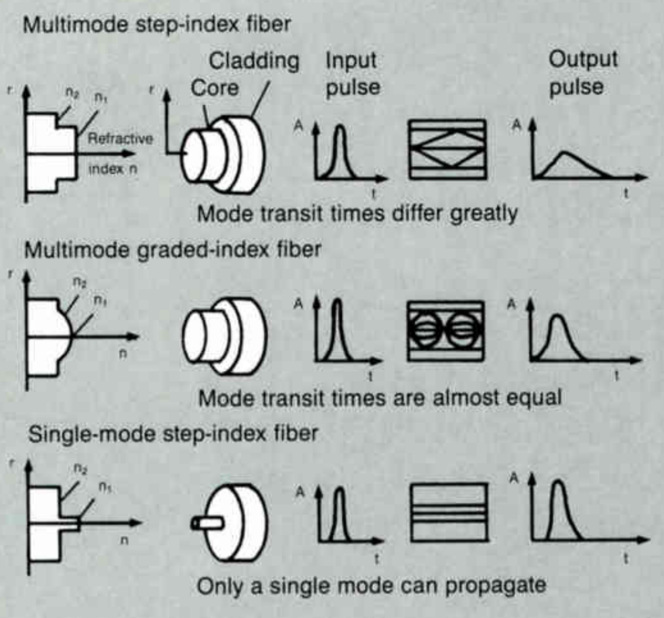
Figure 2: Fiber types and operations mode



Improvement in the fabrications processes by the fiber manufacturers have permitted them to produce optical waveguides with very low losses in the 1,100-1,600 nm region (this spectral wavelength band is referred to as the long-wavelength region). Since the 1,300 nm wavelength region presents minimum signal dispersion to signals in pure silica fibers, it has been widely used as the choice wavelength in present-day uses of single-mode fibers. The transmission properties of an optical waveguide are dictated by its structural characteristics. The structure basically establishes the information-carrying capacity of the fiber and its environmental response.

The most widely accepted structure of an optical waveguide is the single solid dielectric cylinder or radius *r* and index of refraction n_1. (this is known as the core of the fiber). The core is surrounded by a solid dielectric known as the cladding having a refractive index n_2, which is less than n_1. The cladding facilitates the total light reflection into the core, it adds mechanical strength to the fiber and protects the core from surface contaminants.

Variation in the material composition of the core gives rise to two commonly used fiber types shown in Figure 2. In the first case the refractive index of the core is uniform and undergoes an abrupt change (step) at the cladding boundary. This is called a step-index fiber. In the second case the core index is made to vary as a function of the radial distance from the center; this is known as a graded-index fiber.

Both the step- and the graded-index fibers can further be divided into single-mode and multimode classes. As the name implies, a single-mode fiber sustains only one mode of wave propagation, whereas multimode fibers support many hundreds of modes.

Since multimode fibers have larger core radii, it is easier to launch optical power into the fiber and to interconnect similar fibers. Another advantage is that light can be launched into the multimode fiber using an LED source. A disadvantage of multimode fibers is that they suffer from internal dispersion. When an optical pulse is launched into the fiber, the optical power in the pulse is distributed over most or all modes of propagation that the fiber supports. Each of the modes propagating through the fiber travels at a slightly different velocity, causing the signal to spread out in time as it travels along the fiber. This is called modal dispersion.

A measure of the information capacity of an optical waveguide is usually specified by the bandwidth-distance product in GHz km. Since intermodal dispersion effects are not present in single-mode fibers, they can have very wide signal bandwidth transmission capabilities.

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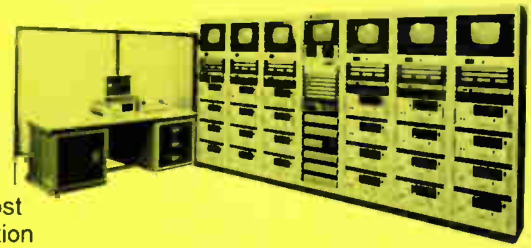

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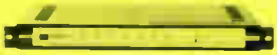

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Fiber optics in CATV: 10 years of progress

By John Holobinko
Vice President, Marketing and Sales, American Lightwave Systems

Ten years ago the promise of fiber optics in CATV was the ability to transmit signals impervious to EMI (electron magnetic interference) and RFI (radio frequency interference) noise, with longer distances between active electronics (amplifiers) than coaxial semiflex cable and no "suck-outs" or other mechanical failures common to coax. The hope was that these attributes would result in a trunking alternative that could deliver better quality signals and require significantly less maintenance than other interconnect technologies.

In fact, the ultimate dream for fiber was to replace coax trunk runs completely and carry all the channels of a CATV system on a single fiber transparently. However, in reality one big disadvantage of fiber vs. coax systems was fiber's laser noise performance, a disadvantage that today has shrunk in proportion but still remains.

The VSB-AM (vestigial sideband-amplitude modulation) technique requires a very linear system. It is the accepted transmission format for most coaxial transmission applications due to its efficient bandwidth utilization. In applications where a higher quality signal is required, an alternate transmission technique used is FM/FDM (frequency modulation/frequency division multiplexing). An FM-based system uses more bandwidth than an AM system; therefore, its total channel capacity is significantly reduced. In return it provides both enhanced signal-to-noise (S/N) over carrier-to-noise plus an additional noise tolerance. So, FM is the preferred technique for analog signal transmission where an S/N improvement is desired. Typical applications for FM include long coaxial cable runs, satellite-delivered and long-haul microwave—but not AML (amplitude modulated link) communications—and fiber-optic systems.

In early fiber systems, the noise-contributing components were so great as to reduce the capacity that could be effectively carried on a fiber using FM to four channels. Maximum distance was limited to a very small number of repeaters before noise buildup became intolerable. It was true that the signal could be sent approximately three miles without any repeaters, but whereas a coaxial system needed only one cable to transmit 24 FM channels, a fiber system needed six fibers. So, over equal distances fiber systems had less electronics locations, but six times the number of transmitters or receivers per location.

The hopes that fiber would reduce overall electronics counts significantly were dashed, at least temporarily. Still, one advantage of fiber was clear: On runs of under three miles all electronics were indoors and accessible all of the time. Performance of these early systems was usually in the range of 52 to 57 dB S/N, depending on repeaters for channel loading.

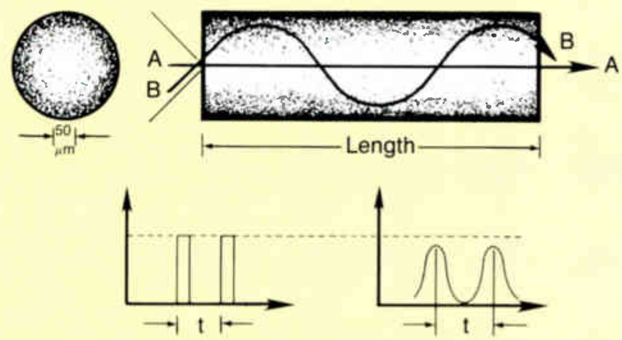
Current fiber system capabilities

State-of-the-art fiber-optic systems are capable of transmitting 16 channels per fiber today over distances of 18 miles without repeaters. Some even guarantee worst-case performance exceeding RS-250B medium-haul video specifications, including 60 dB S/N contribution with full 16 channel loading. To see how systems have achieved this performance level (and how up to 60 channels per fiber has been achieved in laboratory settings), a short history of fiber-optic development is presented in the accompanying sidebar.

Lightwave transmission over fiber exhibits many of the same characteristics as microwave waveguides. All early fiber allowed multiple paths (modes) for the light to travel down the fiber within a large active core diameter, thus referred to as "multimode" fiber. The paths that light can travel in a multimode fiber allow a light pulse to travel different distances in differing paths within the fiber. Imagine if a light square wave were injected into one end of a multimode fiber. The output at the other end of the fiber would be a parabolic distribution of arriving signals, which is a result of their varying path lengths.

If two square waves are rapidly sent in succession, the longer they travel down the fiber, the greater the "smearing," and the more difficult it will be to sense each individual pulse. This is because of the overlap between

Figure 1: Graded-index fiber



Source: ALS/Times Fiber Communications, *Fiber Transport Systems Catalog*, June 1983.

the latest arriving light from the first pulse and the earliest arriving light from the second pulse, due to the varying path lengths (see Figure 1). This phenomenon produces a bandwidth/distance limitation in multimode fiber similar to roll-off in CATV cable. In FM-based systems, this limits the total channel capacity of the fiber and is the major reason that early CATV fiber systems were limited to four channels per fiber.

In contrast to multimode fiber, a single-mode fiber only allows a single light path down the fiber. It was clear to researchers that for a given optical wavelength, single-mode fiber was the desired type for long distance transmission because it eliminated one of the two major sources of optical smearing. Two obstacles stood in the way: As late as 1983, single-mode fiber was difficult to produce in quantity, and laser light sources had to be developed small enough to couple an adequate amount of light into the fiber. The deregulation of long distance telephone forced both of these advances.

Another major cause of optical smearing was due to the fact that most lasers emit not one frequency of light but a closely packed set of frequencies. Light of differing frequencies usually travels at differing speeds through optical materials. An example of this is the simple optical prism. Visible light travels through the prism at different speeds and is spread into a rainbow. If this occurs in a fiber, some light arrives earlier or later than the rest of the light, similar to the problem of multimode fiber. To manufacture a laser that emits a single frequency to solve this problem is very expensive.

The alternative is to manufacture fiber that is chromatically flatted, i.e., allowing light frequencies within a certain set of narrow bandwidths to travel precisely at the same speed down the fiber. If all the light entering the fiber travels at the same speed regardless of frequency, then the bandwidth of the fiber will be practically limitless. The only factors that will then limit fiber-optic capacity are the attenuation of the fiber and the bandwidth of the transmission electronics themselves. This is in fact the case for modern fiber-optic systems.

Attenuation vs. wavelength

In modern fiber systems, the limitation of maximum transmission distance is based on the attenuation of the fiber. The attenuation of light by a fiber is directly affected by the selected transmission wavelength. In general, longer wavelengths travel with less resistance than shorter ones. In modern fibers typically produced in the last three years, light at 1,550 nm travels with less resistance than 1,300 nm, which in turn travels with much less resistance than light at 840 nm. Table 1 illustrates typical ranges of optical attenuation for various light transmission wavelengths.

Ideally, all fiber systems should be based on long-wavelength technology. Selection of light transmission frequency has always been limited by available laser semiconductor technology. Until 1984, the only 840 nm lasers were available in quantity capable of being manufactured at a cost of under $10,000. Early lasers of 1,300 nm and 1,550 nm frequencies varied greatly and were incredibly expensive. Therefore, early fiber systems utilized 840 nm wavelength lasers for optical transmission.

However, 840 nm device physics is far from ideal and reliability suffers accordingly. Intercooling the laser to control its temperature helps; this

Table 1: Typical ranges of fiber attenuation

Frequency	Attenuation per kilometer (1 km = .61 miles)
840 nm	2.5 to 4.0 dB
1,300 nm	0.5 to 0.3 dB
1,550 nm	0.4 to 0.2 dB

is done as a rule with virtually all semiconductor lasers today. Early 840 nm lasers tended to have average lifetimes of 10,000 hours or less (almost one year), and today only have lifetimes approaching 40,000 hours (about 4½ years). Hence, a common complaint of early fiber system users was that the lasers needed frequent replacement, even more often than klystron tubes in microwave systems.

We developed a circuit that sensed laser aging by measuring the required bias voltage to create a given light output from the laser. As the laser aged and the bias voltage went beyond a certain level, a warning indicator on the front panel flashed on, giving the operators fair warning weeks before an actual laser failure could occur. CATV operators could therefore change out the transmitter with a spare at their convenience and avoid a hard system outage. Today, most manufacturers offer this important feature.

Today, 1,300 nm single-mode devices are cost-effective and are the laser of choice. The device physics of 1,300 nm lasers is such that average lifetimes of these devices are in excess of 17 years (150,000 hours). Unfortunately, 1,500 nm devices are still more expensive than 1,300 and may not provide any performance advantage. The reason for this is that until recently fiber chromatically flattened at both 1,300 and 1,550 nm was not available. Therefore, where single-mode, dual-window (low attenuation at both 1,300 nm and 1,550 nm) fiber has been installed (over two years ago), it is probably not chromatically flat at 1,550 nm. If a standard 1,550 nm laser is used with this fiber, bandwidth roll-off due to chromatic dispersion will limit transmission distance to less than 1,300 nm systems, even though optical power is more than adequate.

With this fiber, the only 1,550 nm solution is an expensive distributed feedback (DFB) laser in order to compensate for chromatic dispersion. DFB lasers emit a single frequency of light. Most often the only time a DFB laser is warranted is when an existing fiber cable is fully loaded with channels at 1,300 nm and the cost of installing additional fibers for expansion is prohibitive. In this case, combining a 1,500 nm DFB and 1,300 nm standard laser with an optical multiplexer will double existing fiber capacity.

CATV fiber-optic hardware

Based on both current fiber-optics technology and fiber transport product development, early systems using 840 nm multimode lasers and fiber were quite limited. Initially, since fiber systems were much more costly than other alternatives, first- and second-generation fiber systems were designed to minimize their cost. These systems consisted of a series of individually packaged modules that were hardwired together by a series of cables, a cable harness or other means of interconnecting the system. Each module was designed for a specific channel frequency assignment, which meant that a spare module was required for each and every channel and module type.

To adjust the system or change out a module meant using two people, one in the back of the rack to access the wiring and one in the front. Adjustments in many cases meant disconnecting a module and unscrewing covers, or using specialized access cards to do the same. Changing a power supply meant disconnecting whole groups of modules, thus shutting down a portion of the system. Since every module was separate and 19 inches wide, the system took a large amount of vertical rack space. These compromises were made to minimize the overall system cost.

Third-generation systems still used individual modules. but now the frequency could be adjusted by an access point in order to change the assignment. Some systems used one type of module for half the channels and another for the other channels. Other systems kept a fixed-frequency module for every channel, and used one adjustable spare module that was more expensive, to cover failures. This design called for careful management of repairs, since if a channel came back from repair, the spare had to be removed to be available in case of failure on another channel.

In earlier systems, optical AGC (automatic gain control) was accomplished simply by a circuit in the receiver. This measured the average optical-received power and adjusted the gain if the received power varied from the value set at initial system installation. This method was relatively loose and became truly a problem for systems that sent NRZ (non-return to zero) data along with video, since the data carrier is present only while data is being transmitted. The solution designed into some third-generation systems was to generate a pilot carrier at the transmitter and use the level of the pilot carrier to determine AGC in the receiver. Third-generation systems were the first to provide this very necessary feature, which is still preferred today.

With fourth-generation systems, it is clear that fiber optics is being used to connect multiple headends together to carry large number of channels. Reliability, maintainability and flexibility have become key. Fourth-generation systems feature all universal modules, which can be used for any channel interchangeably. Channel frequency assignments are digitially synthesized and channel assignment is made by way of a front-mounted rotary DIP switch. Whereas earlier systems required rear rack access, fourth-generation systems use front mounting, slide-in modules that can be installed and removed by sliding them into a universal 19-inch mainframe while under full power. All electrical connections are made automatically; once the system is installed, there is no need to go to the back of the unit. Therefore, these systems offer a very fast mean time to repair.

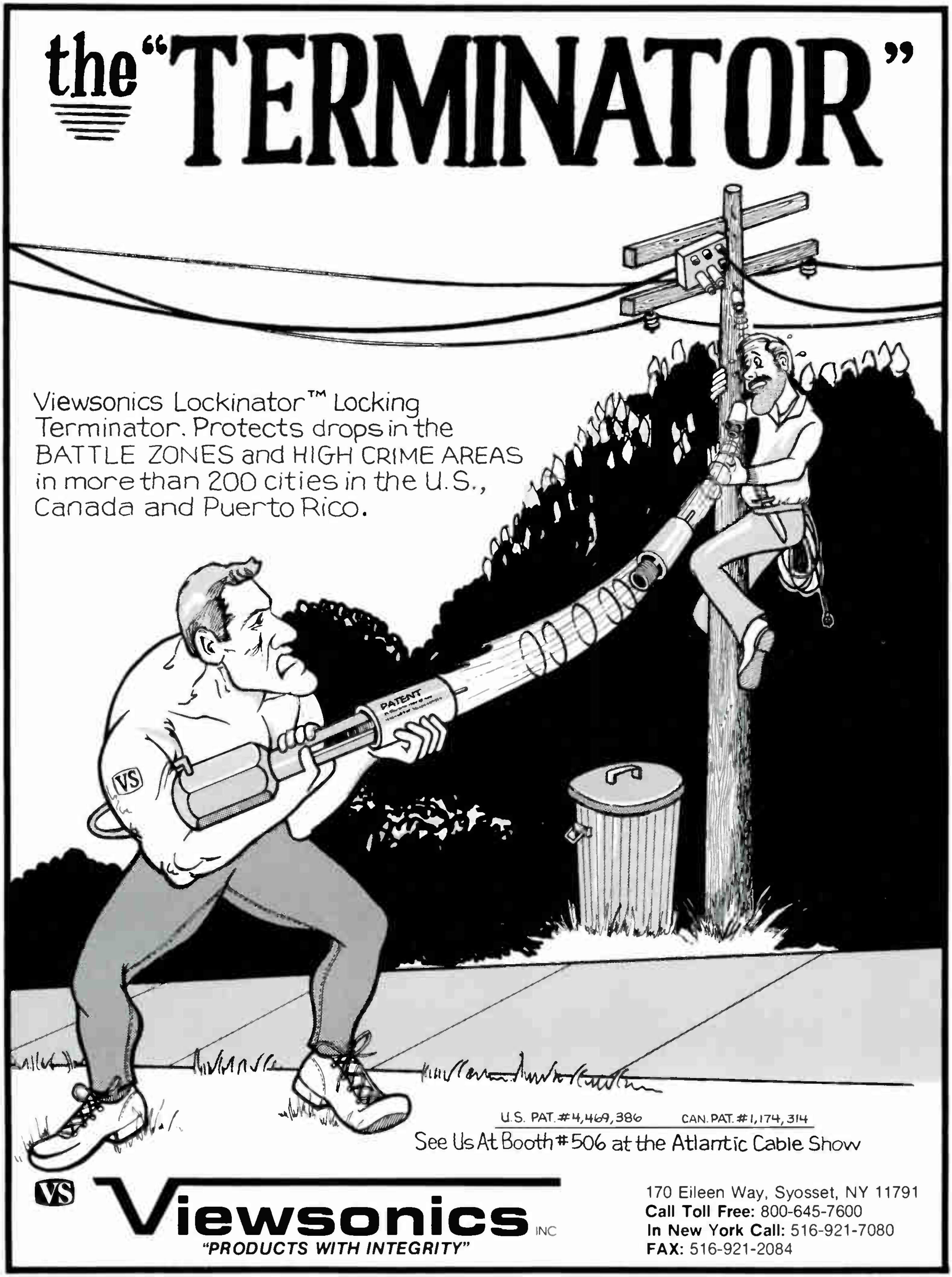
These systems offer the capability of transmitting voice and data besides video. They also are being used to provide corporate, institutional and educational interconnects. Some of these systems even offer a performance measurement and monitoring feature. This option allows fiber-optic equipment at all headend locations to be continuously monitored from any remote site. Operation at the system and module level can be tracked and even plotted graphically using a standard PC spreadsheet program to schedule maintenance and evaluate system performance. If a soft or hard alarm condition occurs, the monitoring program informs the operator of the location and the actual module that needs to be examined or replaced. These systems are designed to allow multiple equipment locations to operate unattended and minimize overall systems maintenance costs.

Advances in the near term for fiber systems will most likely be in the area of additional channel loading per fiber. Only one year ago the average system carried 12 channels per fiber maximum. This year, 16 channels per fiber are being delivered with equal performance. Perhaps the greatest obstacle for fiber to replace the majority of long coaxial cable runs in CATV systems is the noise performance of lasers, which forces the additional cost of frequency modulation and demodulation equipment. Laser technology needs to improve by a minimum of 15 to 20 dB in order for VSB-AM transmission to be possible. American Television and Communications Corp. has been working with the various fiber-optic system suppliers in an attempt to stimulate this application direction. Most experts see this as a possibility within five years.

Other major areas for promise remain in the fiber itself. Every five years has seen a major leap in the ability of fiber to transmit signals significantly further without reamplification. Quite recently, GTE announced a laboratory-fabricated fiber that theoretically can transmit signals virtually across the United States without a repeater. For the long term, this bears implications not only for CATV systems applications, but more importantly on the entire argument of digital vs. analog transmission for many wide-band services. For example, if no repeaters are required, long distance transmission of digital vs. analog video loses much of its appeal, since the cost of digital conversion is about five times the cost of FM, and most wide-band services such as television do not have the complex routing requirements of telephone and data applications.

Fiber optics vs. alternatives

Recent studies by CATV operators show that the current cost of fiber-optic systems makes them an attractive alternative to other technologies.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For example, a recent study by Charles Cerino of Comcast showed the capital cost for a fiber system about equal to an FM coax trunk and less than AML, but with much higher picture quality and no active line electronics required. Jim Kersnowski of Continental Cablevision in Springfield, Mass., found that fiber was more attractive based on long-term savings and received signal quality for a multiple headend rebuild. The following are considerations to use in examining fiber-optic interconnects vs. alternative systems:

Fiber vs. microwave

- Received signal quality—A better signal at each headend by fiber will allow longer system cascades delivering the same or higher signal quality to the customer.
- High-power klystron replacement—To serve multiple headends and have adequate system margin requires high-power klystrons. Factor into your analysis periodic klystron tube replacement.
- Headend building costs—You can't just put a microwave tower anywhere in the city. The space requirements also must be considered. A fiber-optic headend will take less square footage and can be located optimally in the city relative to cost, convenience, size and service.
- Roll-off—Fiber systems give the same basic performance across the spectrum. You need to computer roll-off in the upper channels for microwave.
- Channel blocks—If all your channels aren't together and must be reorganized, don't forget that video reprocessing equipment in your microwave is expensive.
- Customer satisfaction—Microwave fade due to thunderstorms, etc., often comes at high viewing times. Check with the marketing department for the value of continuous uptime.
- Alternate services—Fiber can be used to carry data channels and telephone trunking. Are any of these potential revenue gainers?
- Capital costs—Fiber hubs don't have an initial high expense but rather are evenly priced over the headends required. The expenses can be proportioned as systems are rebuilt, instead of a high upfront capital cost.

Fiber vs. FM trunking and supertrunking

- Received signal quality—A better signal at each headend will allow longer system cascades delivering the same or higher signal quality to the customer.
- Maintenance—No electronics in the run means no trucks to roll. What is the cost of a truck? Can you factor in the people costs? What if you include remote status monitoring: Could you run a remote headend virtually unattended and schedule preventive maintenance by computer? How much would you save in these people costs?
- Reliability—No standby amplifier power backups along run, no amplifiers along run to replace. Fewer electronics means higher reliability.

History of fiber-optic developments

1978	First video trunking system installation in United States. First-generation fiber transport equipment!
1979	First multichannel CATV installation in the United States.
1980	Premiere of second-generation systems, featuring modular components. Second-generation transmitters/receivers with automatic laser compensation, four channels per fiber.
1982	First use of wide-deviation FM equipment.
1983	Third-generation systems. New modulator and demodulator designs. Installation of the largest fiber-optic trunking system in the CATV industry, with 20 channels and nine repeaters using 840 nm technology.
1984	Development of frequency agile SAW (surface acoustic wave) circuits for RF switching products. Improvements in transmitter and receiver linearity.
1985	Beginning use of 1,300 nm single-mode technology in trunking systems, resulting in transmission of eight to 12 channels per fiber.
1986	Introduction of fourth-generation systems with 16 channels per fiber and universal module designs, including adaptation of frequency agile SAW circuits to frequency agile modules. The move to telco-quality modular power supplies.
1987	Introduction of status monitoring functions to fourth-generation systems.

Deciding on costs and vendors

Fiber: As the United States became relatively heavily wired with fiber optics for the long distance telephone networks, the volume production of fiber increased dramatically while demand peaked. The last year has seen a decrease in the price of fiber to under 10 cents per fiber foot for multifiber loose-tube aerial cables. In fact, in large configurations prices have been quoted as low as 7 cents per foot. Armored, flooded cable usually adds about 12 percent on average. Assume 16 channels per fiber for maximum loading plus at least one spare fiber if possible for unanticipated expansion.

Splicing: Typically, a splice is required every 1.2 miles. There are two field-proven methods of splicing fiber today: fusion and rotary mechanical splicing. Each has its own merits. Use a budgetary figure of $300 per splice location.

Installation: Use the same numbers as for CATV construction. Fiber installation is becoming very competitive, and modern fibers are relatively easy to install.

Electronics: Fourth-generation systems can carry BTSC signals directly as composite video. Compute these channels at $4,500 each for the first two headends and $2,250 for each extra headend. If audio must be carried separately as subcarriers, add $900 for the first two headends and $450 for each additional headend, respectively, per audio. These figures include all modulation and fiber transmission electronics. Use 18 miles for maximum repeater distance. If a repeater is required, compute at one per active fiber at $9,000 each.

Test equipment and miscellaneous: Fourth-generation systems do not require much test equipment beyond normal CATV headend electronics test gear. An optical power meter is $1,500. An emergency splice kit to perform permanent or fast, temporary field splices costs approximately $2,000.

Good engineering sense is required whenever a large capital investment is called for in the overall CATV system. Therefore, some common rules of sense apply. First, a vendor should have a proven track record. How do you determine that? For example:

1) How long has the vendor been in business?
2) How long has its *current* engineering team been in place?
3) Does the vendor have a record in providing a migration path from earlier generations of equipment, or is each product family incompatible with new generations of equipment?
4) Are performance specifications on data sheets "typical" or guaranteed worst-case performance over all operating environments?

A vendor also will help you with system distance and channel loading calculations. Watch out for the vendor that doesn't include optical safety margins of at least 3 dB in your design after connectors, splice losses and cable attenuation are taken into account. For example, a common ploy is to compute margin using the maximum rated output of the laser. (This gives the appearance of an additional 3 dB of optical power over competitors' systems.) However, if the average drive level is set to this value, which is typically 0 dBm, the laser will be consistently overdriven and its life shortened. Make sure that the calculations include the guaranteed performance of the system with the maximum channel loading that you are planning over the life of the system.

A field-proven alternative

There are approximately 50 fiber-optic installations in CATV today with the rate growing. The technology is proven in long distance applications, with tens of thousands of miles of plant now installed. Fiber optics offers the highest quality alternative for transmission of video signals over long distances with very low maintenance and long plant and equipment life. Ten years after its first CATV installation, fiber is a viable, field-proven alternative for the industry.

The Problem

Moisture is a major concern for today's cable system operators. It is the leading cause of damaging corrosion, resulting in premature cable failure and signal leakage, ultimately causing poor reception and increased customer dissatisfaction. The end result — rising maintenance costs and frequent replacement.

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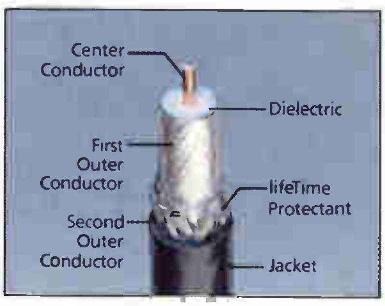

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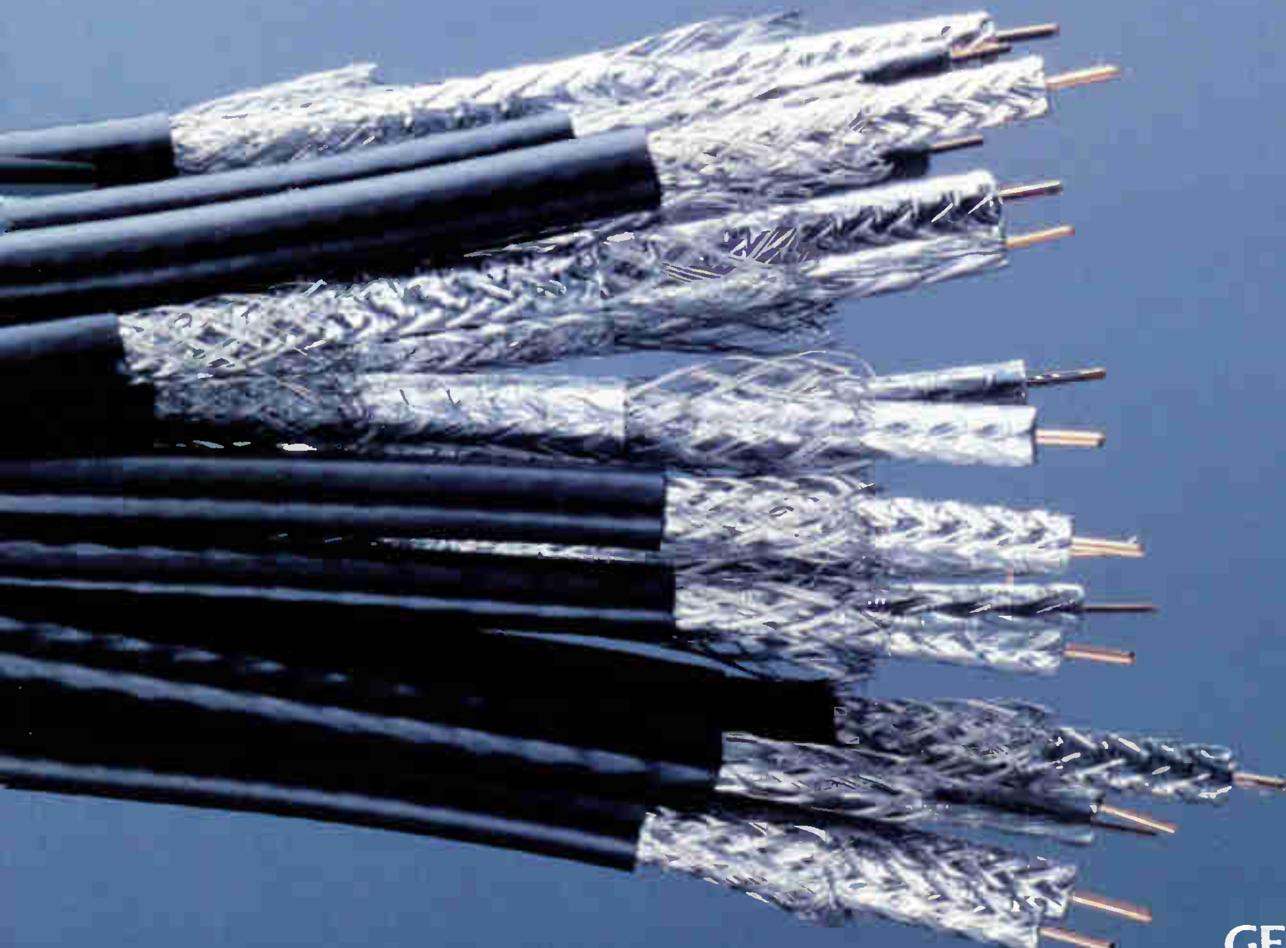


How to conduct a CATV drop audit

By Charles Jetton
National Audit Director, Times Mirror Cable TV

It's estimated that theft-of-service costs the cable TV industry over $1.4 billion annually. If you run a system with 5,000 subscribers this could mean over $60,000 out of your pocket each year. It's been shown that 90 percent of theft-of-service is caused by internal factors over which management has total control. These factors include physical disconnects not being performed, converters not being retrieved from disconnected subscribers and services left on due to improper office records. Each of these factors can be successfully controlled through a well-planned and implemented drop audit program.

Unfortunately, most theft-of-service meetings focus only on external factors, and many people comment after that they had hoped to learn how to audit their systems. This article outlines the steps necessary to establish a successful drop audit program. These can be adjusted to the personnel and resources of any size system. It makes no difference if you have 100 homes passed or 500,000.

Drop audit team

The first step in establishing a drop audit program is to put together a team. You need an audit clerk (recordkeeper) and a few field auditors. A good auditor can work 1,500 passings a week. You can operate with individual auditors or in teams. If you only have one or two people available, an auditor can also act as the clerk. With normal system assistance, two auditors can work a system of 30,000 homes passed in 2½ months.

Audit costs run from 31 to 68 cents per home passed. With special audit projects, they can be very profitable when running from 68 cents to $1 per home passed audited. With a basic illegal conversion rate of 59 percent and a pay-to-basic conversion rate of 122 percent, this is very profitable to any system. For larger MSOs, corporate or company audit teams are more efficient to perform full audits than are system teams. System personnel have a tendency to get tired and discontinue audits before they are completed.

The basic responsibilities of a drop audit by the team are:

1) *Physically check out and count all units* in the cable area, including total active drops, total inactive drops and total units passed but not wired.

2) *Find out all illegals and potential illegals*, for both basic and pay.

3) *Convert illegals to paying customers*, according to a pre-established conversion plan.

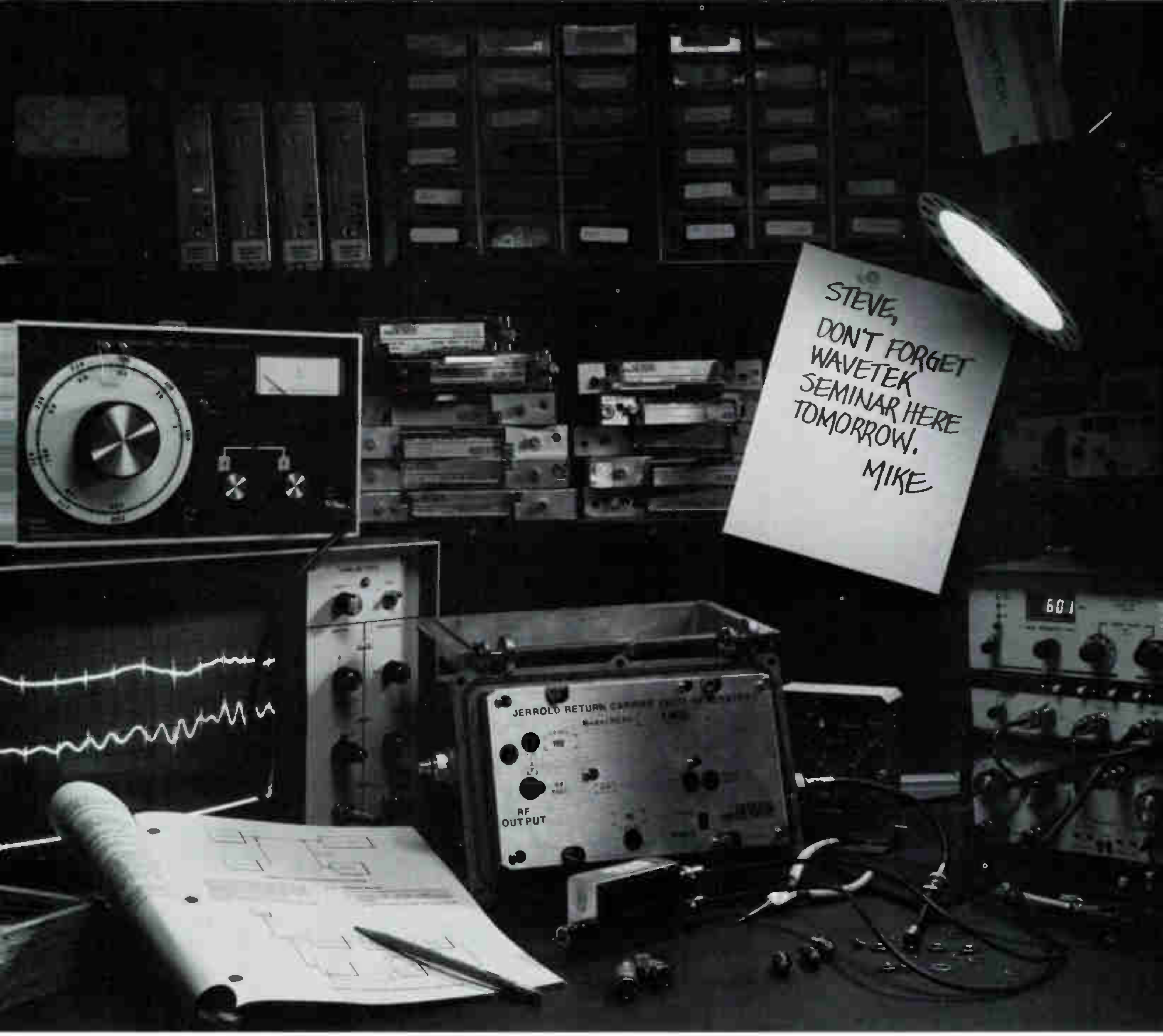
4) *Disconnect illegal services*, applying proper security on drops not converted in designated time period. Disconnect and tap-lock basic cable illegals. Apply or remove all security devices to disconnect illegal pay services; use security shields where needed.

"Be sure to include a quality assurance program that checks 20 percent of your weekly disconnect drops."

This disconnect procedure is the most productive part of a drop audit. If properly conducted with proper rechecks, it will produce more conversions than most sales campaigns. People living in these units will be forced to call in for cable services. It contributes most to a complete "house cleaning" and creates ongoing security efficiency by employees of the system being audited.

5) *Update the homes-passed list*. Supply updates to the system so it can ensure that only true addresses appear on the street list. This improves office and field efficency in this never-ending process and makes marketing more accurate and economical.

6) *Implement and emphasize the procedures*



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Drop audit update

System name (one pay trapped)	Date 8-11-87
Homes passed	
Homes audited	4,744
Disconnected drops	1,774
Basic-only illegals	45
Basic & pay illegals	451
Total basic illegals	496
% of disconnected drops	28
% of homes audited	10
Pay-only illegals	390
Total pay illegals	841
Total drops illegal	866
% of homes audited	18
Total potential illegals	1,337
% of homes audited	28
Sales conversions update	218
Basic cable conversion	
% of contact	44
% of basic illegals	
Pay cable conversions	479
% basic sold	220
% of pay illegals	57
Cross-street reference update	
Add	290
Delete	(110)
Net	180
No drops	917
Total connects	1,557

for an ongoing drop audit for illegal subscribers. This develops an enthusiastic cooperation between the office and field personnel in carrying out their security methods and performing their work properly. It also encourages system managers, supervisors and all other employees to make regular security checks.

At the end of each audit an "action memo" describing the security procedures for the system to follow should be left with the system manager. Most of these procedures should already be well in motion before the audit is completed. This should be included in the final audit report. Written responses from people coordinating these recommendations are required.

Be sure to include a quality assurance program that checks 20 percent of your weekly disconnected drops. Have a written disconnect procedure that everyone signs and develop a four- or five-step system drop audit program.

7) *Record those items in need of repair or immediate attention.* The system must be informed immediately, when necessary, of items needing urgent attention. Situations of urgency can be reported daily if systems wish. If necessary, a complete record of "in need of repair or immediate attention" should be included in the final report.

8) *Special assignments* are designated prior to initiating the audit in a planning meeting. Establish the degree of marking, tagging, taplocking, security shields, cleanup work or any specific needs of the individual system that the audit team will perform. Also establish the disconnect method and conversion plan as well as special assignments.

9) *System responsibility*: The system must be notified in plenty of time prior to the audit to have the required quantity of drop audit supplies (tags, markers, tap-locks, shields, keys, door hangers, equipment to buzz our apartment and underground areas, etc.) in stock.

10) The system should receive a *weekly updated drop audit chart*. This is designed for each individual system being audited according to the services offered and the security methods used. It should show a complete picture of how the audit stands at the end of each week. (See accompanying table.)

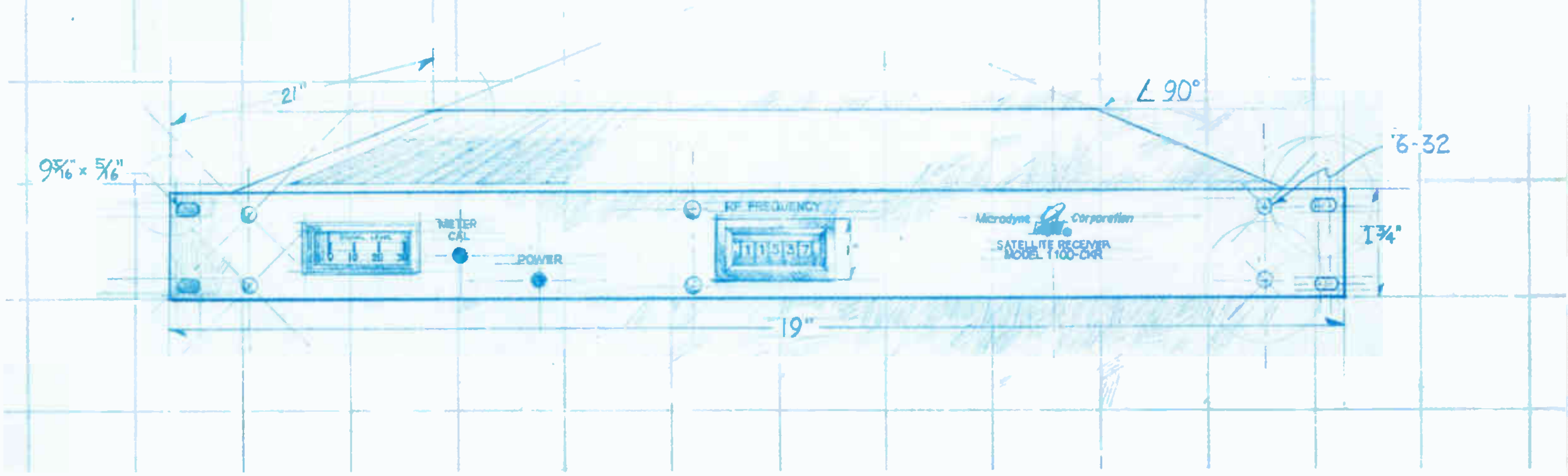
Drop audit procedures

Request a complete homes-passed list for the system. The more information an auditor can carry into the field, the easier the job. If a complete printout is not available, you can still conduct a good audit if you have file cards, an address list or just record the addresses and all information possible on blank paper.

In some larger systems you may want two copies, one for the field and one for your records. Determine if it is necessary to request separate lists for tax codes, ZIP codes or cities. In large systems requests can be made by quarter section, T-areas, franchise areas, power supplies, etc. This will be decided during a pre-audit planning meeting with the system manager.

Include all addresses on file: active, disconnected and not wired. The printout should be by installation addresses in street name and number order. Double- or triple-space to have plenty of

Inch For Inch



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room for addresses not listed and for not-wired addresses. Skip to a new page each time a street name changes, with no two streets on the same page. All streets can be broken down into areas.

Physically check the status of every dwelling or address in each area, as follows:

1) Using a city map, break down the streets in the cross-street reference or printout into well-planned areas. Each person needs a folder for the homes-passed list. This is good protection for the printouts and makes writing more comfortable. Also, give each person a small map and attach a list of the applicable streets to the folder.

2) Study the areas to be worked, equipment, transportation and personnel available. Decide when and where to use one-, two- or three-person crews, ride or walk and use walkie-talkies.

3) Every person should know the audit plan. The different methods can be discussed and decided upon during the planning meeting, including codes for audit crew to record on printouts and codes on homes-passed list, representing all services and other information auditors should know about the particular system being audited.

It is necessary that the clerk, system people and all auditors understand this plan and talk the same language. Everyone must study and understand all services, tag systems and colors, traps and colors, and converter types. The plan for each individual system will allow for the auditing of all services or as many as the system security program will allow. It also will code all potential illegals.

4) Record the correct status of every address passed by cable. If you have no field records, record this information on a blank tablet: active drop (plus all services), disconnected drop or not-wired address. Write in correct addresses and their status if they do not appear on printout. Mark all duplicated addresses and include special information or projects the audit requires (markers, tag numbers, in need of repair, etc.).

Compare the field readout with the most up-to-date homes-passed list or other records available. Auditors will turn in their completed work at the end of each day. Then, the audit clerk should identify all illegal services and record them properly on the printout. Also the clerk should record all illegals on a four-part form: white for audit reports, pink for systems reports, yellow for the sales department (if available) and gold as an extra copy.

The audit clerk or the audit manager must update the cross-street reference each week. The updates will be discussed with and given to the system person in charge of the updating process.

Converting illegals

The system's plan for converting illegals should be decided at the audit planning meeting. One approach cuts down on the costs as well as amount of work system installers have to perform:

The audit clerk or audit manager gives the illegals lists to sales department each morning. Sales at once contacts and sells all illegals possible. A time schedule can be worked out between the sales and audit departments. The sales department returns the illegal copy to the audit department and all "no sales" are disconnected or trapped not later than the following week. The salespeople will make another follow-up after the disconnect is performed.

After performing disconnects, the audit manager pairs the yellow copy with the white copy and the audit clerk will see that they compare with records on the homes-passed list.

The "disconnect as you audit" plan works differently: The audit clerk checks the cross-reference printout against the latest updates before the auditors take them to the field each day. (This is very accurate if the system is on-line.) The auditors then disconnect and trap as they go and leave door hangers. The audit clerk checks the auditor's work each day and prepares the illegals list.

The illegals list is turned over to the sales department for follow-up. The salespeople turn their completed yellow copies over to the audit manager after their follow-up and the audit clerk completes the records.

Both of these conversion plans work well and can be combined. The conversion rates are going to end up about the same either way. You can use the first plan, but trap (pay-only) as you go. This is best when pays-only are going to be sold by telephone sales. Most of these people call in and buy a pay service after they have been disconnected. Be sure people on night duty have a complete illegal disconnect list.

The size and experience of the audit crew, size of sales force, size of the system, type of illegals and time allotted for the audit will determine the plan. These methods can be changed with little trouble when necessary during the audit. There are areas in some systems where one needs to disconnect the illegals and get out. The illegals will talk to you and be more pleasant after they are disconnected than when an auditor tells them that they are being disconnected because they do not buy the service; many will walk in and buy. Special rechecks need to be made on these areas.

The audit team and sales department can work together on special checks, disconnects, difficult cases and close many sales or cause people to come in and buy. This develops a very close and important working relationship. The audit crew performs all disconnects, required trapping, tap locking, security shields, security checks and carries out complete security so illegal addresses will have to buy the services. This assignment produces more conversions and future subscribers than any part of the audit. A sales effort is not necessary for a successful audit.

It's important to note that many illegal drops are in MDUs and underground areas where the addresses are not properly marked. Therefore, marking drops, cleaning up and locking lock boxes and pedestals are an important part of the audit.

Too much talking

Well-disciplined drop audits, the converting of illegals to paying subscribers and the effects of ongoing system programs have had an immense tendency to reduce pay illegals that are difficult to audit. Too many systems do too much research, thinking and talking, and little action. Get your available resources together and audit your systems. It will pay dividends for years to come.

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To convert a thief

By Laurence M. Bloom
Partner, Cable Resources Inc.

"No person shall intercept or receive or assist in receiving any communications service offered over a cable system, unless specifically authorized to do so by a cable operator. . ." *Cable Communications Policy Act of 1984*, Public Law 98-549, "Unauthorized Reception of Cable Service."

As long as there have been paying subscribers to cable TV there have been freeloaders. For the past three years I have discussed with cable operators the depth of the problem in New England. In general, they all agree that there is theft in their systems, but it is not a major problem to be solved today. Others insist they have no illegal attachments because their system is addressable and therefore can't be broken into. Still others say that there is nothing to worry about because paying penetration is at an all-time high.

The primary way a system acquires unauthorized attachments is through its field procedures for disconnects. Most systems' procedures require picking up the converter and terminating the drop from the home. The termination portion is often not done; it is a lot of work to climb the pole to do the disconnect. (I've heard this type of disconnect referred to as a "coffeebreak disco." Since those cable operators who don't have follow-up procedures cannot ensure a drop has been properly terminated, the *dis*connect might not be performed.) All one has to do is reconnect the cable to a TV set. Even to totally honest people the temptation can be great. The usual violators are people just like your neighbors who do not even remotely think of themselves as criminals. The perpetrators put cable theft in the same category as cheating "just a little" on income taxes.

"Since those cable operators who don't have follow-up procedures cannot ensure a drop has been properly terminated, the disconnect might not be performed."

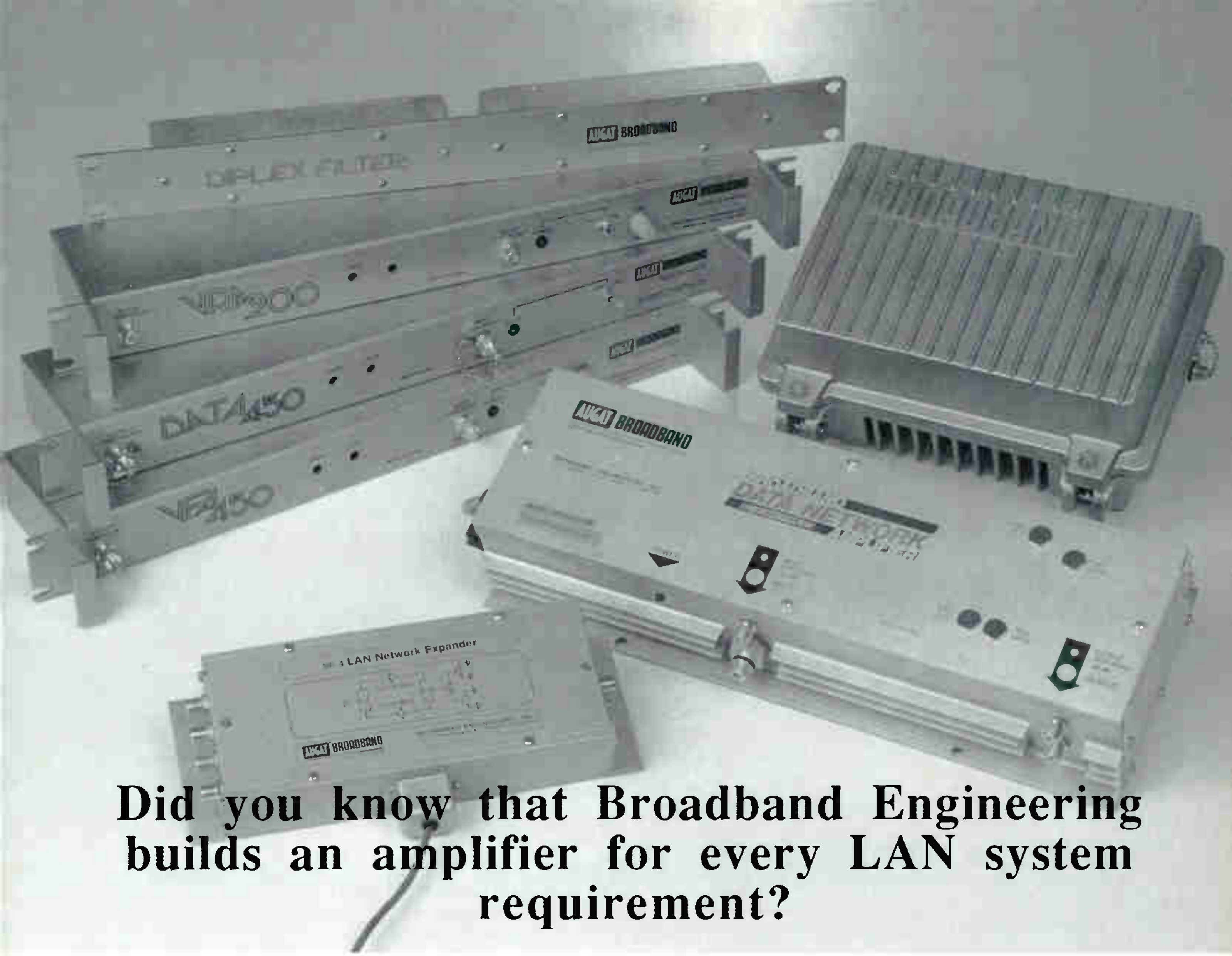
A frustrating problem

Anyone ever involved in theft-of-service can attest to the frustration in solving the problem. In most instances the operator is not even looking for a problem; it just pops up. Usually it begins when someone does something outrageous like showing movies and sports in bars without proper authorization, or a group selling "black boxes." The situation gets complicated quickly because of the antiquated way the problem is handled today.

The frustration is exacerbated by the criminal court system, which many times is cumbersome and complicated. To win in criminal court the operator first has to hire an attorney and detectives to investigate and gather evidence of the theft. Next, the city or state prosecutor has to be convinced that a crime has been committed before agreeing to file a court action. If successful, a year will have passed and over $1,000 spent. The court grinds slowly, and it is only after more money and time that a verdict is reached. If the case is won, the theft might be eliminated but the court-awarded penalty might not cover the costs of having filed suit.

In my opinion, this method of combatting theft-of-service has failed. It is time to evaluate a new approach, a program that will eliminate the problem and remove all unauthorized attachments to a system. The Cable Communications Policy Act of 1984 may have within it a framework for a whole new approach to the problem, one that is streamlined and can provide an easy and direct way to get to court without hassle. In this approach, the operator can get quick satisfaction by going to civil court and filing an action that is based on lost revenues caused by unauthorized use of the system. The degree of evidence necessary is not as strict as for criminal court. The ability to go to court easily should just be one tool in a theft-of-service program.

If you analyze theft-of-service solutions, you might find that they involve many different skills. The emphasis of a program should be to convert



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the illegal into a paying subscriber; court action should be the last resort. A comprehensive program can be conducted in three phases—*engineering, marketing* and *legal*.

The technical staff begins by conducting an initial survey to identify all drops on the cable system. Field teams are assigned the task of driving block by block throughout the entire system. Their function is to locate each drop off the system and determine whether the drop is connected or properly terminated. A street-by-street chart is created with every drop located on it. The field information is then compared to the cable system's data base. A report can be prepared identifying all of the drops on the system as either being authorized or illegal.

Staff members then revisit all of the drops that were identified as unauthorized. Each drop is tested electronically to determine if it is "hot" or not. It is during this visit that all of the proof necessary for court action is gathered. The test results of all of the hot drops are recorded so that they can be produced later as evidence along with sworn affidavits by engineers attesting to the results.

All of the drops are terminated and the staff leaves a notice of apparent violation at the residence in question. The purpose of the notice is to give the reason for the disconnect. It states that an electronic audit was conducted on the cable system and the drop to the house was not authorized. The notice informs the person that it is against the law to intercept cable television signals without making payment to the cable operator.

Besides informing the person of the disconnected service the notice serves to inform the person that he will be held accountable for violating the law. To give credence to this statement the proper sections and legal penalties of the state and the federal law are cited. On the softer side the notice also gives directions on how the person can enroll and become a subscriber. Within 48 hours after the disconnect, a registered letter is sent from the system. The letter restates the same message: Subscribe now or pay a fine later.

Marketing phase

At this point the staff goes into the marketing conversion phase. The objective is to persuade the illegals that they should become paying subscribers. An emphasis is placed on the fact that the person will not be getting free cable anymore. If there is no voluntary response to the notice, communication with illegals is done through salespeople or by a telemarketing and correspondence campaign along with scheduled home sales visits. In a very positive context it is explained that the choice is either to subscribe or pay a fine for being illegally hooked up. The marketing approach should be firm.

Once communication is open between the cable company and the illegal, the sale should almost be certain. At this point the staff should be successful in converting over two-thirds of the unauthorized attachments into paying subscribers.

The last step in the conversion phase is more formal than the others and less friendly. After allowing the sales team 30 days to complete the conversion, the marketing program shifts to the consequences of not cooperating. A final letter is sent that reviews the past contacts and the fact that the person has chosen not to resolve the matter amicably. The letter gives a last opportunity to either subscribe to the service or pay a prescribed penalty in order to resolve the issue and avoid going to court.

At this point the account is turned over to the staff for final legal action. Some state and federal laws governing the operation of a cable system have been revised to recognize theft of cable service as being illegal. For example, Section 633 of the Cable Act recognizes an ownership right by the cable operator for all of the signals on the system. The act makes it "illegal" to tap into a cable system without permission and payment for the services received. It also recognizes the civil court as a place for the cable company to get relief. An operator can take legal action against any person harboring unauthorized attachments without having to involve any local authorities. The operator also may collect lost revenues directly from the illegal.

A word on amnesty programs: They are only partially successful. Unless an operator takes complete action after the amnesty program ends, the problem will return with greater frequency. This means that those who were stealing before will remain, plus some who were cautious will illegally attach because they know that no action will be taken. An amnesty program may get some new subs but unless the theft-of-service problem is rooted out it will return.

Installation of fiber-optic cable

By Scott Stevens
Siecor Corp

Fiber optics has reached far and wide in the last four years, penetrating all areas of telecommunications. At one time, only the telephone companies had knowledge and experience with the installation of fiber-optic cable. However, with the tremendous quantity of sheath miles installed for businesses, campuses, local area networks, utilities, etc., most contractors now can claim some familiarity with it. What they discovered was that there is nothing magical about installing fiber. Indeed, if one has any experience at all with installing coax or copper, the transfer to fiber cable is very simple.

Fiber cable is surprisingly rugged, as Oceanic Cablevision discovered when a friendly neighbor drove over the figure-eight cable lying in front of her driveway. The cable was checked and no damage was found. It is also very lightweight, making it easier to install than regular coax. Even so, there are two critical specifications that must be observed at all times in order to prevent damage to the fibers.

The first parameter is the *minimum bend radius*, which specifies how tightly the cable can be coiled or bent around corners. The cable manufacturer will normally specify two different minimum bend radii, one for during installation and one for system operation. While the cable is under any tensile loading, the "during installation" number (typically a 9- to 10-inch radius) should not be exceeded. Once the cable is installed and no longer under load, the "free bend" number (typically a 6-inch radius) becomes the number not to exceed.

Some routes, particularly in duct systems, may require bend radii less than the specified minimum for installation. If so, the cable must be routed out of the bend and hand-assisted at that point. In no case should the free bend radius ever be exceeded, as damage to the fiber may occur. (Cable bend radius should not be confused with fiber bend radius, which is typically 3 inches.)

The second parameter is *maximum pulling tension*, which is the amount of tensile load that can be applied to the cable. The industry standard for fiber-optic cable is 600 pounds. To ensure this number is not exceeded, the use of a monitoring device is needed. A running line tensiometer, a power capstan with a slip clutch, a dynamometer and a remote pulling sensor are all acceptable methods to monitor or control the maximum tension during the installation.

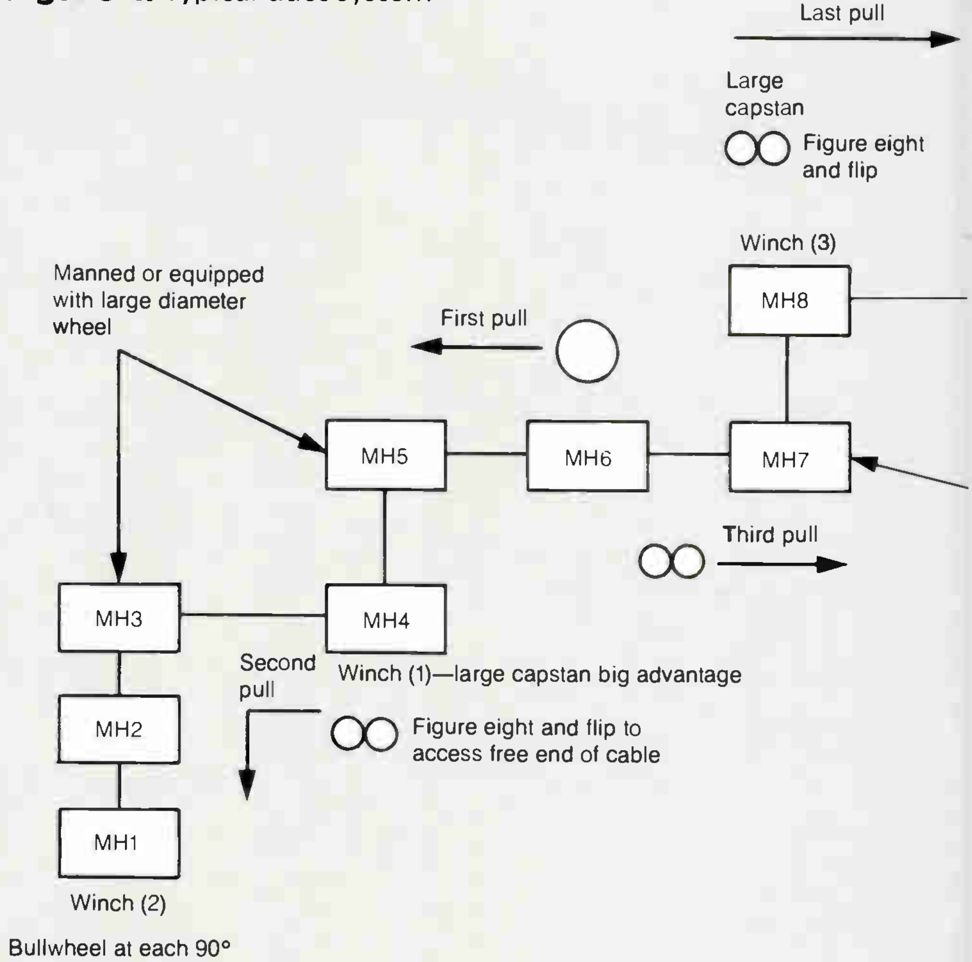
Duct installations

In general, the installation of fiber-optic cable in a duct system follows conventional cable pulling methods with a few modifications. A wire mesh pulling grip and pulling swivel are standard hardware items used to connect the cable to the pulling line. The swivel is important because the de-reeling of the cable and the stranding of the pull line can induce a dangerous torque on the lightweight fiber cable. Around corners and in and out of manholes, large diameter wheels (typically 20-inch), pulling sheaves or cable guides should be used to meet the requirements of the minimum bend radius.

The goal is to pull as long a length as possible to reduce costs associated with splicing. These costs include time, labor, materials and additional attenuation (optical power loss) at the splice point. Since the maximum pull rating of 600 pounds is almost always the constraining factor in duct installations, any method that can reduce the load on the cable is beneficial.

The effective coefficient of friction (COF) is the key factor in determining the load on the cable due to friction. While this parameter is not easily determined, a more useful measurement that is directly correlated to the COF is the fill ratio of the cable to the duct. (The fill ratio is calculated by dividing the cross-sectional area of the cable by the cross-sectional area of the duct.) When-

Figure 1: Typical duct system



ever possible it is recommended the fill ratio be kept at 50 percent or lower; e.g., a 1-inch sub-duct can accommodate a cable outer diameter up to 0.71 inch.

If feasible, pulling tension can be minimized by locating bends in the beginning of the pull when cable tension is still relatively low. Bends tend to multiply pulling tension instead of adding to it. For example, if a cable goes into a bend at 20 pounds of tension, it may come out at 30 pounds. However, if it goes into the same bend at 200 pounds, it may come out at 300 pounds.

A lubricant can be used to reduce friction in some of the more difficult pulls. (Some petroleum-based lubricants are not compatible with the polyethylene jacket of fiber-optic cable. Always check with the manufacturer for approved suppliers.) Most efficient use of the lubricant can be made by following the manufacturer's instructions. These commonly call for calculating the correct amount of lubricant based on the inside diameter of the duct and the length of the system. Normally, half this quantity is poured into the conduit prior to the beginning of the pull and the remainder is applied to the cable after half the cable is pulled in. If the cable is lubricated, craftsmen at hand-assist points will need gloves specifically designed to handle lubricated cable; alternately, rags can be used but tend to wipe off the lubricant. For additional reduction of friction the pull

Figure 2: Pull-in method

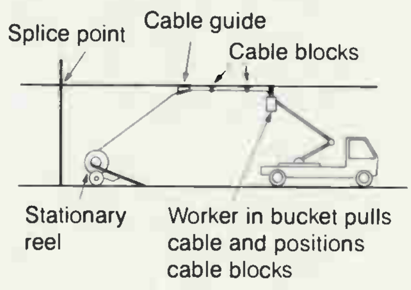
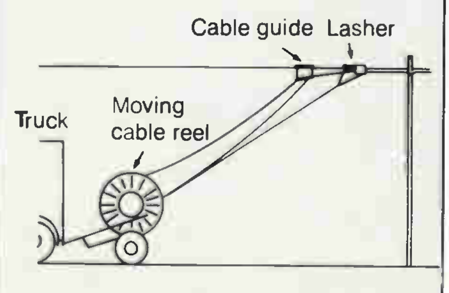
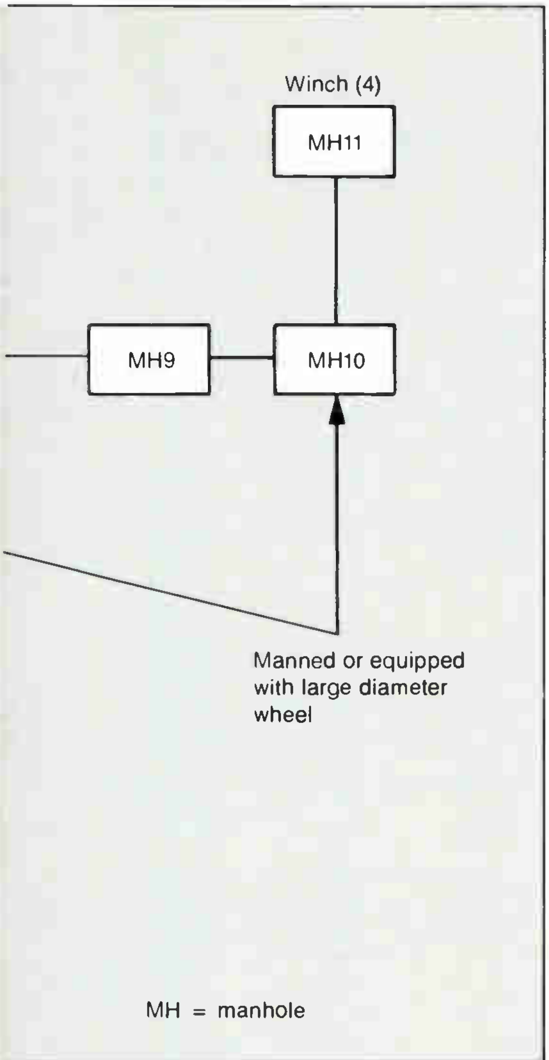


Figure 3: Drive-off method





line can also be lubricated.

Except for short pulls, the method of choice for installations is center pulling. This involves starting the pull at the midpoint of the system and pulling into the conduit in one direction until that section is complete. The remaining cable is then de-reeled by hand and placed in a large figure eight on the ground. The purpose of the figure eight is to avoid tangling and kinking. Once all the cable is on the ground, the exposed end is ready to be pulled into the conduit in the other direction.

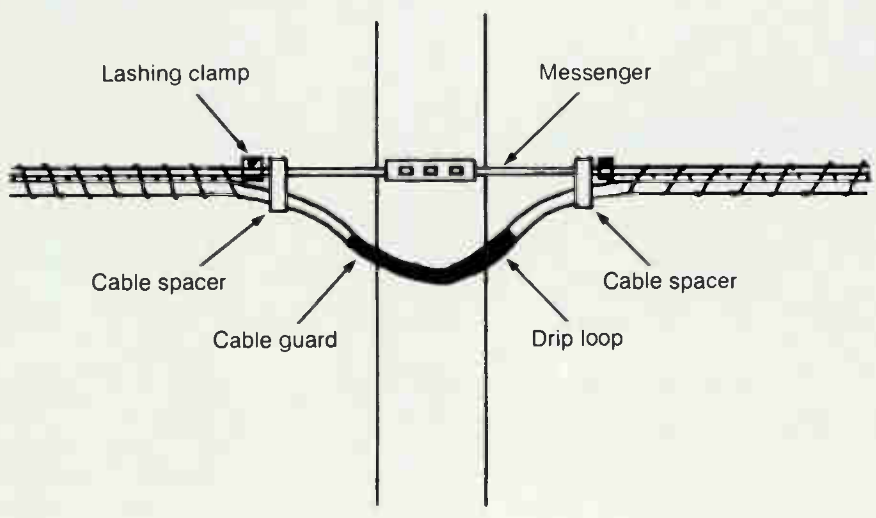
The concept of center pulling can be taken further by setting the winch at an intermediate manhole and working with a series of pulls (see Figure 1). The cable for an entire section is pulled through and out at the intermediate point, figure-eighted at that point, flipped over to expose the free end and then pulled back in to the next point. This technique usually requires a winch drum of sufficient radius to meet the cable's minimum bend radius specification.

Field personnel often resist the idea of figure eights because they are perceived to be labor intensive and may slow down the pull. However, experience shows that a series of short pulls can be done quickly. One hundred feet of six-fiber cable can weigh only 10 pounds. Because fiber cable is much more flexible than copper or coax, in the field 2,000 feet of cable has been figure-eighted in less than 45 minutes by two workers.

A final method to facilitate the pulling is to hand-assist at intermediate points. Because the cable is lightweight, hand-assists can be very effective. Short runs can be done entirely by hand. In longer runs, hand-assists can make the difference between reaching the end in one pull or stopping at an intermediate manhole.

The installations of buried cable can be the simplest, though not the cheapest, method of placing cable. It also takes advantage of the longer reel lengths available with fiber (up to 12 km). The cable should be jacketed with corrugated steel tape to prevent damage from rodents and crushing forces. Most cable can be placed by conventional plows and by vibratory plows (though some manufacturers do not rate their cable for vibratory plows). Typical depths are 3 to 4 feet. Aside from observing the bend radius, the plow operator should maintain control of the cable payoff. Having some cable slack at the shaft of the plow will minimize the forces on the cable as it enters the ground. Alternately, trenching can be used as the method of installa-

Figure 4: Drip or expansion loop



tion. The operation is the same as placing standard copper or coax.

One precaution that applies to both the plow and trench methods is to be sure large, sharp rocks do not crush the cable once it is in place. To help prevent this, rocky soil can be pre-ripped when plowing and the open trough can be backfilled with one foot of sand when trenching. Also, if desired, fiber-optic warning tape can be buried above the cable as an additional precaution against future dig-ups.

For CATV projects, aerial installations are the most common method of placing cable. Messenger wire (typically 6M) or existing coax plant are both acceptable hosts for fiber-optic cable. If the structural soundness of existing plant is in question, contact the cable manufacturer for stress calculations.

Two methods of lashed installations are recommended—pull-in and drive-off. The pull-in method (also known as back-pull or stationary reel) has the cable stationed at the beginning of the run while the free end is pulled along the messenger (Figure 2). Cable blocks are hung every 30 to 45 feet and a craftsman in an aerial bucket places the cable on rollers while pulling it along. Another craftsman guides the cable from the reel. Once the cable is pulled through all the rollers, the craftsman lashes the cable to the messenger and clamps it to the poles.

It is important to maintain control of cable slack at both ends. At the pulling end, tension is needed to prevent sagging, which can damage the cable by exceeding the bend radius. At the cable reel end, a braking action is needed to prevent excessive free running and to prevent the cable from winding around the messenger during stranding. Radio contact is recommended for instant communication should a problem arise.

The drive-off method (also called moving reel) is used where a cable reel trailer or aerial lift truck can be moved along the pole line (Figure 3). Any cross obstructions will slow the installation since the entire reel will have to be passed over these. However, no temporary cable blocks are needed.

The installation requires the free end of the cable to be tied off at the beginning of the run and the cable reel to be mounted on a trailer. The truck moves between spans and the cable is lashed as it comes off the spool. Tension must be maintained on the cable to prevent the lashing wire from wrapping around the cable around the messenger. At each pole the truck stops, and the craftsman in an aerial bucket transfers the lashing equipment to the next span and clamps or terminates the lashing wire. A cable guide should be used four feet ahead of the lasher to prevent kinking.

Standard lashing equipment is used to secure the cable to the messenger. At each pole the lashing wire should be clamped, but not necessarily terminated. A cable guard to protect against abrasions is recommended only when contact between the cable and pole is likely.

A drip loop (expansion loop) is needed at each pole (Figure 4). The drip loop relieves tension on the cable when the span is subjected to an additional load. The loop also allows the messenger to expand and contract due to temperature changes without affecting the cable. ■

Interfacing BTSC with the VideoCipher

By Robert E. Baker
Plant Manager, Cooke Cablevision

Many of us know which parameters to observe when using the VideoCipher IIC (VCIIC) TV descrambler—AGC voltages, video input levels and even chrominance-to-luminance delay. But one item not often discussed that headend engineers and technicians have or will face is a problem associated with the interface of a BTSC encoder, which requires discrete left and right baseband audio inputs. The problem surfaces when the general manager or chief technician decides to BTSC-encode a signal that has not yet gone to full-time addressable scrambling.

The usual manner for the BTSC encoder interface is to route the composite video baseband to the VCIIC along with the normal satellite video and audio baseband outputs. From there, the discrete left and right outputs of the VCIIC (TB2-1 and -2 for the left and TB2-9 and -10 for the right) are fed to the input of the BTSC encoder, while the video output from J-4 is fed to the modulator input. The composite BTSC output from the encoder is then routed to the modulator audio input.

"The left and right discrete audio outputs in the bypass and authorized modes are totally independent of each other."

This arrangement seems straightforward enough. If all of this wiring occurs while the signal source is "testing" (as in the fixed-key mode, for example), all seems normal. However, when the signal source stops the testing and returns to "in the clear" broadcasting (i.e., the VCIIC goes into the bypass mode), the audio input to the BTSC encoder is suddenly lost, resulting in the obvious loss to your modulator's audio output.

Put simply, the left and right discrete audio outputs in the bypass and authorized modes are totally independent of each other. That is to say, in the authorized mode of operation, these outputs are derived from the incoming encrypted digital signals. In the bypass mode, these outputs are dependent on external inputs at TB2 terminals 3, 4, 11 and 12.

The bypass relay controls which audio signal is fed to the encoder in the various modes of operation. If the VCIIC is in the bypass mode, the left and right discrete audio outputs are derived from the left and right inputs. However, when the mode of operation is changed to authorized, the bypass relay disconnects these inputs and derives the inputs from the decrypted digital audio signal.

The solution

So the solution to the problem is simple: Run jumpers from the "mono" + and – input to *both* the "left" and "right" + and – inputs. This will provide inputs (and outputs) for use when the signal source drops either fixed-key or full-time scrambling and will prevent loss of your audio on a BTSC-encoded channel. Remember to increase the audio output from your satellite receiver's subcarrier demodulator as connecting the mono output to two terminating inputs will cause the audio level to drop. Since these inputs are automatically disconnected when the signal goes into the authorized mode, they will not interfere with the true stereo.

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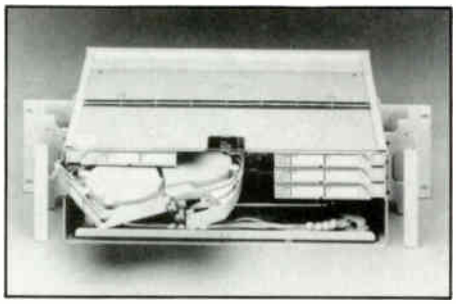
For more information, contact Foresight Products Inc., 10780 Irma Dr., Unit 22, Northglenn, Colo. 80233, (303) 457-0222; or circle #102 on the reader service card.



Fiber-optic panel

ADC Telecommunications announced its Fiber Customer Panel, a termination, storage and distribution device for fiber-optic cable systems and designed for local area networks. The product provides a common point for terminating outside plant cables, mounting and protecting splices and connecting terminal equipment. It can accommodate up to eight or 12 single-mode or multimode connections.

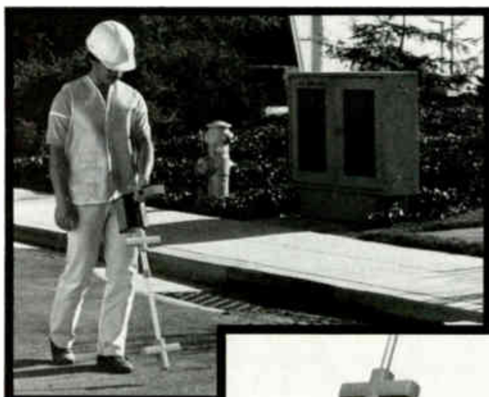
For further information, contact ADC Telecommunications, 4900 W. 78th St., Minneapolis, Minn. 55435, (612) 835-6800; or circle #117 on the reader service card.

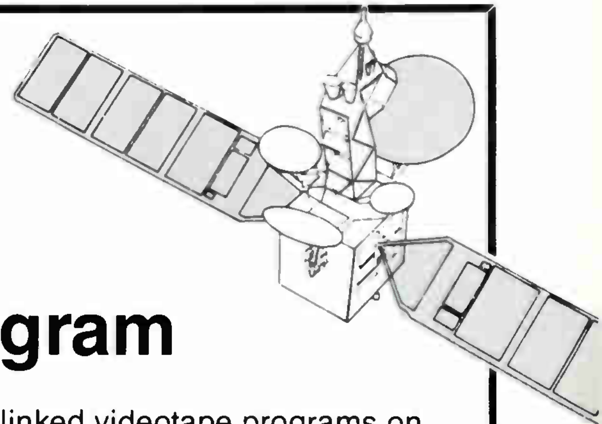
IPPV terminal

Scientific-Atlanta announced its Model 8585 set-top converter that contains an integrated impulse pay-per-view (IPPV) system. The module contains the circuitry to program purchases, automatically tune to marketing barker channels, conduct and record buying activity and report purchases to the control computer via telephone line.

Optional character generated channels guide the customer through the buying process. The terminal's LED display presents the pertinent buying information. Then, the sub responds either with the unit's keypad or via remote control. Access to the IPPV system can be denied unless the sub's personal identification code is entered. Availability for the unit is in December.

For further details, contact Scientific-Atlanta, 1 Technology Pkwy., Atlanta, Ga. 30348, (404) 441-4000; or circle #121 on the reader service card.





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Upcoming Dates for 1987

Oct. 27 — "Signal Processing Centers," a BCT/E review course (technician level) featuring Alex Best, vice president, technical operations for Cox Cable Communications.

Nov. 24 — "Interference Elimination with Antennas and Antenna Arrays," featuring Steven Biro, president of Biro Engineering.

Dec. 29 — "Performing Measurements on Basic Test Equipment," featuring John Shaw, president of Cable Communications Scientific, and Terry Bush, technical support specialist for Wavetek.

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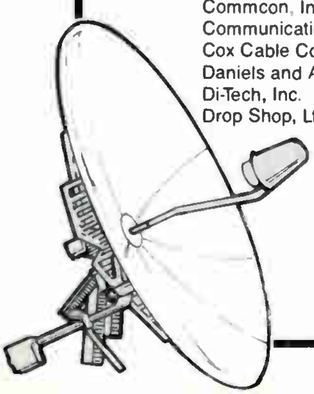
National Cable Television Institute
Newport Cablevision, Inc.
Oak Technology Center
Pico Macom, Inc.
Pioneer Communications of America, Inc.
Qintar, Inc.
RMS Electronics, Inc.
RT/K Communications Group
Regency Cable Products
Reliable Electric/Utility Products
Riser-Bond Instruments
Sadelco, Inc.
Satellite Syndicated Systems/Tempo, Inc.
Scientific-Atlanta, Inc.
Showtime/The Movie Channel
Standard Communications Corp.
Storer Communications, Inc.
Tele-Communications, Inc.
Telecrafter Products Corp.
Televents, Inc.
Tele-Wire Supply Corp.
Texas Cable Television Association
Theta-Com CATV/Texscan
Times Fiber Communications
Toner Cable Equipment Company
Triangle Communications Systems
Trilogy Communications
Triple Crown Electronics, Inc.
Tulsa Cable Television
U.S. Cable, Inc.
United Artists Cablesystems Corp.
United Video, Inc.
Viacom Cablevision
Wavetek Corporation
Western Communications, Inc.
Zenith Electronics Corp.



SPECIAL NOTE:

All Tele-Seminar programs will air from 12 to 1 p.m. ET on Transponder 7 of Satcom IIIR.

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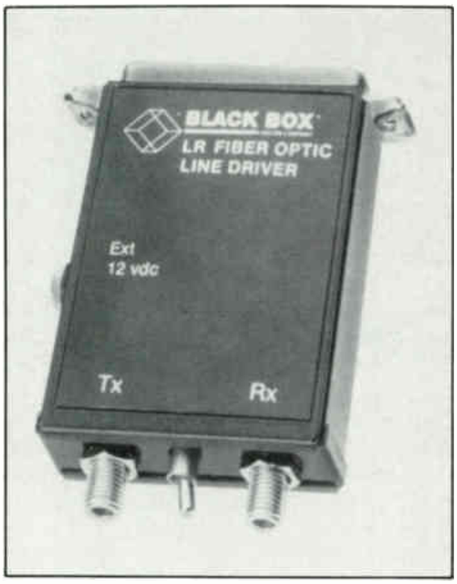
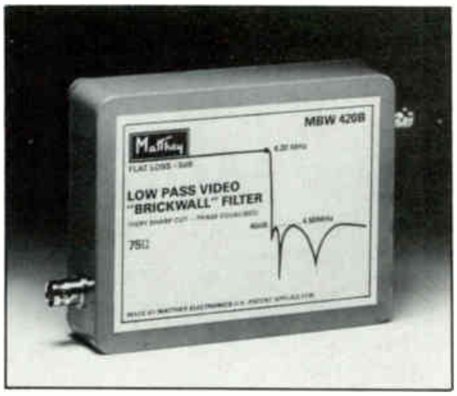


Line drivers

According to Black Box, its fiber-optic line drivers provide EMI/RFI protection and a fast, inexpensive way for RS232 asynchronous devices to transmit interference-free across fiber-optic lines regardless of electrical environment. The standard unit, when used with a 100-micron core cable, can transmit up to 6,500 feet. The long-range unit with the same cable can transmit up to 2.5 miles.

Both units operate either in an active mode (powered by an optional 12 VDC power supply) or in a passive mode, powered by an RS232 interface.

For more details, contact Black Box, P.O. Box 12800, Pittsburgh, Pa. 15241, (412) 746-5500; or circle #122 on the reader service card.



Video filters

Available from Television Equipment Associates, the Matthey brickwall video filters are designed to eliminate spillover due to inadequate separation of video from higher frequency audio signals. The filters are used when unfiltered signals with subcarriers are located too close to the video, resulting in video or audio defects or both. Model MBW420 passes all the video at 4.2 MHz and is 40 dB down at 4.48 MHz; Model MBW680 passes everything through 6.8 MHz and is 40 dB down at 7.25 MHz.

For more information, contact Television Equipment Associates, Box 393, South Salem, N.Y. 10590-0393, (914) 763-8893; or circle #105 on the reader service card.

Underwater cable

Pirelli Cable's Communications Division has produced an underwater fiber-optic cable treated with Hydroget, a compound that prevents deterioration due to hydrogen absorption. The cable's core, containing six single-mode fibers in a loose tube buffer construction, is jacketed with a lead sheath and two layers of steel wires.

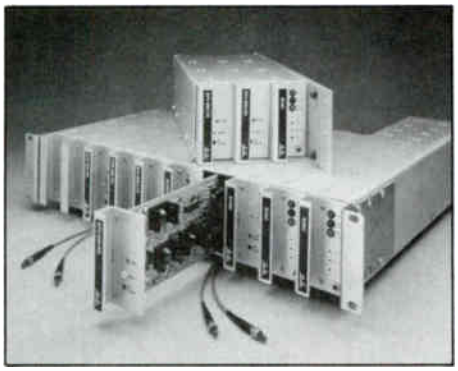
According to Pirelli, the fully enclosed cable is designed to withstand swift river currents and other hazards of a riverbed installation, as well as a wide range of temperature variations.

For more information, contact Pirelli Cable Corp., Communications Division, 700 Industrial Dr., Lexington, S.C. 29072, (803) 957-4200; or circle #120 on the reader service card.

Audio controller

FM Systems announced its Model ALM672 stereo audio level master circuit cards. Designed to complement its Model ADM-1 audio deviation meter, the new product is a broadcast quality dual band, gated, audio level control processor that stabilizes audio levels that vary as much as 30 dB to within ±0.3 dB.

For further details, contact FM Systems, 3877 S. Main St., Santa Ana, Calif. 92707, (714) 979-3355; or circle #113 on the reader service card.



FO transmission

Grass Valley Group introduced its Series EZ-Link fiber-optic transmission system for distribution of video and audio signals. It features both LED and laser transmitters for distribution over distances up to eight kilometers. An FM square wave carrier eliminates video distortion due to optical system non-linearities, delivering signal-to-noise performance of 60 dB. The system can be configured in an eight-module rack mount tray or a two-module wall-mount version.

For more information, contact Grass Valley Group Inc., P.O. Box 1114, Grass Valley, Calif. 95945, (916) 273-8421; or circle #115 on the reader service card.

Design software

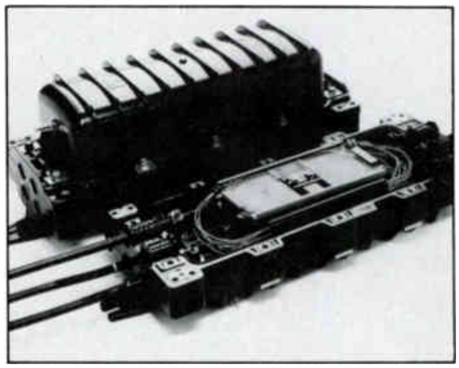
The SIGnal System from Friction Design Co. is a cable TV distribution design package that runs on all IBM PCs and compatibles. Capabilities of the software include distribution design, project bill of materials, trunk design, auto-selected splitters and line extenders in the design, powering (wattage and nominal current), cost analysis bill of materials, and an amplifier level analysis module.

For more details, contact Friction Design Co., 19372 E. Purdue Circle, Aurora, Colo. 80013, (303) 680-0221; or circle #114 on the reader service card.

Ladder pivot

North Consumer Products introduced its Saf-T-Pivot dismount section, a new accessory for the company's Saf-T-Climb fall prevention system. The product is said to dramatically reduce the danger of falls when climbers get on and off the top of a ladder. It allows climbers to attach themselves securely before they swing out over the ladder.

For more information, contact North Consumer Products, 16624 Edwards Rd., Cerritos, Calif., (213) 926-0545; or circle #108 on the reader service card.



FO splice case

Designed specifically for fiber-optic cable, the Model 2178 splice case from 3M's TelComm Products Division can be used in a variety of applications, including aerial, underground, customer premises and pedestals. The closure does not require encapsulating compound or special tools and uses standard sealing materials. The case can be pressurized to accommodate pressurized cable.

For more details, contact 3M, P.O. Box 2963, Austin, Texas 78769-2963, (512) 834-6563; or circle #116 on the reader service card.

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8	22	36	50	64	78	92	106	120	134
9	23	37	51	65	79	93	107	121	135
10	24	38	52	66	80	94	108	122	136
11	25	39	53	67	81	95	109	123	137
12	26	40	54	68	82	96	110	124	138
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For more information, contact Jim Trenter, Technical Applications Manager, GNB Incorporated, P.O. Box 64140, St. Paul, MN. 55164. (612) 681-5000.

GNB Incorporated

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Krejci

Jones Intercable Inc. named **James Krejci** as group vice president. He retains the position of group vice president of Jones International Ltd.

Elizabeth Steele was named vice president/corporate counsel and corporate secretary. Prior to this, she practiced law with the Denver law firm of Davis, Graham and Stubbs.

Also at Jones, **Kevin Coyle** was named corporate treasurer. He will retain his position as senior vice president of financial services for The Jones Group Ltd. Contact: 9697 E. Mineral Ave., Englewood, Colo. 80112, (303) 792-3111.

Anixter recently appointed **Gordon Halverson** as executive vice president of its CATV Group.

The company also named **Roland Watkins** as vice president of engineering and product management, **Shellie Rosser** as vice president of business development, **Jim Warren** as vice president of sales and marketing and **Bob DeBolt** as vice president of business services. Contact: 4711 Golf Rd., 1 Concourse Plaza, Skokie, Ill. 60076, (312) 677-2600.

CaLan Inc. named **Phyllis Thompson** as national sales manager. Prior to this, she was sales manager for the company. Contact: R.R. 1, Box 86T, Route 739, Dingman Plaza, Dingmans Ferry, Pa. 18328, (717) 828-2356.

GTE Supply appointed **Barbara Simpson** as Western regional manager. Prior to this, she was director of small business systems at GTE's Business Systems division. Contact: 5225 Wiley Post Way, Lakeside Plaza 2, Salt Lake City, Utah 84116, (801) 537-5237.

Sophinos

Chris Sophinos was appointed chief operating officer of **Midwest-CATV**, a division of Midwest Corp. Previously, he was distributor sales director for General Instrument's Jerrold Division. Contact: P.O. Box 271, Charleston, W.V. 25321, (304) 343-8874.

Schmalzried

Chaparral Communications named **Sharon Schmalzried** as Western account manager. Prior to this, she was manager of the company's customer service department. Contact: 2450 N. First St., San Jose, Calif. 95131, (408) 435-1530.

Thomas Kilmartin was appointed vice president of **AM Communications**' Field Services division. Prior to this, he was vice president and regional operations director at Contel-Executone Inc. Contact: P.O. Box 505, Quakertown, Pa. 18951, (215) 536-1354.

Huffman

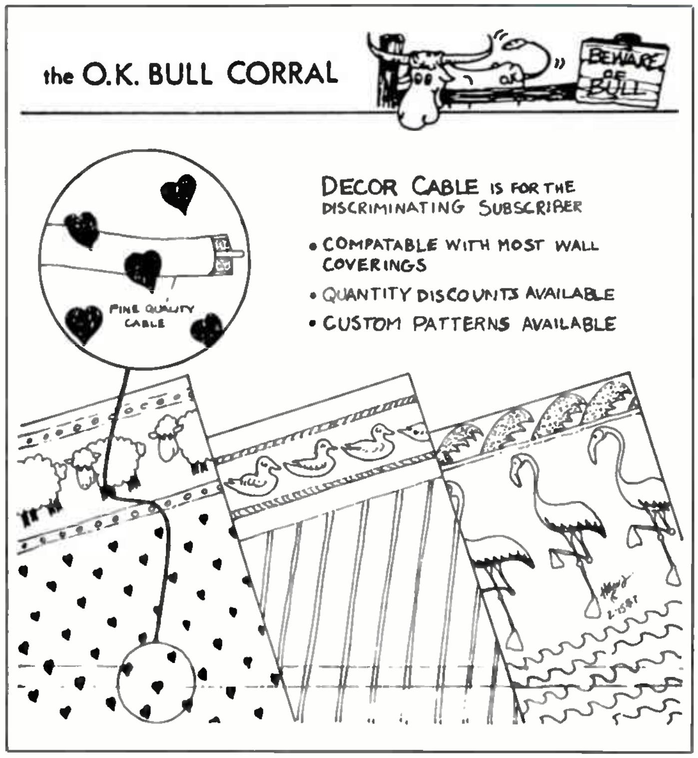
Reliable Electric/Utility Products appointed **J.W. Huffman** as national accounts manager of GTE products. Previously, he was director of purchasing for General Telephone of Florida. Contact: 11333 Addison St., Franklin Park, Ill. 60131, (312) 445-8010.

John Fitzpatrick has joined **Northwest Cable Interconnect** as chief engineer, where he will oversee expansions and improvements. Prior to this, Fitzpatrick was with Viacom Cablevision's Pierce County, Wash., system. Contact: 401 Second Ave. South, Suite 219, Seattle, Wash. 98104-2883, (206) 624-6464.

Dynair Electronics appointed **Bob Jorgenson** as application engineer. Prior to this, he was a design engineer at RCA. Contact: 5275 Market St., San Diego, Calif. 92114, (619) 263-7711.

David Green was appointed account executive at **Intercept Communication Products**. Previously, he was with RMS Electronics and E.M. Electronics in senior sales positions. Contact: 85 Fifth Ave., Building 16, Paterson, N.J. 07524, (201) 471-2212.

Barry Gorsun was named executive vice president and chief operating officer of **Summa Four Inc**. He joined the company in 1984 as vice president of operations. Contact: 2456 Brown Ave., Manchester, N.H. 03103, (603) 625-4050.



Courtesy Parallex

Dennis Fell has been promoted to plant manager of **Adams-Russell**'s cable system in Bangor, Maine. Previously, he was technical supervisor for communities serviced by the Bangor system.

Also, **Phil Newbury** has been named construction coordinator. Prior to this, he was a technical supervisor for the system. Contact: 278 Florida Ave., Bangor, Maine 04401, (207) 942-4661.

Business Directory

Reader Service Number 60.

Reader Service Number 61.

Reader Service Number 62.

Reader Service Number 63.

AD INDEX

Digital future shock II

By Walter S. Ciciora, Ph.D.
Vice President of Strategy and Planning
American Television and Communications Corp

Last month we discussed digitized video and the capacities of digital fiber links to carry video channels. The discussion was motivated by reports of an advanced fiber-optics technology and by the keynote speech at the 15th Montreux Television Symposium in Switzerland during June of this year. As was mentioned last month, a very high capacity fiber technology (five gigabits per second) was developed by SEL of West Germany. This month we'll concentrate on the Montreux speech.

The Montreux keynote speaker was Dr. Masahiko Morizono, deputy president of Sony. He is responsible for all of Sony's R&D. His speech considered technological trends for television's future. He was invited by the symposium's committee to look at least 10 years into the future. This time frame fits nicely with last month's discussion. It provides considerations that are likely to have impact over the next life cycle of many cable systems. He discussed solid-state technology, digital signal processing and recording technologies. Most of the technology he discussed had strong digital implications.

A major part of the success of electronics in general and consumer electronics in particular has been due to the progress of solid-state electronics technology. The big question is how close are we to the end of this evolution? According to Dr. Morizono, we have a ways to go before we run out of gas.

Currently, the state of the art in semiconductor design involves geometries interconnected with conductor lines that are about 1 micron wide (one-millionth of a meter). His prediction is that a 10 times reduction will be possible with the next generation of advanced lithography. A 10 time reduction in linear measure results in a 100 times increased density. Dr. Morizono sees this as making possible memory chips with 64 to 128 megabits per chip. (This is about the capacity of an IBM XT's 10 megabyte hard disk!) With that kind of semiconductor memory, a solid-state audio recorder will be possible. Instead of a magnetic tape cartridge, a semiconductor plug-in chip would be used. The desire to make this into a consumer product will eventually drive down the price of massive semiconductor memory.

Looking a little further into the future, a very exotic-sounding technology was mentioned. It's called "photochemical hole burning memory." It's in the very early stages of research. Multi-wavelength laser beams can store about a kilobit of information per laser spot. The result, according to Dr. Morizono, is the ability to store over an hour's digital video in a square centimeter of this stuff. This kind of memory is at the far end of the time frame being considered.

Perhaps the second most important contributor to consumer electronics product advancement has been recording and playback technology. Two types have been very important: magnetic and optical. Magnetic recording has given rise to the audio tape machine and VCR. Optical techniques gave us the laser video disc, the compact audio disc (CD) and now, CD video.

Where does Dr. Morizono see all this going? There are two levels of advancement of magnetic media on the horizon. First the move to "metal" tape. Either metal particle or metal evaporated tapes will allow a greatly increased recording density. Then magnetic perpendicular recording promises even higher densities. This approach stands the little magnets on their ends rather than laying them down side by side. These higher densities will enable recording in digital form rather than the current analog.

Already we see this trend in audio recording. The digital audio tape (DAT) machines provide both higher quality and longer playing times in much smaller cassettes. A particular benefit of digital recording is the ability to make multiple generations of recordings without loss of quality, something impossible with analog approaches. Dr. Morizono sees the practicality of six hours of digitally recorded NTSC video using 8mm format tape cassettes.

Advances in optical recording will generate new opportunities. The crippling disadvantage of the laser disc was its inability to record. This allowed the VCR to pass it up. Now the laser disc is making a comeback under the impetus of CD video (see my August column). The optical approach becomes more exciting as recording capability is added.

Write-once optical discs have been available for commercial purposes for some time. The first quasi-consumer application will be storage devices for personal computers. The technical world loves acronyms; these devices are called WORM (write once, read many) discs. The next step will be true erasable discs, which are in the laboratory now and should be in commercial products within the next few years. The laser disc will then be on a more nearly even footing with the VCR. Its major disadvantage will be a shorter record time per disc vs. the VCR cassette. However, the disc has one very important advantage: much faster access to all of its contents.

Several Hollywood studios are already transferring raw film to disc for the editing process. The faster access time to frames on the disc compared to the rolling through of film or tape reduces the time to edit. This saves both the high-priced creative personnel's time and usage of costly editing facilities. Less expensive workers then use the edited disc to execute the cutting of the film itself. A logical next step in optical recording evolution is to record digital video signals.

While the data density of optical techniques is very high, the disc format limits the total amount of information that can be conveniently handled. An interesting combination of techniques yields the optical video tape. Rather than recording on magnetic media, the laser disc technology is applied to a linear strip. Dr. Morizono predicts an interesting period of "format battles" as these various advanced techniques fight it out for dominance.

High speed, high density semiconductors have stimulated a new class of integrated circuits called digital signal processing (DSP) chips. By operating on a number of data bits in parallel, very fast processing of signals is possible. This capability has motivated the evolution of computational techniques for bandwidth reduction of signals. While the capability to transmit and store digital bits is dramatically increasing, DSP techniques are simultaneously reducing the amount of data that must be transmitted and stored for quality pictures and sound.

So what does this mean for cable? We can clearly expect that the inner workings of consumer electronics will become more and more digital. We've already seen the digital TV and the digital VCR. But they are just the beginning; they really have not taken advantage of all of the digital technique's power. More features, better quality, higher reliability, smaller size and lower costs are on the way.

The "more features" probably means further complications for the consumer electronics interface with cable. More ways to be incompatible, more ways to connect things up incorrectly. "Better quality" and "higher reliability" mean less tolerance for video and audio imperfections and outages. "Lower costs" give rise to the most important consumer electronics trend—proliferation—consumer electronics products in every room of the house. This will make multiple set charges cumbersome and eventually unacceptable.

The first cable impact of the consumer electronics evolution will be an overall need to do our jobs better: better picture and sound quality, fewer outages, more emphasis on being consumer electronics friendly. Our video and audio quality must be up to the digital challenge. This doesn't mean we have to deliver digital video and audio signals, but the signals we deliver have to be of comparable quality.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