COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

The 1990s and beyond: Gazing through the crystal ball

December 1989

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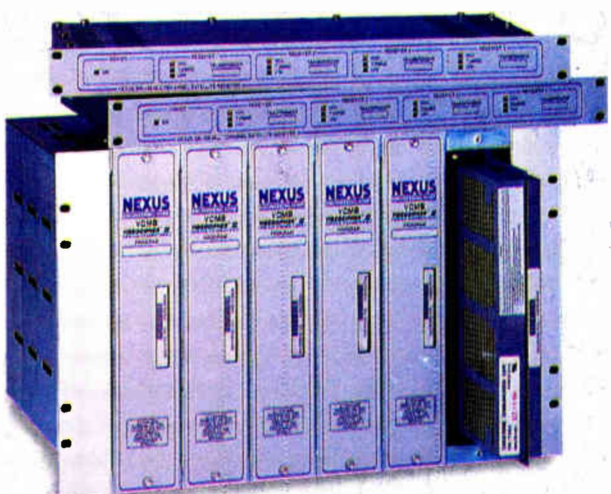

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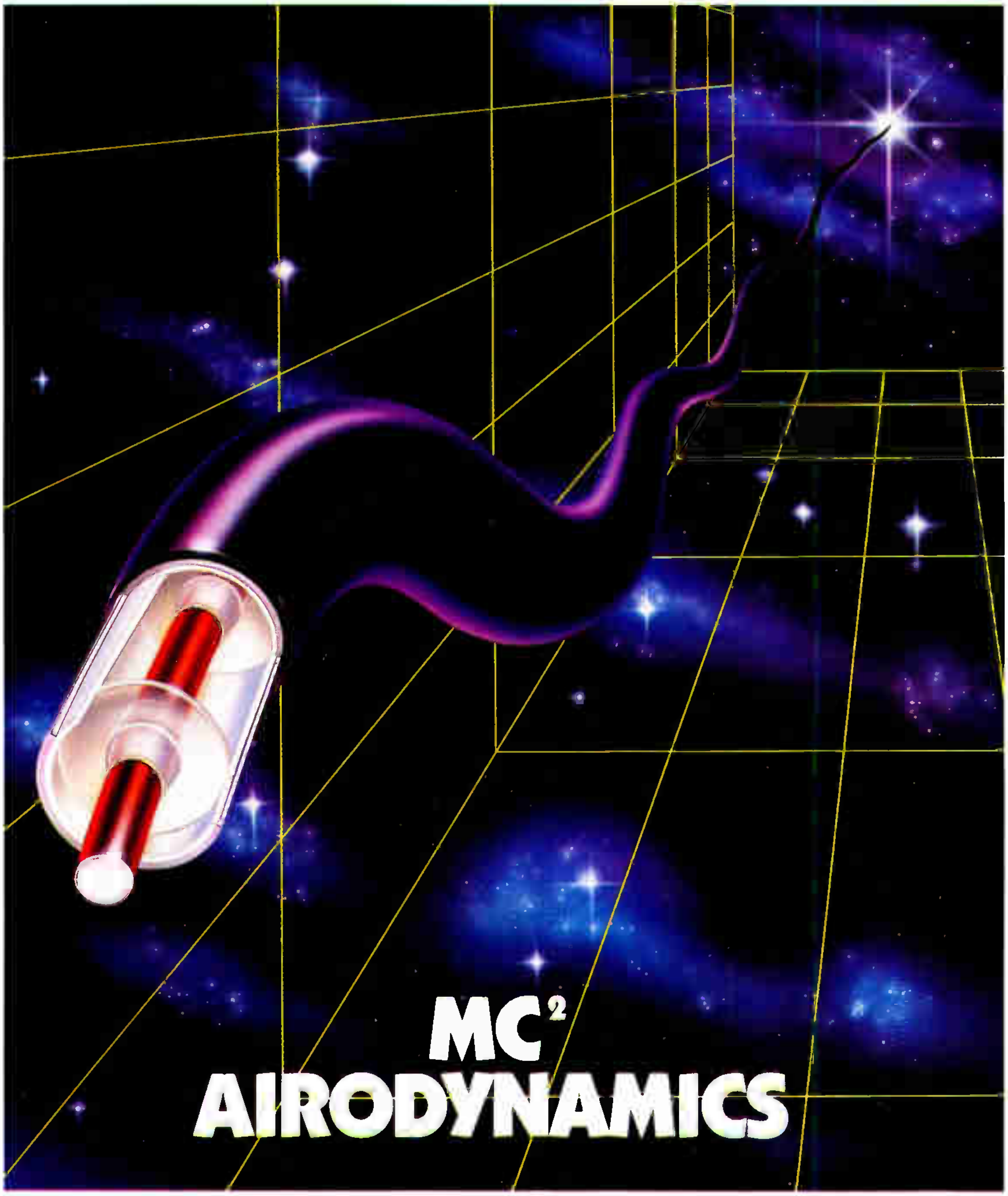

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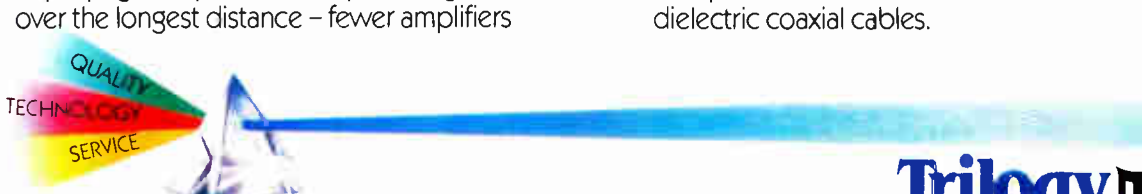

See us at the Western Show, Booth 269.
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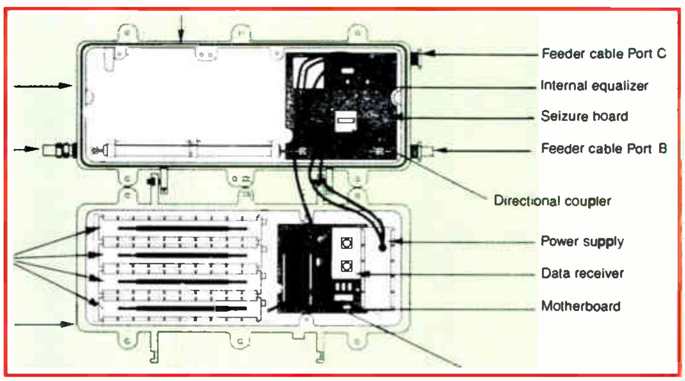

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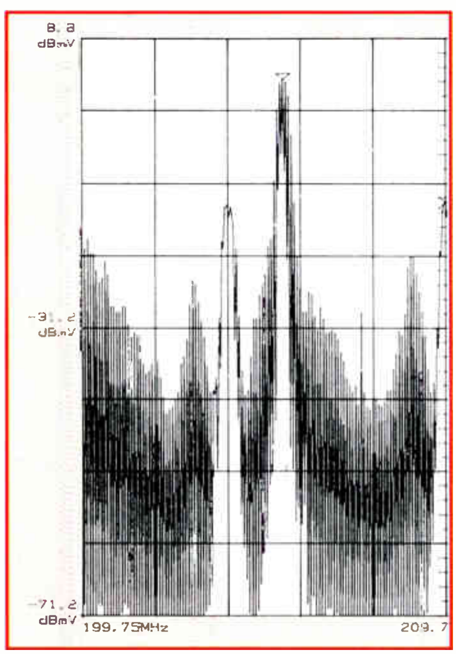

Measuring in-depth 45

Features

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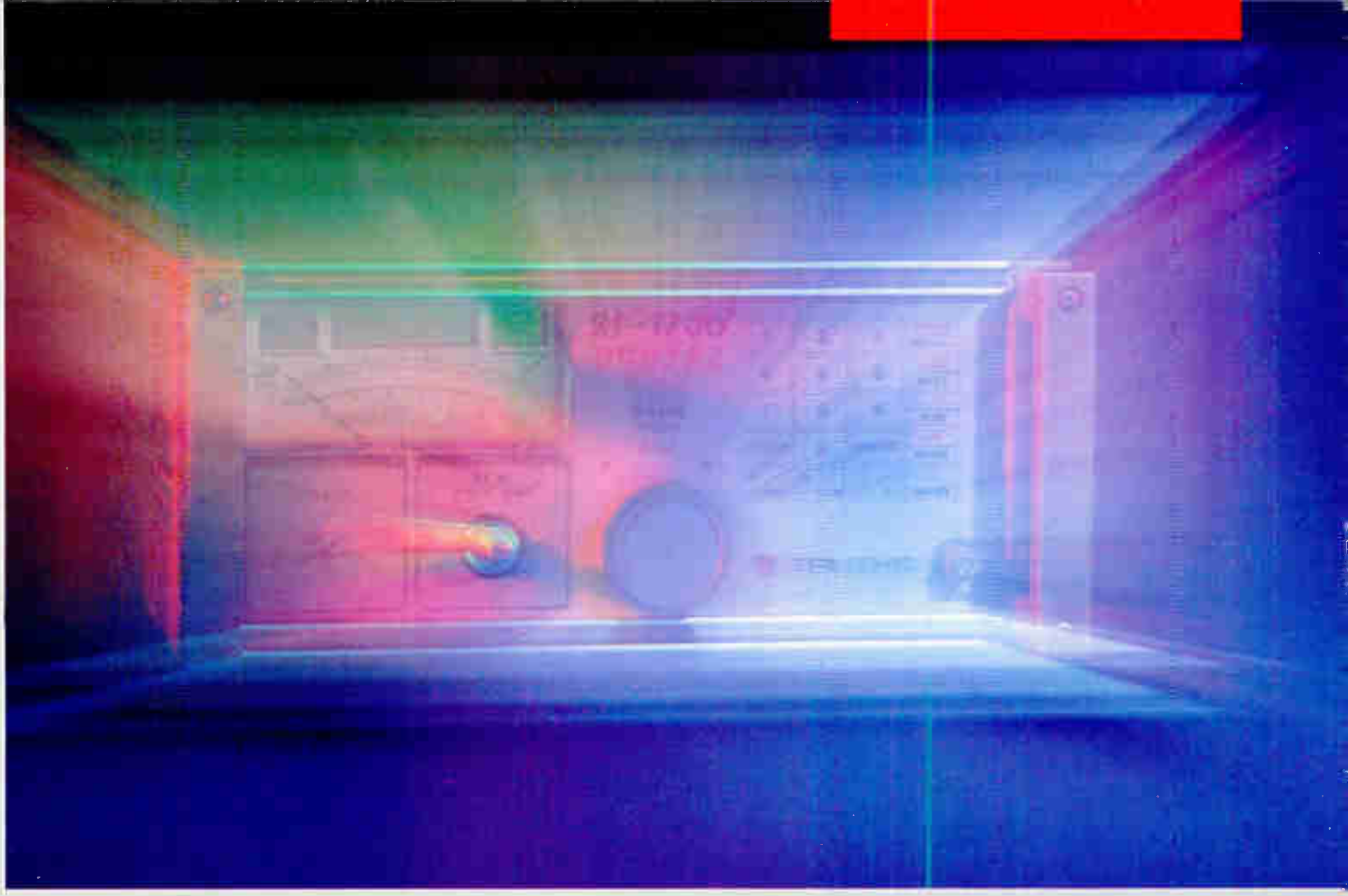

0 to 600 in .035 seconds

Because of its exclusive spin knob, the Trilithic SP 1700 Digital signal level meter can cover its range of 5 to 600 MHz quicker than any other meter on the market today. The SP 1700 Digital has the accuracy you need ensuring that precision test results are always there when you want them.

The smooth, analog meter movement, combined with the large digital readouts make the SP 1700 as quick to read as it is easy to use.

The SP 1700 stands up to heavy use thanks to construction that is engineered to meet the MIL STD 810D drop test. It's also highly water resistant, has a front panel replaceable F connector and comes in a padded carrying case.

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TRILITHIC

Reader Service Number 19.   ***See us at the Western Show, Booth 1509.***

Launching a new decade

A new decade waits outside the door; opportunities for growth and change accompany it. During the '80s, CATV technology made one or two minor quantum leaps, such as:

- Fiber optics lighting the way to future improvements in picture quality, channel upgrading and digital delivery.
- Innovative approaches—MultiPort and on- and off-premises devices—addressing the issue of consumer friendliness.
- Formats being developed that ensure cable's ongoing participation in delivering advanced TV signals.
- Plus technology providing the means to eliminate signal leakage, to keep our systems properly maintained and to serve our subscribers better.

In order for our industry to stay competitive, everyone must join together in a commitment of progress and never-ending improvement. At Transmedia, we feel the same way. And so, starting next month, we will merge *Installer/Technician* into the pages of *Communications Technology*. More than ever, there is a need to address the entire technical community within the pages of one journal.

Now, in one publication, we will reach *all* technical levels, from the installer to the chief tech to the vice president of engineering. By combining engineering articles with more basic instruction, we will create lines of communication among all technical personnel, opening the lines for better service to cable's customers.

But the good news doesn't stop there. I'm also very excited to announce that with the combination of these two magazines, *CT*'s circulation will jump from 15,000 to 25,000. What a thrill it is to be able to reach—and better serve—an even greater number of readers!

The 1990s and beyond

Once again, Anaheim, Calif., will come alive with the annual Western Show Dec. 13-15 at the convention center. This year's theme is (appropriately enough) "Creating a new decade of television."

Technical sessions will take a look at the challenges the cable industry faces in the coming decade.

I'm sure you'll also find time to examine all the great new products on display on the show floor. And, of course, the *CT Daily* will be there to keep you abreast on what's happening. If you have a show-related announcement or product, just give the written information to one of our staff (there will be 13 of us there, so it shouldn't be too hard to find one) or just leave it in the press room by 2:30 p.m. on Wednesday and Thursday.

Fond farewells

At this time I'd like to say goodbye to two familiar names who have been part of *CT* for several years. Walt Ciciora began his "Ciciora's Forum" column in April 1987; each month, without fail, he has informed, entertained and even scared us with emerging technology issues such as HDTV, telcos, digital downloading and consumer friendliness. This month he closes his series by summarizing the main points of the past three years of columns. We'll miss him.

We'll also miss Rikki Lee, who has stepped down as editor of *CT*; this is her last issue. Rikki is gearing up for some exciting things of her own: On Jan. 2, she launches Rikki T. Lee Written Communications Services, a consulting firm that will offer editing, writing, proofreading, promoting, training and other services to the CATV technical community. Call Rikki at (303) 321-7551. And she'll continue to write "Specs" for our sister publication *MSO*. Good luck, Rikki, and thanks for the memories.

And to all, a Merry Christmas and Happy Hanukkah.

COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

A Transmedia Publication

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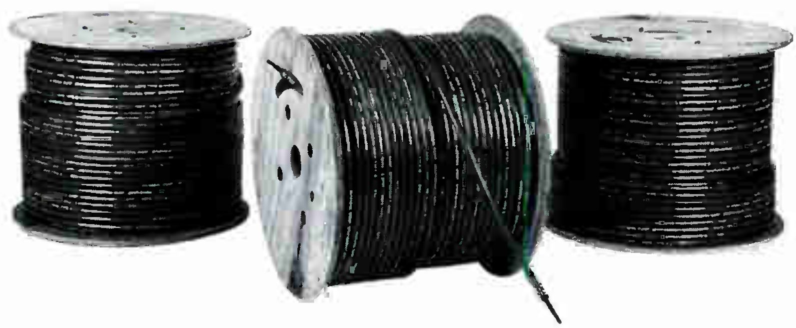
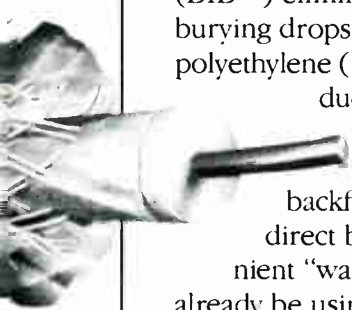
Integral and Channell: Setting the standards for underground plant.





Integral's new Cablecon Drop-in-Duct (DID™) eliminates the "crunch" when direct burying drops. Manufactured of high density polyethylene (HDPE), DID is tough and durable, due to its ratio of diameter-to-wall thickness. Resistant to shovel impact and hostile backfills, DID can be easily installed by direct burying, or with the same convenient "walk behind" equipment you may already be using.

Marketed exclusively by Channell Commercial, DID is available in two colors (gray or terra cotta) so that your CATV underground plant can be easily identified from other utilities. Available in 10MM, 13MM or ½" duct sizes with your choice of RG service wire, DID is easy to order and is an excellent, low-cost solution for protecting your underground drop. DID is available in 1,000′ or 2,000′ reels and is backed with the only pass-through warrantee from Comm/Scope, Inc. and Times Cable in the CATV industry.

With millions of feet of direct buried drop already installed in North America, industry leaders predict that 100% of it will be replaced within five years. To reduce this statistic, DID will undoubtedly play a major role, but if any of your **existing** direct buried plant gets damaged, Channell's KCP™ Series Splice Kits offer another great solution. KCP Series Splice Kits permit easy repair of drop or coax and protect CATV connectors in both underground and aerial applications. Inexpensive and effective, they're the only splice kits available in the CATV Industry with a **money back guarantee.**

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Channell COMMERCIAL CORPORATION

See us at the Western Show, Booth 1129.
Reader Service Number 9.

Western Show '89 creates new decade

ANAHEIM, Calif.—The California Cable Television Association (CCTA) will present this year's Western Show here at the Convention Center Dec. 13-15, with the theme "Creating a new decade of television." In cooperation with the CCTA, the Society of Cable Television Engineers will provide three days of technical seminars. The agenda for the show follows. (See accompanying breakdown for technical sessions.)

Wednesday, Dec. 13
8 a.m.—Registration opens
10 a.m.-5:30 p.m.—Exhibits open
1-5 p.m.—Technical sessions
1-2:30 p.m.—Welcome reception and keynote panel
4-5:30 p.m.—Cocktail party in exhibit hall

Thursday, Dec. 14
8 a.m.—Registration opens
8:30 a.m.-5 p.m.—Technical sessions
10 a.m.-5:30 p.m.—Exhibits open
12-1:45 p.m.—Luncheon address

Friday, Dec. 15
8 a.m.—Registration opens
10 a.m-2 p.m.—Exhibits open
9-12 noon—Technical sessions
10:30 a.m.-12 noon—Closing general session

Technical sessions

Wednesday, Dec. 13

- **1:30-3 p.m.**—"FCC Washington update." Moderator: Steve Ross (Fletcher Heald and Hildreth). Speakers: Bill Riker (SCTE), Wendell Bailey (NCTA); Ben Nakamiyo (FCC), Brian James (NCTA) and Ron Parver (FCC).
- **3:15-5 p.m.**—"Cumulative leakage index: Flyover and the continued use of aeronautical channels." Moderator: Brian James (NCTA). Speakers: Brent Bayon (Viacom Cablevision), Ted Hartson (Post-Newsweek Cable), Chris Duros (CableTrac Inc.), Bob Dickinson (Dovetail Systems) and Richard Hickman (MetroVision).

Thursday, Dec. 14

- **8:30-10 a.m.**—"Customer satisfaction and its technical aspects." Moderator: Joseph Van Loan (Consultant). Speakers: Fritz Baker (Viacom Cablevision), Pam Nobles (Jones Intercable), Tom Elliot (Cable Labs) and Brad Johnson (Warner Cable Communications).
- **10:15-11:45 a.m.**—"Consumer interface." Moderator: Jim Chiddix (ATC). Speakers: Claude Baggett (Cable Labs), Alex Best (Cox Cable), John Burke (Jerrold), Jim Farmer (Scientific-Atlanta), Del Heller (Viacom Cable) and Tom Mock (Electronic Industries Association).
- **1:30-3 p.m.**—"Fiber-optic planning." Moderator: Pete Petrovich (Petrovich & Associates). Speakers: Rob Yates (DTI Telecom Inc.), Hermann Gysel (Synchronous Communications), Scott Esty (Corning Glass Works), Ron Wolfe

(ATC) and Sanford Lyons (Siecor).

- **3:15-4:45 p.m.**—"New developments in fiber." Moderator: Jim Chiddix (ATC). Speakers: David Lang (AT&T Bell Labs), Howard Westlake (British Telecom Research Labs), Ray Johnson (BT&D) and David Robinson (Jerrold Cableoptics).

Friday, Dec. 15

- **8:30-10 a.m.**—"System evolution: Where do we go from here?" Moderator: Ed Callahan (E.J. Callahan Cable TV). Speakers: Nick Hamilton-Piercy (Rogers Cablesystems), Dan Pike (Prime Cable), Dave Large (Raynet) and Bob Young (Jerrold).
- **10:15-11:45 a.m.**—"Preparing for the era of advanced television." Moderator: Craig Tanner (Cable Labs), Gary Chan (Rogers Cablesystems), Bronwen Jones, (Advanced Television Test Center and Cable Labs), Walt Ciciora (ATC) and Craig Tanner (Cable Labs).
- **12 noon-2 p.m.**—BCT/E and Installer Certification exams

Jerrold to display AM laser technology

ANAHEIM, Calif.—Jerrold will demonstrate at this month's Western Show its second generation AM fiber-optic backbone system based on a new high performance laser. The lasers are said to be the first built with CATV's specifications in mind. According to Jerrold, the system will handle 80 channels with a 56 dB carrier-to-noise ratio over 15 km using two fibers. It also has a 65 dB composite triple beat and second-order distortions measured according to NCTA recommended practices.

Under Jerrold's proprietary DFB laser program, Ortel Corp. has delivered lasers with Jerrold's system specifications. Jerrold expects one or two other laser suppliers also will attain those specifications within the next 12 to 24 months. The units will be available around spring to MSOs for field testing. Patents are now pending on the transmitter design.

With modularity, operators will have the option of replacing an old product with a more advanced model with minimal headend disruption according to Jerrold. Also, operators will be able to adjust the laser to their specifications and to trade-off noise with distortion. Once that decision is made, a microprocessor will keep the configuration in line.

Texas system loses three leaky channels

WASHINGTON, D.C.—As reported by the National Cable Television Association, on Sept. 19 the Federal Communications Commission reacted swiftly to what the Federal Aviation Administration termed "a case of harmful interference with air traffic." After a complaint from FAA officials, the FCC Field Operations Bureau traced a case of alleged interference to a cable system in Texas. The 22-channel system was monitored for leakage; major leaks were discovered. The FCC ordered the system to stop using three channels immediately.

Upon further investigation, it was discovered that certain pieces of the leak detection equipment were being incorrectly operated. However, the FCC had no trouble in making the equipment perform correctly. It found several large, unlogged leaks in the first few minutes of inspection. With the new signal leakage rules coming into effect on July 1, 1990, the FCC has shown it takes the matter seriously. It

JULY 1990

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By July 1, 1990, excessive signal leakage must be eliminated and then effectively contained to meet the minimum FCC cable operating specifications. PPC offers the **only** tools you'll need to get the job done.

These three unique tools, in conjunction with PPC's CFS-6U and/or CFS-59U connectors, will assist you in making all the necessary drop connector installation procedures required for **both** RG-6 and RG-59 cable, and they work universally! On single braid or tri-shield, from 40% braid right up to and including quad cable, this one tool set and our patented connectors consistently provide positive and leak free connections.

For free information illustrating with clear, step-by-step photographs how to make cable preparation and connector installation simple and easy, write PPC or call toll free today: 1-800-468-2288.

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PPC

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urges cable systems to bring their properties into compliance or fines and loss of rights to certain frequencies could result.

SCTE membership now exceeds 6,000

EXTON, Pa.—The Society of Cable Television Engineers' national membership recently shot past 6,000, representing a drastic increase from the 1988 year-end count of 5,000 and the 1987 figure of 3,800. The 1989 total indicates that an average of nearly 100 members joined each month of the year.

"Reaching the 6,000 mark is an important event in the Society's history," said SCTE Executive Vice President Bill Riker. "It indicates the broadband industry's increased appreciation of the training and service the Society provides. Membership in the Society has become very important to industry personnel in the years since its formation, and as SCTE concludes its 20th year of existence, we will strive to sustain the excellence that has become synonymous with the Society of Cable Television Engineers."

At an Oct. 15 board meeting of the National Cable Television Center and Museum at Penn State's University Park campus, SCTE Executive Vice President Bill Riker (left) announced that the Society will donate its entire historical records to the center. Accepting a symbolic presentation of the SCTE materials from Riker are Marlowe Froke, museum director, and Benjamin Conroy Jr., chairman of the museum's board of directors.

- Pioneer announced that four cable systems recently ordered additional BA-5000 addressable converters; the combined purchases total more than $3 million. Orders came from Group W Cable of Chicago; Prime Cable of Chapel Hill, N.C., and Las Vegas; and Warner Cable in Houston. Also, Warner Cable purchased Pioneer BA-6000 addressable systems for five operations. Finally, Mid-Atlantic Cable purchased two BA-6000 systems and additional converters for a third system.

- A free copy of AT&T's 1990 fiber-optic training catalog is available by calling (800) 872-4637. Class schedules, locations, fees, enrollment information and more are included, as well as descriptions of courses on installation and splicing and aerial and underground placement.

- Effective the first week of November, Trilithic Inc. has moved to new facilities at 9202 E. 33rd St., Indianapolis, Ind. 46236, (317) 895-3600. The toll-free number, (800) 344-2412, remains the same. Trilithic's new facsimile number is (317) 895-3613.

- Trilogy Communications Inc. announced recently that production of its MC² trunk and feeder coax cable in its Pearl, Miss., plant is running 50 percent ahead of production rates set five months ago. This will cut lead time for product deliveries to six to eight weeks. Also, lead time in Trilogy's Freehold, N.J., plant for CATV drop cable is at three to four weeks because of a reported 25 percent production increase.

- Industry veterans Ron Cotten, James Holland and Ronald Livesay have formed Engineering Technologies Group Inc., a consulting, engineering and construction firm specializing in cable TV, microwave, satellite and fiber-optic communications networks. The company offers engineering, construction and support services.

Reader Service Number 17.

Dave Wachob: A look ahead

What's looming for our industry in the 1990s? This month, Dave Wachob (director of advanced technology for General Instrument's Jerrold Division) reveals the signposts ahead for fiber, HDTV and other projects.

CT: Please give us your post-mortem on the '80s and compare this decade's technology with the next 10 years.

Wachob: In comparing the last 10 years vs. the next 10, the technological advances in the next 10 are going to be much quicker. Lots of things have happened (certainly in the last 20 years) but only in the last 10 have they come into fruition. And everything's starting to come together and gel where a lot of neat things are going to happen in the next 10 years.

This is not to say that neat things haven't happened in the last 10 years, but it's been somewhat slower. We're still using basic scrambling techniques that have been around since the '60s and '70s. Consumer interface is still an issue. Shots have been taken at solving it, but they were somewhat limited in their effect. So I think technically things have been occurring but they're just now getting to be applicable and cost-effective.

CT: So everything that's been thought of or developed in the laboratory, would you say its time has come in the '90s?

Wachob: Yes, and that's very well-put.

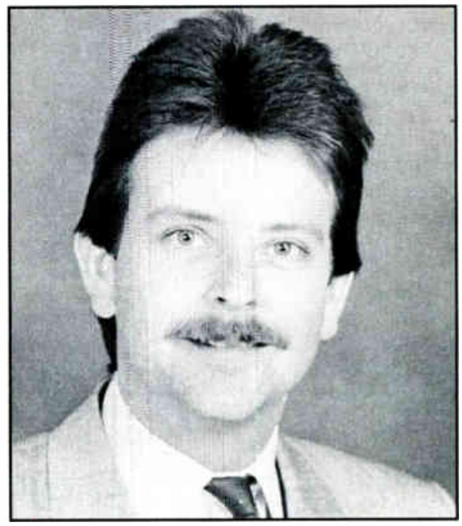
CT: What in particular stands out as the single most industrywide changing technology?

Wachob: A couple of things are very closely related: fiber/digital. You don't necessarily need to have fiber to deliver digital, but I think the technology of those two things has been around for a while. They represent the biggest opportunities in the next 10 years; after that is high definition TV, obviously.

CT: So you think digital should be the transmission medium of the future rather than maintaining AM or FM?

Wachob: There's a place for digital and it's in an evolving state. But if you look at some time near the year 2000, then digital will have been perfected and will be a very viable alternative. Obviously that's 10 years away and the question is, "Should we pursue the analog HDTV?"

The real issue with HDTV and the analog schemes is how quickly digital will come into play. Some people say it's 10 years; I think it might be sooner than that. How soon is hard to say.



"We agreed two years ago to support the IDTV product and have had an active program since then."

CT: How are you going to get subscribers to buy HDTV sets or digital equipment?

Wachob: From the subscribers' standpoint it will be transparent. All they'll see is a very good picture coming into the house by just the logistics of the old NTSC TV sets that are out there in any scheme that is accepted by the FCC. This will be most likely an analog scheme.

CT: Let's say the MultiPort, HDTV, digital transmission and fiber all come together into one product. Do you see that evolution happening around the same timeline?

Wachob: Yes, as a matter of fact I do. The MultiPort HDTV set in a strict sense is one piece of the puzzle, but again you're always going to have an awful lot of NTSC sets. Even the ones that have MultiPort now are the small minority. Granted, that's going to increase. But to be consumer friendly you almost have to deal with all varieties around you.

CT: Who's going to pay for all the new technology once it starts getting out of the laboratory and into the market?

Wachob: If you broaden advanced TV to include system improvements neces-

(Continued on page 78)

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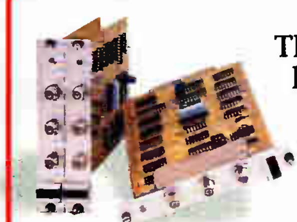

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Whither CableLabs?

This is the first installment of a two-part series on Cable Television Laboratories Inc. The author's purpose in what follows is not to discuss engineering issues facing CableLabs or the cable industry. Rather it is to sketch, as one man's working hypothesis, a strategic concept for the business development of the cable industry.

By Richard S. Leghorn

Dick Leghorn

The primary role of CableLabs is to improve present business capabilities and develop new business capabilities from promising advances of relevant technologies. To do so, it must lead the industry through the tumultuous processes of technological change now characterizing the global economy.

In discussing where CableLabs should focus its efforts, one must keep in mind its paucity of financial resources. CableLabs' annual budget, based on 2 cents per month per subscriber of the more than 80 percent of the industry it represents, amounts to less than $10 million—less than one-tenth of 1 percent of revenues. These figures should be compared with almost $1 billion of funds available to Bell Communications Research (Bellcore), amounting to about 1.2 percent of Bell Operating Companies revenues. And the budget of the Electric Power Research Institute (EPRI) is approaching a half billion dollars, over three-tenths of 1 percent of revenues. The point is that to produce meaningful results, CableLabs' efforts must concentrate on technological opportunities of maximum promise to the core business of the industry; CableLabs must strive for technological leverage by focusing on the critical functions in the process of technological change that offer greatest payoff; and last, through collaboration vertically and horizontally, it must multiply its effectiveness by leading, catalyzing and integrating the technological endeavors of others in behalf of the business interests of the cable industry.

The comments of this article address the substance of development goals, offering the most business promise. In a subsequent article, I will discuss the processes of technological change and how CableLabs can best maximize its effectiveness.

The nature of our core business

Cable in its business and legal essence functions in the economy as a multichannel member of the electronic media—a broadband telepublisher. However characterized, cable gathers, edits, originates, organizes and electronically distributes information to the public primarily in the form of full-motion video, but with growing involvement with other information formats such as audio, text, graphics and single images, often in combination. While cable as electronic publisher of full video and other information products could contract with others for distribution, the overall economic and legal environment will continue to indicate that the industry could and should own and control point-to-multipoint facilities for distributing the information materials it gathers and organizes.

Publishing, whether in print, audio or video form, needs to be contrasted economically and legally with common carriage. A publisher as an editor working on behalf of customers generates and *manages the content* of the information that is delivered. A common carrier *transmits on a first come, first served basis information generated by others* without affecting its content. A publisher functions in an economic environment whose competitiveness federal and state governments and the courts are duty bound to maximize in keeping with requirements of the antitrust laws and especially the diversity imperative of the First Amendment. The public interest in "diverse, robust and antagonistic" expression is of the same compelling order as national security. To flourish, cable must serve *the public interest* in diversity with the deepest dedication, all the while asserting its constitutional right to expression free of government interference. The nation has not yet struck a mature balance between cable's First Amendment rights as speaker and editor, and the public interest in access to diverse speech. Planning for cable's future business capabilities must be rooted in an awareness of this evolving situation.

In antithetical contrast, telcos as common carriers operate governmentally sanctioned and heavily regulated monopoly facilities. These include facilities both for multipoint-to-multipoint communication among members of the public and for point-to-multipoint carriage of electronic publishers who do not choose to distribute over their own facilities. Under Judge Greene's recent modification of the Bell consent decree, telcos may extend their functions beyond carriage to include the storage of information and facilitating the public's access to electronic publishers distributing over these common public facilities. But telcos are now strictly banned from generating or affecting the content of intelligence distributed over their monopoly carrier facilities. They may, of course, express themselves, as is their First Amendment right, using distribution means other than their government sanctioned, monopoly facilities.

The central issue of the telco/cable, telco/newspaper and telco/broadcaster debates now engaging the attention of courts, the Congress, the FCC, industry and academia is whether a governmentally authorized, monopoly common carrier should be permitted to function as a hybrid of carrier and publisher in the same service area. Common carriers as defined in Title II of the 1934 Communications Act are foreclosed from broadcasting (Title III) and cable (Title VI). Similarly in the print world, public mail carriers cannot publish newspapers, magazines or books.

My own prognosis and the central assumption of my working hypothesis for developing cable's future is that the governmental interests in both economic competition and First Amendment diversity are so compelling in our society that the ban on telcos functioning as electronic media or publishers will be continued. If so, cable cannot function partly as a common carrier without foregoing its role as electronic publisher. I assume cable operators in the face of such a choice will want to function as electronic media, not as carriers. As a hedge in case such a prognosis proves faulty, there is exploration in cable circles of investing in hybrid cable/telco operations outside the United States in order to gain carrier experience—just as telcos are doing in reverse. Such opportunities will hopefully prove to be valid capital investments. But in my opinion, such ancillary business opportunities should not guide R&D investments by the U.S. cable industry. This is not only because cable's R&D resources are scarce but also because telco suppliers will be glad to sell cable operators advance technology products such as broadband switches in the unlikely eventuality that cable will ever function significantly as a hybrid of electronic publisher and common carrier.

The same rationale for CableLabs' development efforts applies to cable functioning in the United States as a private contract carrier, such as with I-Net and bypass services. There may be valid business opportunities for capital investments, but private, contract carrier ventures should be regarded as ancillary business—not meriting support from cable's scarce R&D resources.

As land-line transmission evolves from the Copper Age into the Glass Age, the nation will continue to have two information lines reaching into homes, provided cable distinguishes its business from telcos, and vigorously develops its opportunities as a broadband electronic medium, or publisher. Telcos face major, major problems in video distribution. Even as purely video carriers, the techno-economic problems are formidable; costs on the order of half a trillion dollars, long depreciation schedules for existing plant, the major hurdles of video switching, the difficulties of providing power over fiber lines for telephony, and the problems of phasing construction over time when most video programming requires prompt national distribution.

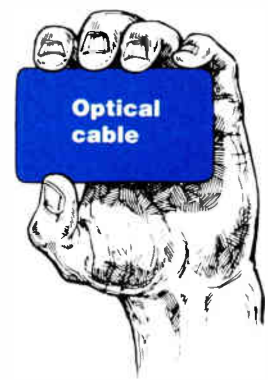
Furthermore, video common carriage is not essential to the public interest, which is quite adequately accommodated by competitive video media, including cable, broadcast, satellites and MMDS, recorded cassettes and discs. Also, regulators are aware that 1) existing copper pairs permit substantial expansion of telco business without video, 2) price cap regulations will diminish cost-plus incentives to invest even when not justified by market demands and 3) open network architectures will inhibit cross-subsidation. Furthermore, to expand beyond a video carrier and function as a video medium, telcos face virtually impenetrable antitrust and First Amendment roadblocks. Telcos will certainly expand the use of fiber in their narrowband voice/data plant. But their expansion into video distribution in the near future will be almost impossible.

In sum, according to the strategic plan sketched herein, all of CableLabs' resources would be devoted to developing cable's capabilities as a broadband electronic media. None would be allocated to developing carrier capabilities.

Five development objectives

While it is not possible here to elaborate particulars, it is useful to identify five synergistically related development objectives for CableLabs. These are:

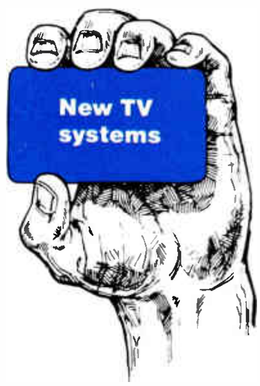
- Optical cable
- New TV systems
- Viewer capabilities
- Security for copyrights
- Multiformat, multimode business



As the industry has come to recognize within the past two years, cable's primary development objective must be the phased incorporation of optical transmission within cable's point-to-multipoint distribution facilities, with a limited return path for control and transaction purposes. Tuning, or possibly switching, will be incorporated for purposes of channel selection by viewers, and of course addressability for selective delivery of channels, discrete programs and other information packages will be an essential feature of point-to-multipoint topologies. However, switching for multipoint-to-multipoint communications should not place any demand on CableLabs resources.

It is generally accepted that, as optical cable works its way down the street and later into the house, cable's distribution plant will evolve from a primarily amplitude modulated hybrid of coaxial and optical cable to incorporate digital transmission.

Although satellite transmission may provide adjunct facilities for directly reaching coaxially served customers, or for extending cable's reach to so-called "white" areas (those not served by the industry's land lines) such capabilities should not place a demand on CableLabs' resources. This is because of the need to prioritize limited resources, the adequacy of development efforts by others, the interim nature of the requirement and a vulnerability to possible governmental prohibition on anti competitive grounds.



As a second objective, CableLabs should help lead development of two new TV systems. The first—improved NTSC—represents an evolutionary approach, layering improvements on the present massive investments in NTSC program inventories and production facilities, in TV sets and VCRs, and in cable, broadcast and satellite transmission facilities. After a half century of exploiting the NTSC standard, the technological imperative for an upgrade of existing facilities is too compelling to be further delayed, but it must be an evolutionary upgrade.

There is also a technological imperative for a radically new system for which I have suggested the acronym WHAM TV, derived from "*w*all-mounted, *h*igh-definition, *a*ctive *m*atrix TV." (This is more lively and descriptive than an earlier suggestion of WAST, for *w*ide-*a*rea *s*uper *TV*.) For a significant improvement in viewing experience, a large-area screen is required, necessitating a wall-mounted, flat display for residential uses.

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Active matrix technology offers the most promising approach. Bandwidth compression techniques, decreasing integrated semiconductor costs, and asynchronous transmission techniques suggest the probability of a system requiring substantially less than 30 MHz, perhaps even as little as 6 MHz, by the time WHAM TV displays can be produced in quantities and at costs for general residential use.

A technological change of the scale of WHAM TV is such a technological discontinuity that successful economic entree requires initial introduction in niche markets. In the case of WHAM TV, this probably means that this radically new TV system will first find a profitable footing in satellite-fed sports bars and electronic theaters, with programs priced by cover charges or ticketing. Thence, it will diffuse as pay-per-view through hotel rooms into widely scattered residences long before it will be distributed generally to residences via cable's land lines. Envision the better part of two decades before the majority of homes are so served.

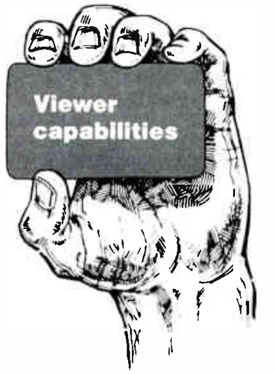
It should be noted that in the process of diffusion, WHAM TV and its principal competitor laser disc video, can be initially deployed free of the government mandated standards. And digital transmission techniques will render moot the international standards hassle resulting from the 50-60 MHz dilemma. Governmentally imposed standards will of course be necessary before WHAM TV will be ready for global diffusion to the general public. And they are obviously necessary for an evolutionary system of improved NTSC. But if mandated standards are attempted too soon for WHAM TV—a major technological discontinuity—successful innovation will be delayed or imperiled.

There is considerable national interest in an intermediate 6 MHz TV system using a hybrid of digital and analogue techniques, but requiring investments in different TV production techniques and in a new generation of CRT receivers with a 16:9 aspect ratio. Beyond testing such systems with ATTC to assure compatibility with cable plant, there is no need in my book for CableLabs to divert its scarce resources to support development of such an intermediate system. It may or may not achieve significant market acceptance for even an interim period.

In short, when it comes to new TV systems, other than largely *defensive* testing of meritorious advanced TV proponents, CableLabs' efforts will bear most business fruit for the industry if they are concentrated *offensively* on improved NTSC and WHAM TV. Large, flat panel, active matrix displays fed by asynchronous, digitally compressed video transmissions offer sufficient promise to warrant a systems management effort by CableLabs to integrate the fast-moving component developments of WHAM TV. And WHAM TV offers an opportunity for leadership in the world's "TV of the future."

One last comment on new TV systems. Hopefully the nation's semi-panic over HDTV is passing. It has been fed by fears of inadequate spectrum allocated to broadcasting, by fears of economic invasion by Japan Inc., by concerns about continued losses of semiconductor markets, by apprehension of telco dominance and by a generalized concern over loss of U.S. industrial competitiveness. Sober analyses of economics and technologies seem to have calmed the extraordinary national anxiety. Perhaps the nation will now embark on a more rational, deliberate development effort. CableLabs can make a significant contribution.

Further to keep matters in sensible perspective, we must keep in mind consumer values. What kind of viewing improvements are wanted and how much consumers will pay for them? How important are these compared with improvements in programming content, diversity and ease of access?



A third development objective for cable relates to the management of technology on behalf of the consumer. This will require major attention to cable's interface with consumer electronics—receivers, VCRs, sound equipment, controllers and other specialty items. It is not too strong to characterize the current jumble of incompatible equipment and interconnections as a mess. A "viewer's laboratory" within CableLabs could do wonders highlighting viewer headaches. By coordinating the integration of hardware and software at the point of viewing, such a system effort on behalf of the consumer could transform the ergonomics of cable viewership.

Furthermore, harnessing technology to serve the consumer also means developing technologically based standards and practices for service engineering—both maintenance and customer service functions. Such engineering functions in a service business are analogous to manufacturing engineering in a product business. Done with excellence, they further the diffusion of technologies and maintenance of a competitive edge.

A fourth objective relates to what many would call scrambling to achieve signal security. I prefer a broader concept of providing for the security of copyrights: 1) protection against unauthorized viewing, 2) protection against unauthorized copying and 3) user-friendly authorization systems such as order and billing functions. Major inadequacies now burden the cable industry both economically and in terms of consumer-friendliness. In addition to a variety of inefficiencies, these include substantial vulnerability to theft and subsequent loss of revenues, incompatibilities of addressable equipment, well-publicized problems with satellite encryption systems and the absence of systems to protect against unauthorized copying.

For the cable industry to attract the very best and freshest of creative product from copyright owners, it must replace the current disorganized sloppiness with a coordinated excellence for the development of copyright security. CableLabs has a significant opportunity to apply system integration techniques and lead the industry out of the present copyright security swamp.

Cable today primarily delivers full-motion video programs for real-time viewing on a scheduled basis. As its fifth development objective cable can expand use of its point-to-multipoint distribution facilities into other information publishing opportunities, summarized collectively as multiformat, multimode services.

Multiformat services include distribution of audio, text, graphics, single-frame images (photos) and other formats in addition to full-motion video. In the category of multimode

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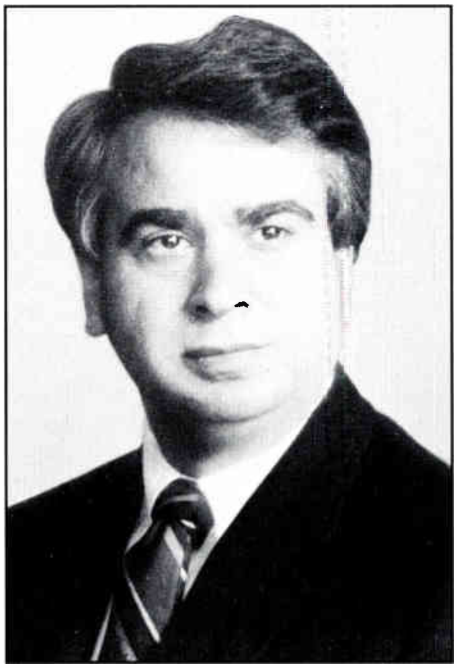
CATV in the '90s and beyond: An integrated view

By Hal Krisbergh
President, Jerrold Communications
General Instrument Corp.



"Technologies that took root in the '80s will bloom in the '90s."

The cable TV industry moved through its adolescence during the 1980s. Now, entering its prime, cable's focus is squarely on the future.

Most futurists agree that at some point in the coming decade voice, data and video will begin to integrate under one control architecture in the home. At the same time, CATV broadband and telco services will continue to deliver signals via separate and parallel systems. True integration will take place in a control mechanism located outdoors, meeting a key objective of the cable industry by locating valuable electronics outside the home.

This activity is already taking place with the new on-premises technology being developed by and for Tele-Communications Inc. This technology will evolve as the decade progresses, heavily affecting cable's future. There are several reasons why this particular method of in-home integration will occur, while distribution networks remain separate. First, the existing telco architecture is narrowband and cannot realistically deliver video. Cable's existing fiber-optic and/or coaxial delivery network is excellent for video and audio but does not currently handle two-way telephony. Cable's infrastructure in the home, however, is well-suited to control voice, video and data and interface with parallel networks that deliver those signals.

We have already seen evidence of this in-home integration. Cable relies on telephony as a return path for pay-per-view data on impulse and as a direct link in ANI (automatic number identification) and ARU (automated response unit) ordering methods. The next decade will simply take advantage of this integration by expanding the number of services available to subscribers. It is only a short leap to such services as automatic meter reading, home shopping and home banking. Technology located outside the home would transparently integrate all these services. Subs would receive CATV and telephony services via in-home signal reception devices that interface with this outside controller.

External limitations

But an integrated distribution network is not realistic in the next decade. The fundamental architectures for telephony and broadband do not provide the same efficiencies and economies for integration as in-home services. A lack of broadband video technology limits telcos. Meanwhile, the potential expense of developing and installing it is substantial. In addition, despite the installed base telcos enjoy, the time frame during which they could introduce video transmission to the home would be 15 to 30 years away. CATV video and audio services, on the other hand, are available to 85 percent of the homes in the country via broadband delivery. However, development of two-way broadband telephony services is not now realistic using the existing point-to-multipoint architecture.

Both the telco and cable industries will increasingly use fiber in the next decade. Probably by the end of the '90s, both will deliver signals via fiber to taps outside the home. From these taps, signals will go to the control center on the side of the house. At that point the controller will integrate the signals and deliver them to subs. Telco fiber-optic activity has been well-documented over the past few years; cable, too, is moving ever more deeply into fiber networks.

AM fiber backbones will proliferate in our industry early next decade. These will provide the immediate benefits of improved picture quality and system reliability. In addition, they will be gateway architectures as CATV expands its bandwidth to 1 GHz. The ability to integrate with existing coax will be crucial. This expanded bandwidth will be the pathway for a number of new in-home services.

Many people today believe there is a need for 1 GHz of bandwidth and up to 157 channels of programming. In fact, programming is now being developed to fill that channel space when available. Such subscriber-specific—and very important—new programming options as narrowcasting also will arrive in the next few years. Using today's PPV ordering technologies, cable operators will be able to segment programming for specific subscribers. This will open a wide range of viewing possibilities, attract still more subscribers and deliver on cable's promise of nearly unlimited programming options. Again, this promise will be met by integrating cable's delivery of broadband signals with telephony's point-to-point return at the home.

Fiber's expanded bandwidth potential also will play a role in the development and introduction of advanced TV over cable. Once again, we will be able to offer programming options unavailable via con-

(Continued on page 109)

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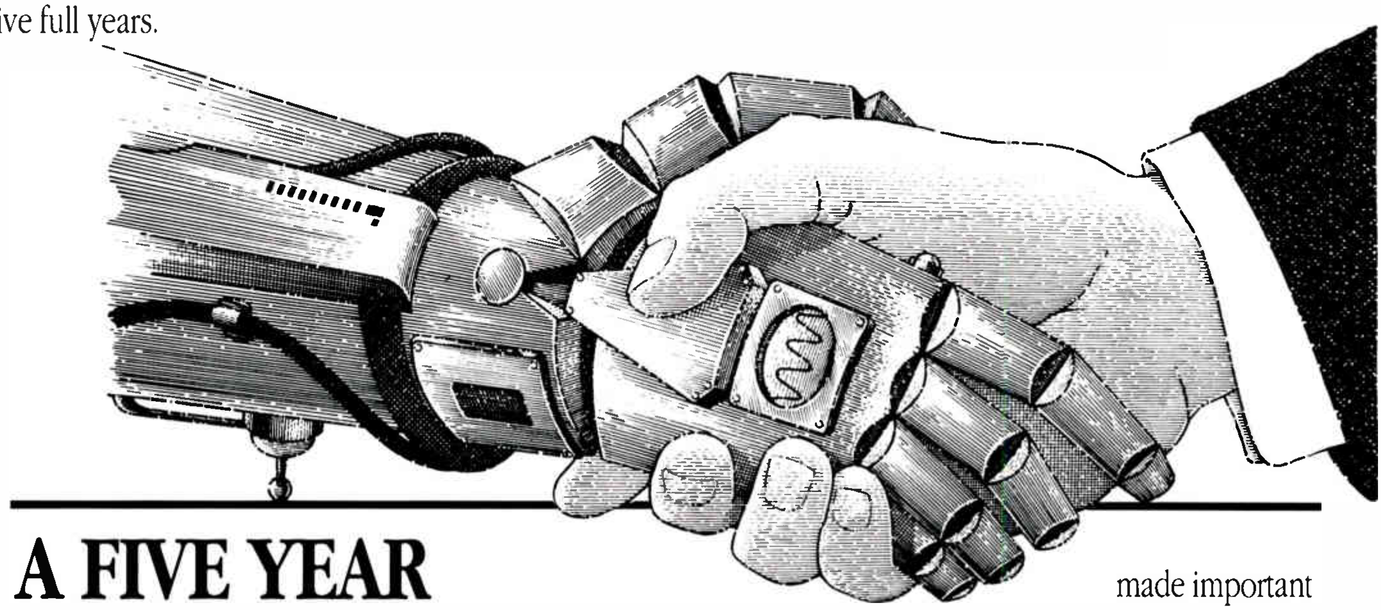

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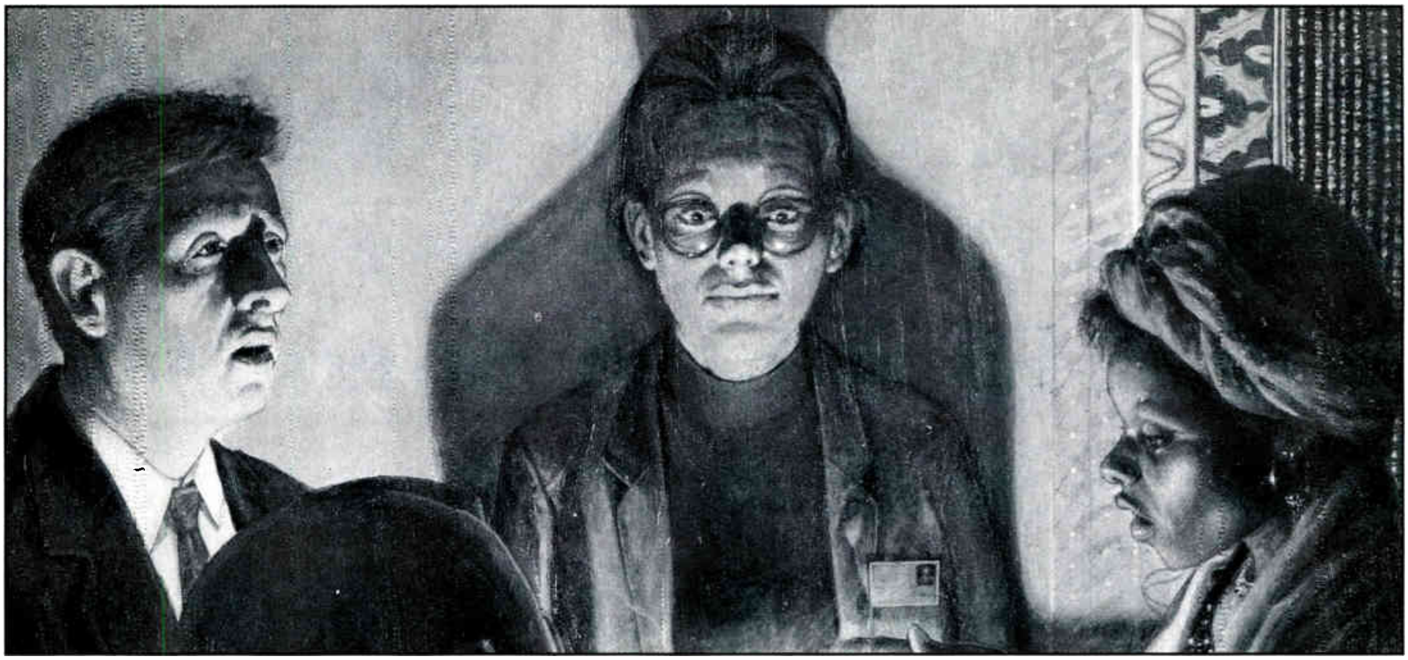

Making pay-per-view friendly for the 1990s

By Vito Brugliera
Vice President, Marketing and Product Planning
Cable Products Division, Zenith Electronics Corp.

Pay-per-view (PPV) on cable has been growing steadily for the past several years; out of 12 million addressable subscribers, 6 million are PPV subs. PPV will continue to grow along its present course as a practical, economical means of delivering premium programming to cable subscribers.

PPV is usually associated with movies and distinguishes itself from premium pay services by offering newer movies on a single-view basis. It is a transaction-based technology; to successfully complete a transaction the following things must occur:

- The event must be identified,
- The sub must be identified,
- The sub must be authorized to view,
- The converter must be deauthorized after the show and
- The transaction must be recorded in the management computer data base for billing and documentation.

Today's technology options

Scrambling, security, delivery and pathways are all part of a successful transaction. Traditionally, the first three functions occur in the home terminal—the addressable converter. Transaction paths use the telephone network or the cable plant. If the cable plant is used as the return path, a transmitter built into the converter sends data to the headend.

The telephone return path offers the operator a choice of several technologies: customer service representatives (CSRs), automatic response units (ARUs), store and forward (S&F) modules and automatic number identification (ANI). In some situations, CSR and ARU can provide simple, low-cost approaches. But in large systems, CSR and ARU technologies suffer from telephone voice network overload under peak loads, and ARUs are inaccessible from rotary phones.

Store and forward solves two problems: 1) It avoids overload by storing transaction data until polled, and 2) since polling is relatively slow, S&F management and system controller computers avoid real-time throughput. But, installing and S&F system requires additional hardware.

ANI, a real-time technology, avoids voice network bottlenecks by routing transactions outside the normal network. The caller's phone number and the number dialed identify the subscriber/address and event. Newer system controllers process data almost instantaneously and ANI systems' don't need additional hardware in the home to store data.

For hardware vendors, ANI requires investments in new system controller technology and new software to handle real-time transactions. Because manufacturers are making commitments to this technology, industry forecasts predict that within six months, ANI's low-cost practicality will provide PPV services to more than 3 million subs.

Two-way cable can be either real-time or store and forward. Real-time technology allows more than just PPV. Opinion polling, home shopping, status monitoring and channel monitoring are just some of the interactive and data gathering services available. Interactivity and data gathering capabilities offer the possibility of new services, new revenues and a wealth of sales and marketing data. Real-time two-way systems have been operating successfully for the last five years. One example is a 4,500 plant mile system serving more than 250,000 subs and defying the conventional wisdom that says two-way doesn't work. No matter what the PPV technology, it's critical that it be easy to use and can be tailored to individual system needs. There is no best technology, only appropriate ones.

Addressability has not grown as quickly as in the past because TV receiver tech-

(Continued on page 104)

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Interdiction colonizes Williamsburg

By Harry H. Johnson Jr.
Manager of Technical Operations
Warner Cable Communications Inc.

And John M. Cochran
Senior Applications Engineer
Scientific-Atlanta Inc.

Off-premises addressability is a long-awaited technology that is becoming a reality in Warner Cable's system in Williamsburg, Va. We see this technology as a major step toward the cable delivery system of the future with significant advantages in consumer interface, operational control, marketing flexibility and security.

Generically defined, off-premises interdiction is addressable subscriber service control from a location in the feeder plant. This approach differs slightly from on-premises approaches where the control electronics are in or attached to the subscriber's house (premises) and accessible by the sub.

In Williamsburg, Scientific-Atlanta's interdiction system will be used in a test area of 250 homes and is scheduled to be fully operational by February 1990. The interdiction system will replace the feeder tap with a four-port subscriber control unit, one port per sub, which is controlled addressably from the headend by the system manager controller.

The subscriber control unit is shown in the accompanying figure. All of the subscriber electronics are contained within the interdiction housing, which has been constructed using proven distribution electronics product design. A brief description follows:

- The housing top and bottom form an enclosure that environmentally protects the interdiction unit's electronics. It has threaded holes for the feeder cable and output F connectors for drop cable attachment. The housing is designed to be compatible with mounting on an aerial strand or in an 8-inch diameter ground pedestal.
- Ports A and B combined provide a through cable path for aerial mounting. Ports B and C provide the cable interface points for pedestal mounting allowing the cable to enter and exit from one end of the housing.
- The gasket allows a water tight seal to be formed between the top and bottom housing. It is impregnated with carbon to

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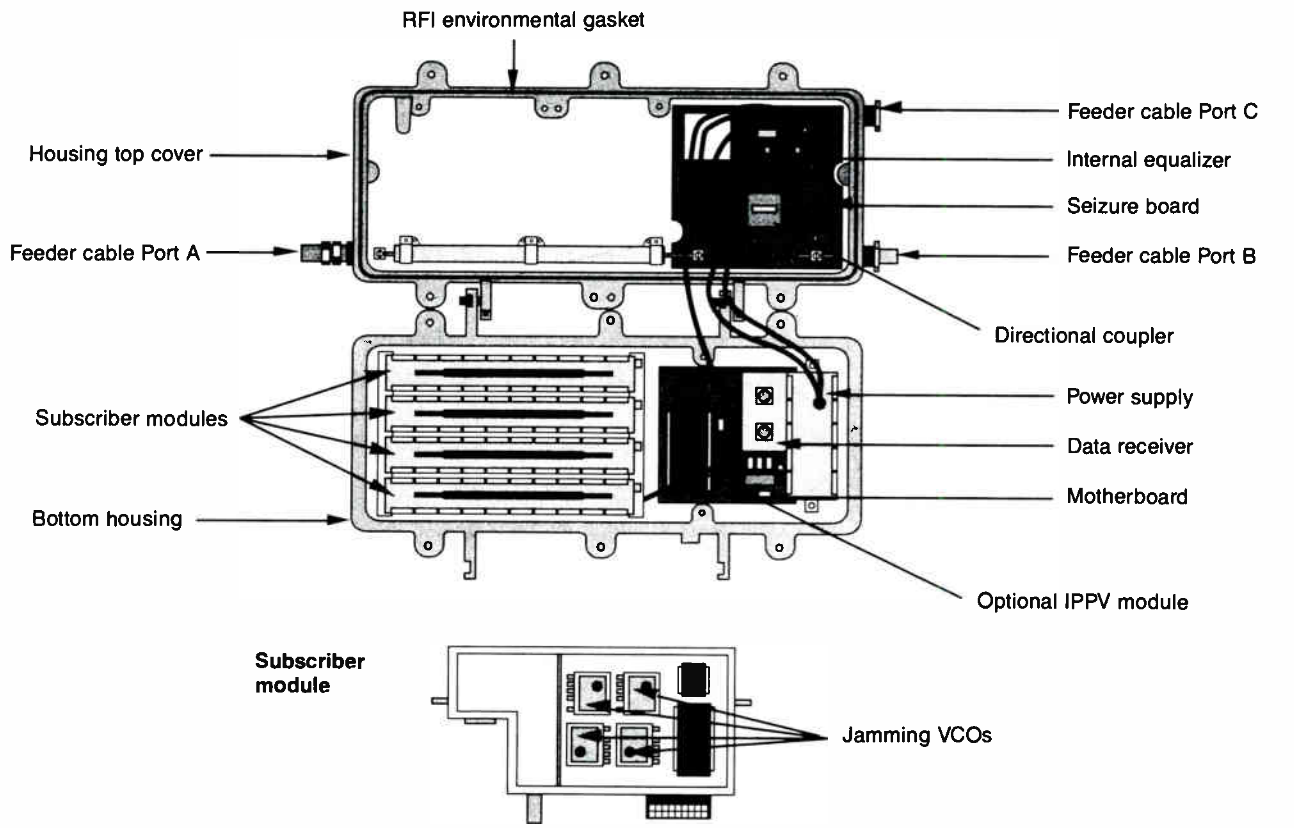
Interdiction subscriber control unit



Fiber optics: The key to improve customer service

By Dean DeBlase Sr.
Vice President of New Business Development, Anixter Cable TV

It is all to easy to mistake technology as the leading instrument of change for the cable TV industry in the '90s. In fact, technological advances will serve only as tools to improve service and meet the increasing demands of our subscribers.

Our industry is entering the most competitive decade in its history, amid threats of reregulation and telco entry into the video service business. We continue to compete with alternative media such as TVRO and videotape rentals. In many areas of cable systems throughout the country today, end-of-line picture quality compares poorly with off-air signals. Meanwhile, the pictures we deliver to subs are being viewed on increasingly sophisticated TV circuitry that is decreasingly forgiving of the flaws and distortions in delivered signal quality. To succeed as an industry in the 1990s and beyond we will need to focus on a set of goals that address one objective: *improve service to the sub.*

Onward with fiber

In the past, programming was the key to success for the industry. However, in the '90s, quality service will be equally important to ensure subs' satisfaction and will in turn give us a more solid footing against competitive forces. Fiber optics has emerged in the last year as the industry's single most effective technological resource and is now being deployed to improve the quality of cable service to subs throughout the country. This comprehensive tool is being used to achieve goals in marketing, programming, technology, operations and customer service that will raise the standards for quality in the next decade.

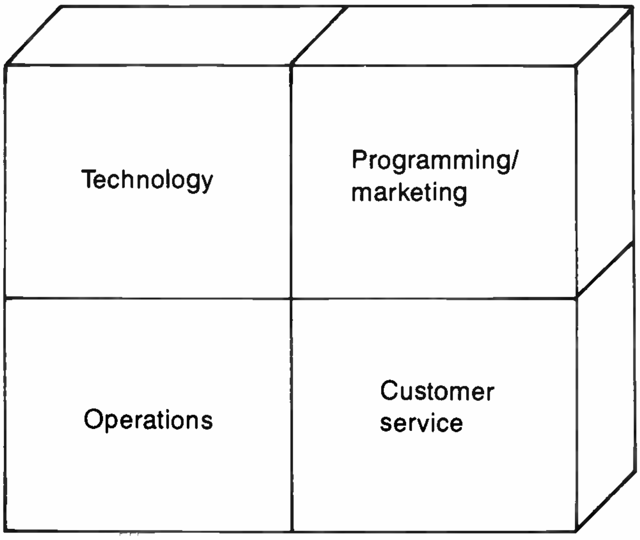
Technology: During 1989 fiber has solved many operators' technical requirements, allowing them to expand channel capacity twofold and threefold while improving the signal quality throughout their systems. This groundwork has positioned fiber as a strategic part of rebuilds, upgrades and new-builds of the future.

System reliability—a key goal during the '90s—has increased dramatically during 1989 with the use of fiber. With the various new system architectures being deployed, operators now have the ability to determine the degree of system reliability by segmenting their plant into smaller service areas, utilizing more reliable electronics, reducing amplifier cascades and specifying various redundant signal plans. With this new technology, enhanced network designs and improved performance levels, operators are poised to upgrade the level of service and value that cable brings to the customer.

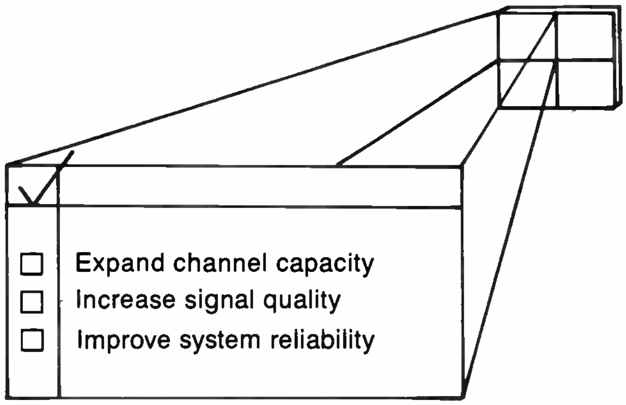
Operations: When optical technology is integrated into the strategic plan of a company or an individual cable system, it lays a foundation for achieving a number of operational goals. Cable systems are now being designed to feed smaller service areas of subscribers from a fiber network, with each node serving

(Continued on page 94)

CATV's goals for 1990



Technology



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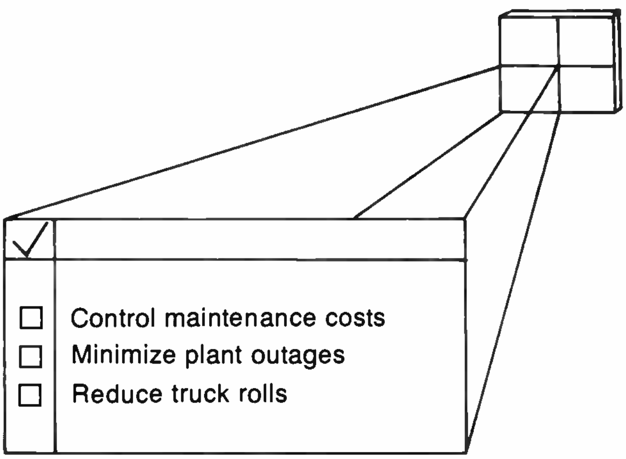

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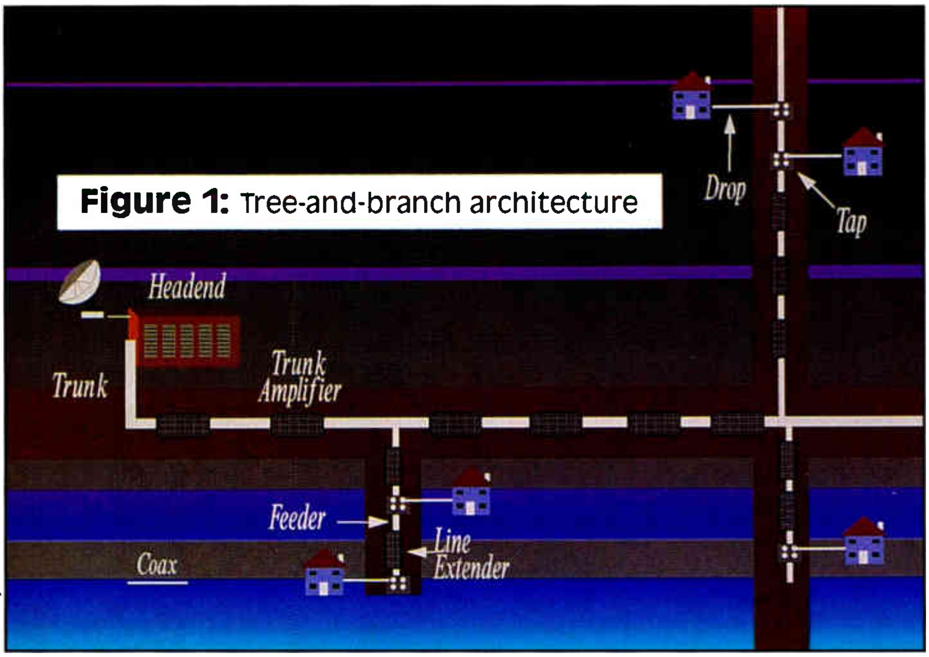
Reader Service Number 25.

Fiber optics: The CATV evolution of the 1990s



Courtesy Jerrold/General Instrument

By David E. Robinson
Director, Cableoptics
Jerrold Division, General Instrument Corp.

A seed planted in the 1980s will blossom in the 1990s. Cable TV will embrace fiber-optics technology, pragmatically improve it and cost-effectively deploy the resulting product. As a result, residential subscribers will receive more and better broadband communications services.

In a sense this fiber-optic evolution is a continuation of a success story that began in the late '40s with TV signal boosters. Coaxial cable and vacuum tube amplifiers became the key broadband technologies of the '50s, while the '60s saw leverage transistors, push-pull amplifiers and the first set-top converters. Subs received more and better, cost-effective broadband services. With satellite technology in the '70s, cable TV nurtured and grew innovative nationwide programming services. As we close the '80s, addressability, impulse technology, two-way cable and 550 MHz bandwidth technologies are well-known tools as the cable operator provides video and audio services to over 50 million subs worldwide.

Three phases of the fiber evolution are projected through the '90s: supertrunk, backbone and to the tap. We will describe each phase in the evolution and also explore the economics, alternative modulation schemes, wavelengths, architectures and other critical technology elements.

Phase 1: Supertrunk

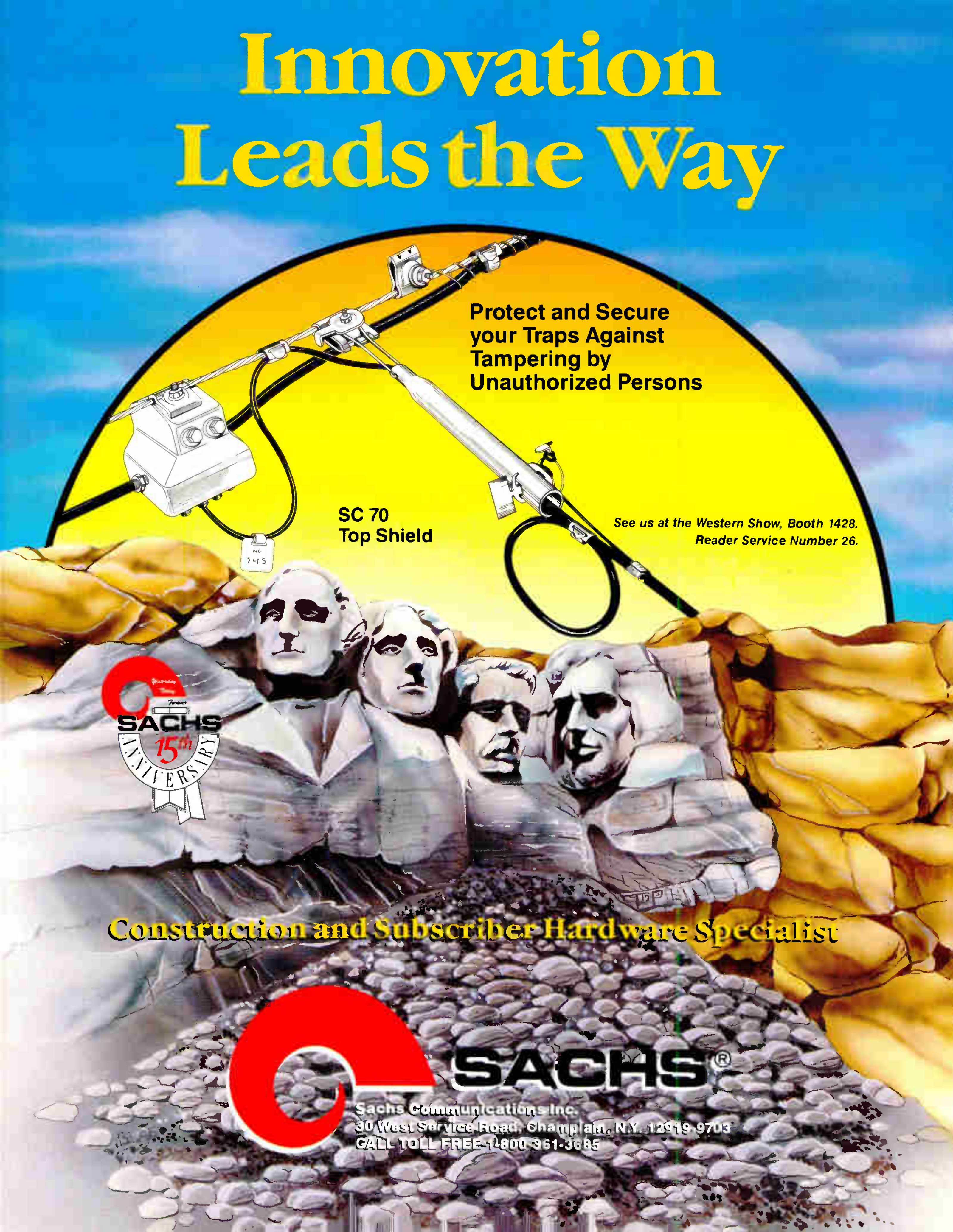
During the 1980s fiber optics became the technology of choice for linking headends. Prior technologies for these supertrunks, some of which are still employed in new construction, were coaxial cable—often with frequency modulation (FM) and/or feedforward amplifiers—and terrestrial microwave.

Figure 1 illustrates a traditional single-headend coax distribution system and its key elements. Figure 2 illustrates a multi-

(Continued on page 95)

CATV use of fiber optics has been waiting for a reliable AM system developed specifically for cable.

In 1990, the wait will end. The specifications and other details David Robinson outlines in this article are being met today. At this month's Western Show, an AM fiber-optic backbone system that can handle 80 channels with a 56 dB C/N over 10 miles will be demonstrated. The C/N further exceeds 50 dB at distances up to 20 miles. It uses two fibers and has 65 dB composite triple beat and second-order distortions measured according to NCTA recommended practices. Volume production of the new system will start in the middle of 1990.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Fiber backbone: Multichannel AM video trunking

By James A. Chiddix
Senior Vice President, Science and Technology

Dave M. Pangrac
Director, Science and Technology

And Herzel Laor
Fiber-Optics Implementation, American Television and Communications Corp.

Optical fiber transmission technology has achieved rapidly increasing acceptance by the cable TV industry. While 87 percent of the homes in the United States are already passed by broadband coax, coaxial technology (as it is presently being used) is beginning to approach its performance limits. Fiber offers a high bandwidth, low loss transmission medium that has the potential to allow significant performance improvement in today's cable systems.

For some years, there has been increasing use of fiber for supertrunking: high quality point-to-point video interconnections between major system hubs, earth station/headend connections and links between headends to allow simultaneous insertion of local ads. These supertrunks have proven themselves to be highly reliable and cost-effective, offering in many situations a viable alternative to microwave interconnection.[1,2]

It is, therefore, natural that the industry has sought additional ways to use this new technology to improve its systems. The authors previously described an approach to such a use, termed "fiber backbone."[3] In examining current CATV system architecture, it was noted that most of the performance limitations, reliability, transmission quality and useable bandwidth stemmed from the long amplifier cascades required by typical CATV tree-and-branch architecture when used in medium to large communities. This in turn is a product of the relatively high loss of coaxial cables (on the order of 1 dB per 100 feet: a loss of half the signal voltage every 600 feet). This loss (and the large number of amplifiers required in series to counteract it) requires that CATV system bandwidth be limited far below the potential of the coax transmission medium in order to achieve acceptable signal transmission performance. Current system architecture is illustrated in Figure 1.

The fiber transmission medium exhibits extremely low signal loss (on the order of 1 dB of signal power per mile). The fiber backbone approach is designed to replace long runs of coaxial plant, which often contain 20 or 30 amplifiers in series, with completely passive low loss fiber trunks (as illustrated in Figure 2). With a fiber system within one or two miles of all subscribers, CATV signals can be handed off to an existing RF coax network for delivery. By limiting the total number of amplifiers between the headend and any subscriber to a small number, significant improvements in reliability and signal quality can be achieved. There is an opportunity to upgrade the remaining coaxial portion of the network to achieve substantially greater bandwidth than possible in traditional CATV systems.[4,5]

While conceptually simple, optical terminal technology capable of delivering broadband multichannel signals to the coaxial portion of a system is technically very challenging. Nevertheless, substantial progress has been made on this front by a number of system developers. Implementation of both demonstration and operational fiber backbone systems was begun by a number of cable operating companies during the last year. There is growing acceptance of the idea that a hybrid fiber/coax CATV system has the potential to provide significant improvements in performance and channel capacity at relatively

Figure 1: Tree-and-branch architecture

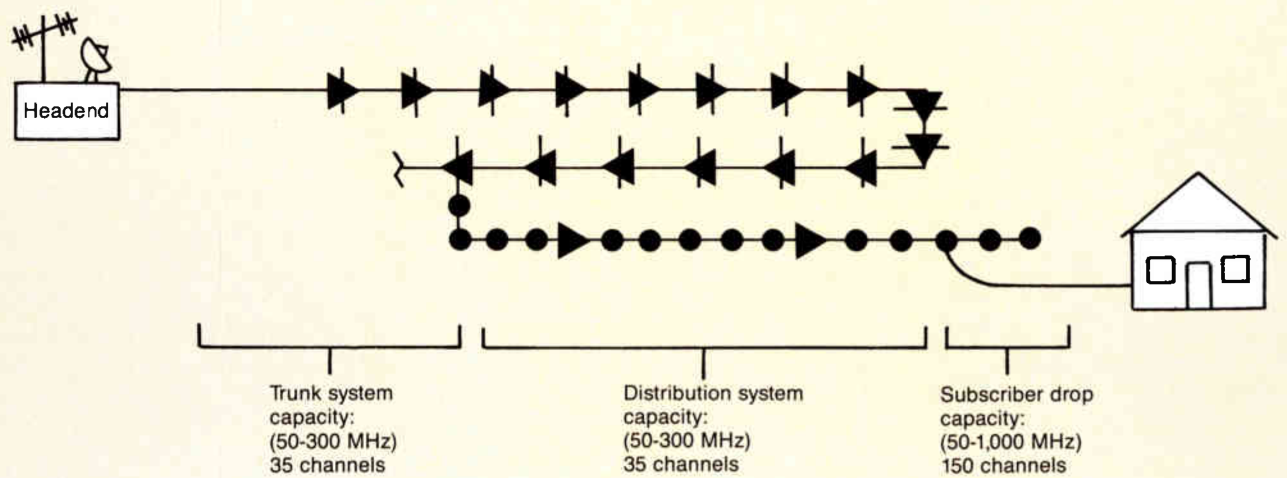
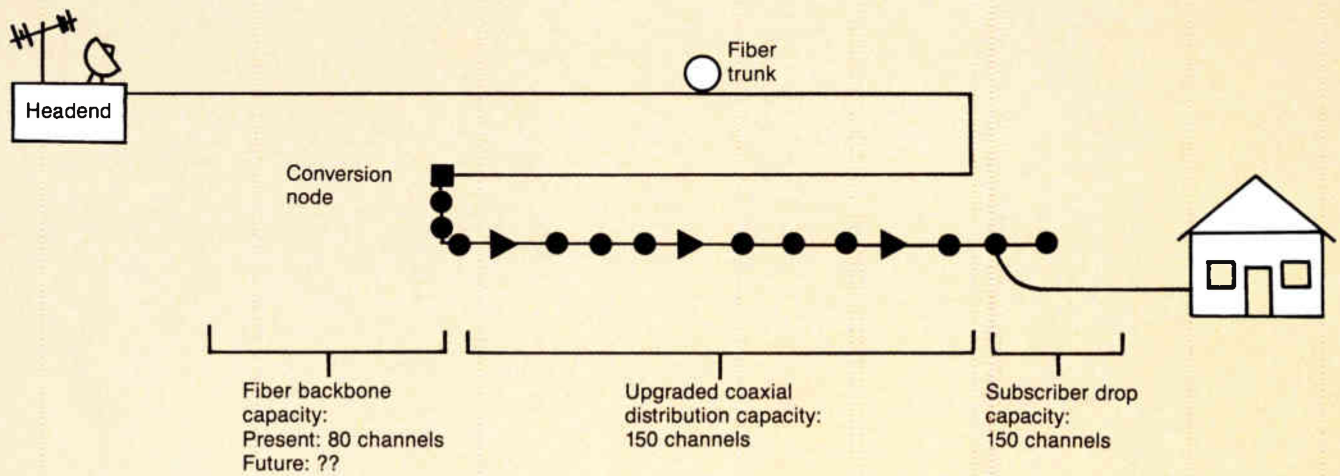


Figure 2: Fiber backbone architecture

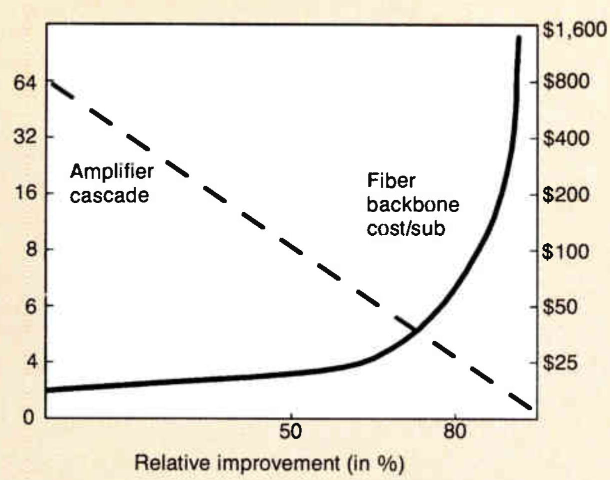


modest cost as the industry faces the challenges of the next decade.

There are many different network topologies that could be adopted using a hybrid fiber/coax transmission medium. Questions naturally arise as to what forms of modulation should be used in which portions of the system and how close to the home the fiber portion of the hybrid plant should extend.

Amplitude modulation: There are several types of modulation available for the transmission of video information. The most obvious is amplitude modulation with a vestigial sideband (AM-VSB). This is perhaps the most bandwidth-efficient practical modulation system available for video transmission and is used for over-the-air TV broadcasting as well as in current CATV systems. With it, NTSC video can be transmitted within a 6 MHz channel. In addition to bandwidth efficiency, AM-VSB enjoys tremendous ubiquity. It is estimated that there are over 160 million TV sets in use in the United States today. All of these sets are designed to accept AM-VSB video on RF channels at their input. It follows that, regardless of the transmission modulation system adopted, AM-VSB must be the final product of a CATV system at the point of hand-off to the customer's set. Today's cable systems use AM-VSB throughout, with a simple broadband coax transmission medium carrying signals all the way to the set. Some televisions require a channel converter, a heterodyne frequency conversion device, if they cannot tune all channels provided by the cable system directly. Our research indicates, however, that 52 percent of cable homes currently own at least one cable-ready set capable of tuning non-standard cable channels directly. While converters with built-in descramblers are also sometimes used for signal security, particularly for premium services, the cable industry's approach of delivering signals all the way to the home in directly tunable multichannel AM-VSB form is clearly highly attractive.

Figure 3: Cost benefits of cascade reduction



Frequency modulation of video signals in the RF domain allows high quality multichannel video transmission. FM video requires substantially more bandwidth than AM, usually from 10 to 40 MHz per channel, depending upon the performance improvement sought. FM video is widely used for satellite transmission as well as for cable supertrunking. At some point in any distribution system using FM, however, there must be demodulation of the FM signal and AM-VSB remodulation of the resulting baseband video in order that it may be received by today's TV sets.

Carrying FM video all the way to the home would require an FM receiver to demodulate the selected channel and an AM modulator to remodulate it for viewing or recording. One of these receivers would be required for each TV set or VCR in the home. Many of the built-in features of televisions and VCRs, such as remote control tuning, would be rendered useless. FM is used today for high quality supertrunks. Upon delivery of FM signals to a system hub, each is demodulated and remodulated using AM-VSB onto the correct RF channel for coaxial transmission to the home. FM has transmission quality advantages over AM, but the costs of modulation conversion limit how deep into a CATV system it is economically practical to use it.

Digital modulation is an obvious approach to video distribution in systems that use fiber transmission. Although highly bandwidth-inefficient, this will matter less in the future as fiber systems realize greater bandwidth. Digital modulation has the

(Continued on page 85)

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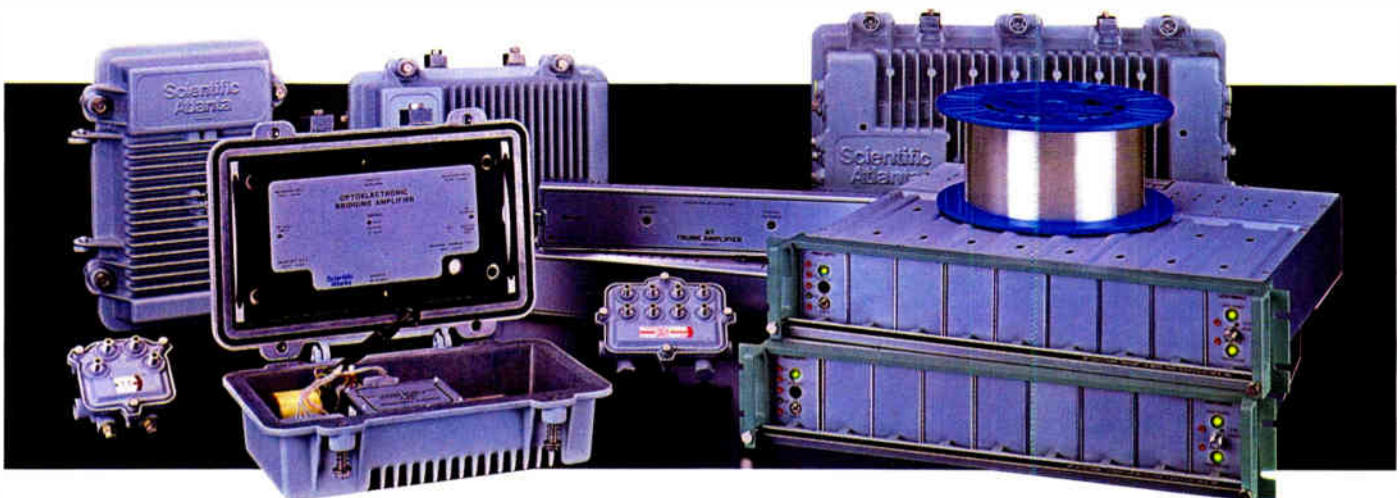

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Small systems— The last frontier

This is the ninth and last in a series of articles designed to help the small system operator or entrepreneur avoid some basic (and perhaps fatal) mistakes. This installment concludes a discussion of the economics of small systems. Editor's note: Any opinions expressed are those of the authors, based on their experiences in building small systems.

By Bill Grant
President, GWG Associates

And Lee Haefele
President, Haefele TV

Let's conclude this series by estimating revenues and rates. Here's where the "art" comes in and where the rose-colored glasses had better come off. To avoid subsequent unpleasant surprises you simply have to be coldly objective and completely realistic now.

You know how many homes the plant will pass. You must estimate how many of those will subscribe to any level of service at all. Ask yourself once again, "Is this a real number or just wishful thinking?" Whatever your number is, how many of these subs will pay more for higher grades of service?

Take a good hard look at these numbers. If you believe you've been as accurate as possible at this point, then this is the subscriber base that must produce the previously established revenue objectives (per last month's discussion). You have three projected numbers for subscriptions to three grades of service. But the rates charged for the different levels of service offered may change your earlier estimates of the number of people who would pay more for additional services.

Service rates

If we know what the revenue objective is per year, dividing by 12 produces the revenue requirement per month. The revenue required from each sub regardless of the grade of service purchased is equally easy to establish: Simply divide the monthly revenue requirement by the total number of subs you project.

For example, if the revenue objective is taken to be $36,000 per year, then the monthly objective is $36,000 divided by 12, or $3,000. In a system that serves 150 subs, each sub must generate $20 per month to meet the monthly requirement of $3,000. The basic service rate could be taken to be this same amount ($20).

Higher grades of service offering special programs will introduce additional costs for license fees. We might establish higher rates for these by simply adding the actual cost of fees to the basic rate. This approach is simple enough, but it does not produce any additional revenue for the system operator from those subs. It merely recovers the cost of the services.

A different approach would exploit the greater appeal that these services presumably have due to the restricted and varied nature of the special programming itself. What we will try to do is reduce the basic rate and recover the required additional revenue by increasing higher grade service rates beyond their actual program cost level on the rationale that more people will take higher services than will take only the basic service.

It's getting a bit complicated so let's try this example as clarification: Suppose we estimate 300 homes passed and believe that 150 will become subs. We further "guesstimate" that 50 will take only basic service, 50 will take a higher grade (more expensive) Service A and the remaining 50 will take the highest grade (most expensive) Service AA.

(Continued on page 80)

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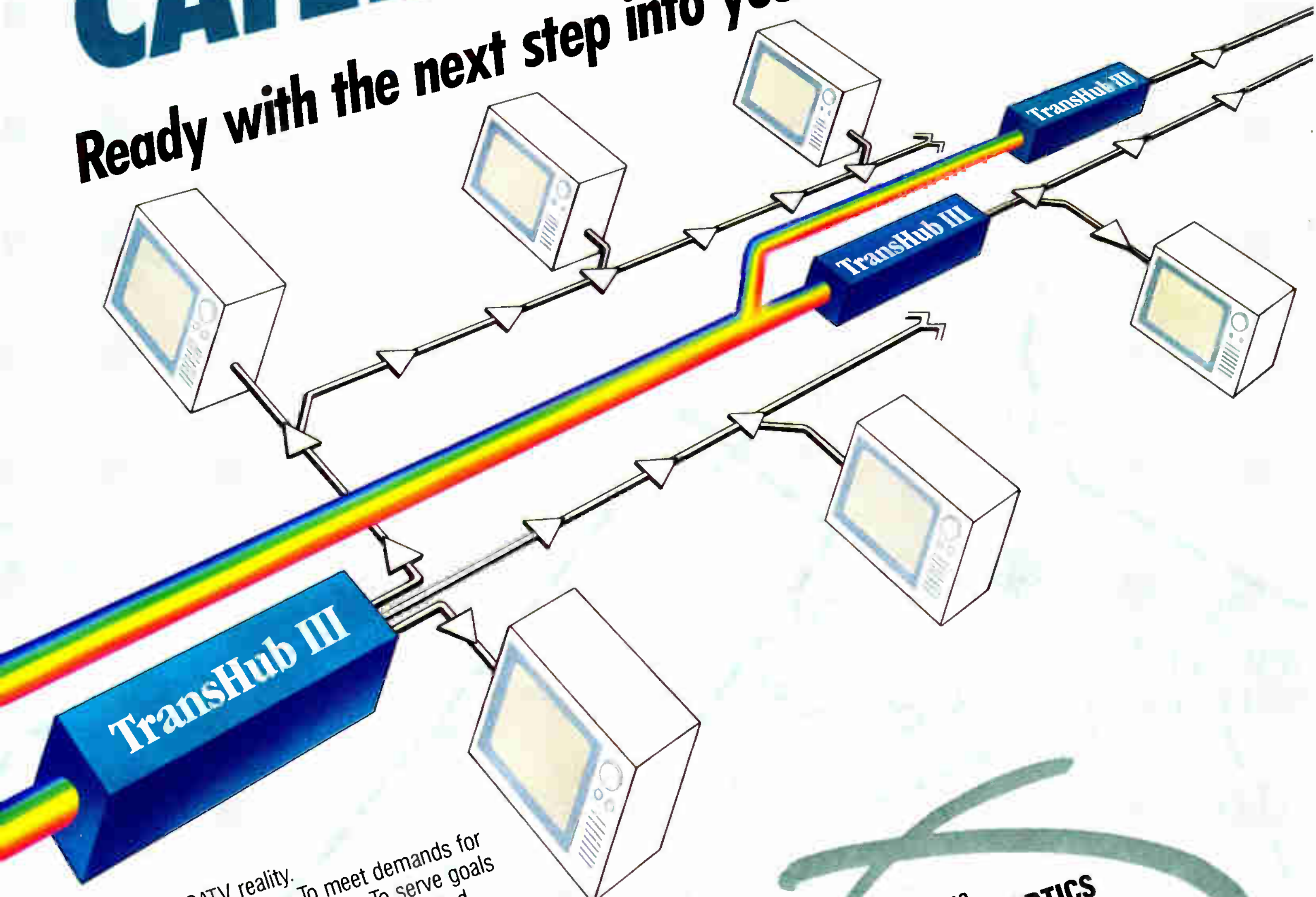

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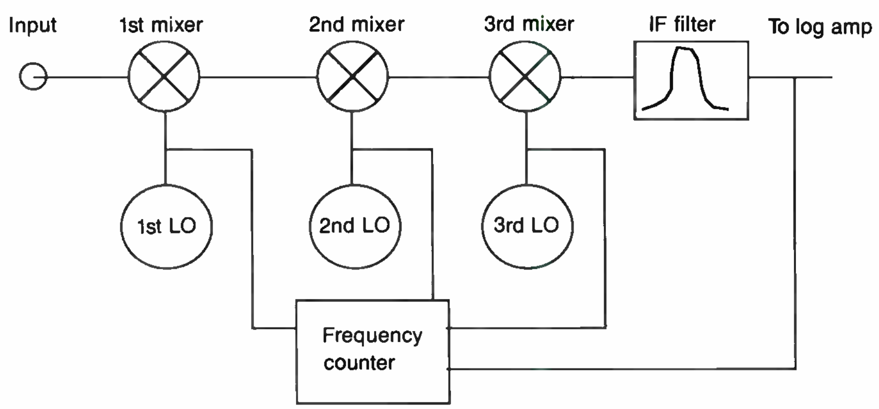
Part II: Measuring in-depth

This is the second in a series of articles on making technical measurements in cable systems. This month's installment describes frequency counting.

By Bill Benedict
Applications Marketing, Tektronix Inc.

The art of frequency counting has evolved through the years from being a laborious and time-consuming task of 10 years ago to a simple task today. In the good old days, one needed a stable oscillator, a frequency counter and a spectrum analyzer to perform a frequency count of one carrier on a system of multiple carriers. The oscillator would be mixed with the signal of unknown frequency until the beat notes between the two signals indicated a null on the spectrum analyzer, then the frequency counter would count the external oscillator for a relatively accurate frequency. As you can imagine, this process gets very laborious when counting 40 to 50 carriers and the accuracy of the measurement is dependent on operators and how well they beat the external oscillator with the carrier being measured. With frequency accuracy requirements of ±25 kHz, characterizations such as these are adequate. Today, accuracies of ±5 kHz are expected with significant consequences if frequency tolerances within the aeronautical bands are not maintained.

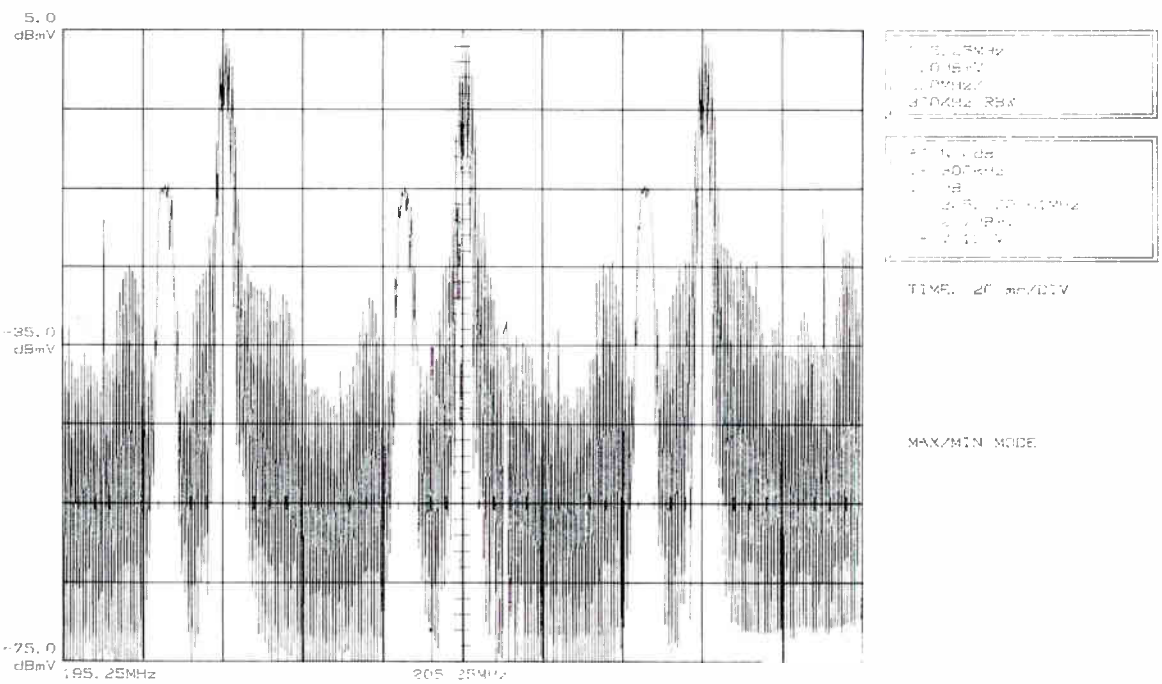
Figure 1: Spectrum analyzer with built-in frequency counter



If the zero beat method was not used to measure the carriers, one could always connect a counter directly to the modulator for each carrier. Once again this is time-consuming and may or may not require removing the modulation from the carrier during the count, thus requiring late nights or early mornings, to keep from interrupting prime-time viewing. There is, however, at least one manufacturer who has tunable counters available that do not require removal of modulation and will work with signal levels found at headend combiner test points.

During the last decade, frequency accuracy in spectrum analyzers has increased to the point where frequencies can be determined accurately. First, synthesizers were added to analyzers for frequency stability and accuracy. By spanning down (zooming in on a signal) one could deter-

Figure 2



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frequency being counted. This also added another benefit. Previously the operator had to span down to a narrow bandwidth to ensure the signal was centered before reading the analyzer's center frequency. By counting the final IF, the need to span down is no longer required, speeding up the process and allowing more frequencies to be characterized within a given time frame. The interaction between operator and analyzer is less, thus the measurements are now less prone to operator interpretation and possible error.

The frequency counter also added an additional benefit. Since the analyzer is counting the frequency of the IF, if the frequency is varying because the signal is FM, the counter will integrate the modulation out and give the unmodulated frequency of the carrier, provided the count is for a long enough duration and the resolution bandwidth is wider than two times the peak deviation (peak-to-peak deviation). This last requirement is to ensure that the carrier remains within the system IF during the count interval.

Counter specifications

Before applying this new knowledge, we need to understand how the counter specs associated with the analyzer apply. In this example we will apply the spec for the TEK 2710 spectrum analyzer. The counter spec is: accuracy = (reference accuracy × counted frequency ± 10 Hz ± 1 LSB). The reference accuracy is the accuracy of an internal crystal controlled oscillator, counted frequency is the frequency of interest as measured by the analyzer, 10 Hz is a term to cover truncation of digits by the internal counter and the 1 LSB covers the final summation of the various counts performed by the instrument.

As an example, by counting a Ch. 12 video carrier with the TEK 2710 opt 01, we get a measurement of 205.250061 MHz. Applying the previous formula we get:

$$(5 \times 10^{-7}) \times 205.250061 \text{ MHz} \pm 10 \text{ Hz} \pm 1 = \pm 114 \text{ Hz}.$$

Therefore the true frequency is somewhere within the range of 205.249947 to 205.250175 MHz or 205.250061 MHz ±114 Hz.

As we can see from the formula, the accuracy of any frequency is determined more by the frequency itself, where lower frequency counts will be more accurate than higher frequency counts. Since most frequencies used in a cable system are less than 500 MHz, we could calculate the error at 500 MHz, which is ±261 Hz, and

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determine that all frequencies measured below 500 MHz will be within 261 Hz, well within the specification of ±5,000 Hz necessary for FCC compliance in the aeronautical bands.

These calculations apply to most spectrum analyzers. As an example, let's use the HP8591A opt 004 spec and calculate the accuracy of the Ch. 12 video carrier measured at 205.250061 MHz. The reference spec we will use is the aging spec of $\pm 10^{-7}$/year. The HP spec is: accuracy = ±(market frequency × frequency reference error + counter resolution + 100 Hz) = ±(205.250061 MHz × 10^{-7} + 10 Hz + 100 Hz) = ±131 Hz.

System frequency requirements

Although each cable system has its own internal specifications, there are some minimum specifications we must all adhere to such as those imposed by the federal government. Federal Communications Commission Rules and Regulations, Part 76.605 (2) states: "(The) visual carrier frequency shall be maintained 1.25 MHz ± 25 kHz above the lower frequency boundary," this being ±25 kHz of the assigned visual carrier frequency (Figure 2). Part 76.612 (a) states: "In the aeronautical radiocommunication bands 118-137 MHz, 225-328.6 MHz and 335.4-400 MHz, ...(1) All such cable carriers or signal components shall be offset by 12.5 kHz within a frequency tolerance of ±5 kHz," this being within ±5 kHz of the newly assigned carrier frequency. Part 76.605 (3) states: "The aural center frequency of the aural carrier must be 4.5 MHz ±5 kHz above the frequency of the visual carrier." This measurement could be made by counting both the video carrier and the aural carrier and taking the difference, or by using the "delta" marker mode in the modern spectrum analyzer (Figure 3).

From the requirements of maintaining visual carriers within ±25 kHz (±5 kHz within the aeronautical bands) and the need to maintain the visual/aural separation (intercarrier frequency) with a tolerance of ±5 kHz, the need for a spectrum analyzer with the counter becomes obvious, especially with its accuracy of ±261 Hz in the frequency band up to 500 MHz. An added benefit not even covered so far is the ability to count all the carriers within a system in the convenience of the office, and not having to trudge up to the headend, if remotely located.

Occasionally in a system a signal will appear as a result of an oscillating device, a beat note between two or more carriers, an ingress signal, etc. Being able to count these signals can help to identify the source. Similarly, connecting an antenna to the analyzer (Figure 4) and monitoring the system for leakage will show many signals in the aeronautical bands. The question is, which ones are legitimate aeronautical frequencies and which ones are leakage components? A quick frequency count of one of the questionable carriers will easily identify it as being related to the cable system or not.

Improved performance

Performance criteria within analyzers has dramatically improved within the last several years. The performance obtained with the older analyzers is only a fraction of the performance obtainable with a modern analyzer, especially with the frequency counting capability. Being able to count one carrier in a multitude of carriers, even when the signals are only 20 dB greater than the system noise without external amplifiers and filters provides a capability yet to be explored by the cable community. The new requirements placed on the cable industry by the FCC in maintaining tighter frequency tolerance of carriers and the continual monitoring for signal leakage, focus on this frequency counting capability of analyzers.

Courtesy Scientific-Atlanta

quencies and jam factors that would result if only premium services are to be denied. There are four pay channels to be controlled via jamming: The Movie Channel, HBO, The Disney Channel and Showtime. The applicable VCO is determined by the channel frequency of the service. The result is one channel within VCO C, two within VCO D and one in VCO E. Growth of up to 12 more pay or premium channels can occur with very high security on each. A larger number of channels can be jammed, maintaining better security than sync-suppression type scrambling, if the Williamsburg system were to expand the premium channel requirements in the future.

The interdiction system uses existing technology for addressable control of subscriber program services. Minor control software modifications and enhancements have been made to accommodate the interdiction product advances. All other controls and billing vendor interfaces remain unchanged and transparent to system operation. From the headend, the system allows a subscriber's service to be connected or disconnected, channels to be authorized or deauthorized, pay-per-view authorization and control of the security level on interdicted channels.

Our objective is to provide a system that delivers quality pictures to subscribers with interface transparency into their home entertainment equipment. The system also must resolve many of the operational issues and maintenance problems associated with today's cable plant.

In Williamsburg, a short trunk cascade of six amplifiers will feed distribution plant, which includes the off-premises addressable taps. From the tap to the home, Warner is implementing "top drop." The corporate engineering department has developed a list of drop materials and installation criteria that will create a trouble free, long lasting, "hardened" drop.

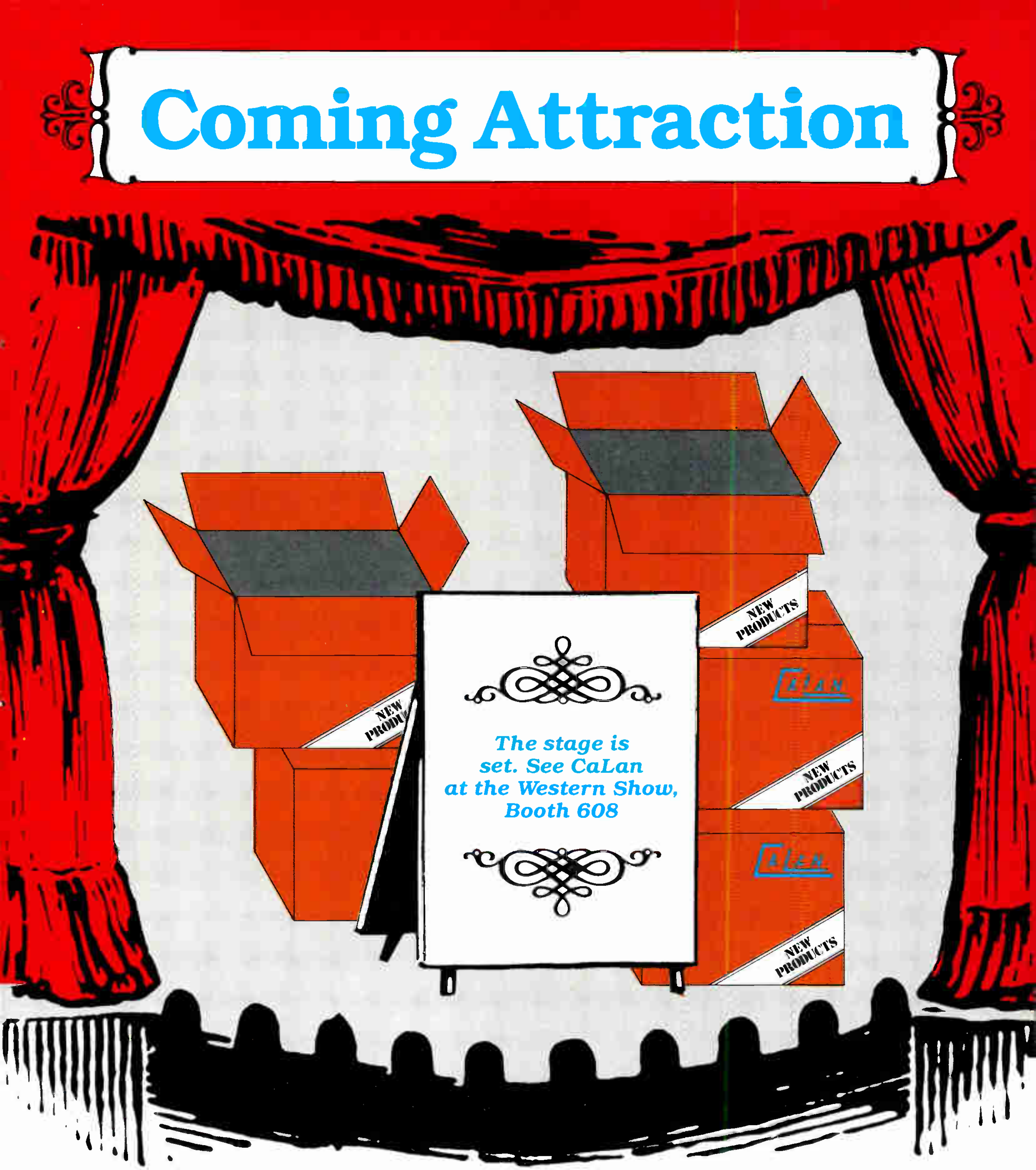
Numerous operational issues are being addressed during this test. Customer satisfaction, financial impact (operating costs and subscriber revenue), sales and marketing positioning and technical field activities are all being evaluated by the local management team.

In the technical department, procedures are being put together to handle this new technology. In the design phase, considerations were made in replacing a conventional tap with an active device. With this in mind, the system was enhanced with grounding at every tap location. The design also had to accommodate the power consumption of the off-premises taps. The power supply count went from one to five supplies in the test area. Construction of the plant is consistent with current construction practices because of the design of the interdiction unit. It can be treated like any tap when being spliced in and allows for simple field-selected tap value with a directional coupler in each unit.

The real issue in construction is the necessity of very accurate, as-built, information after the tap has been installed. Each tap port has its own unique address that must be assigned to a subscriber's street address. That port will stay with the street address indefinitely. This is a departure from the current system, which consists of a billing host, warehouse inventory procedures, and addressable control systems all geared around set-top converters in the subscribers' homes. Warner is finding that many of the cumbersome procedures associated with set-top converters will go away.

A major objective of the test is to reduce, if not eliminate, truck rolls associated with connects and disconnects. Ostensibly, a new customer moving into the area will call in and be instructed on how to connect the cable to their entertainment device. Some subs will need a basic set-top for tuning a non-cable-ready TV set. The subscriber's port will be authorized and service turned on from the headend with no need for an installation appointment in most cases. Since subscriber interface problems associated with converters have been essentially eliminated, and the quality of the drop has been improved, we expect to see significant reductions in truck rolls due to trouble calls.

The interdiction system allows the flexibility to support new cable marketing programs. Its addressability will support standard pay-per-view business via an automatic response unit (ARU) in Williamsburg. With hard drops and addressable control, the objective is to take pay-per-view and service in general a step further. Pay-per-view can be made available to credit qualified non-subscribers. Non-subs will have a drop into the home on an A/B switch. When an event is upcoming that they wish to view, all that is required is for the customers to phone the cable operator and toggle their A/B switch. The capital investment is smaller with only an initial up-front cost and no converter to install or track in most cases. Other imaginative scenarios are under consideration also, such as weekend-only service to subs and limited time service promotions to non-subs.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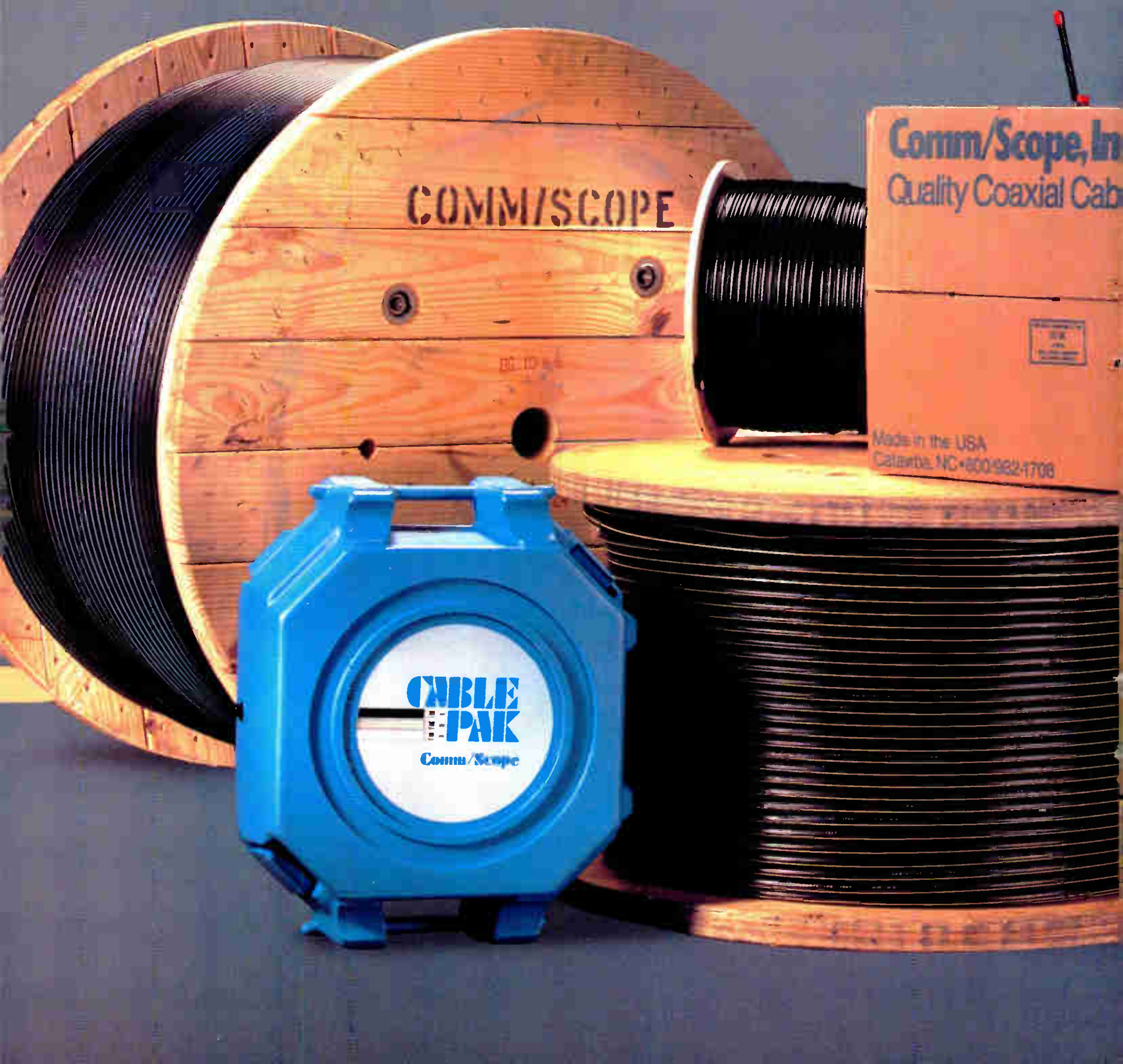
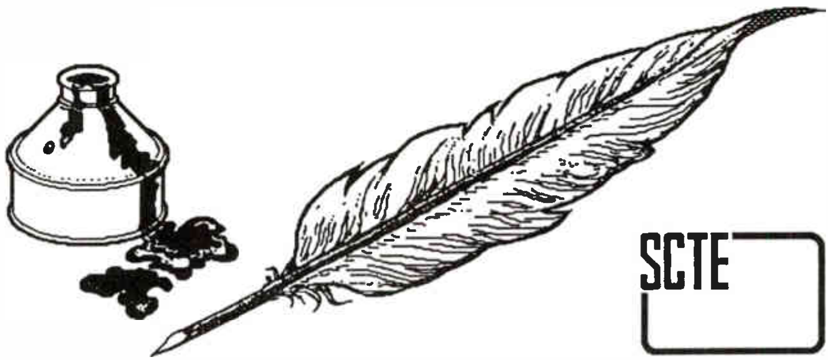


the INTERVAL
SCTE
December 1989

SPECIAL ISSUE
PULL OUT AND SAVE

National Bylaws
of the Society of Cable Television Engineers Inc.
Includes changes approved by the Society's membership on Oct. 19, 1989



SCTE

Society of Cable Television Engineers Inc. Bylaws

Article I

NAME

The name of this organization shall be "Society of Cable Television Engineers Inc." An optional line "Serving the Broadband Industry's Technical Community" may be used with the name.

Article II

PURPOSES

This Society is organized to develop, increase and spread both theoretical and practical technical knowledge of cable television and broadband communications systems thereby providing opportunities for the professional and technical growth of its membership and the industry. The Society and its divisions may engage in any of the following activities or in any other activities that will fulfill its purposes:

a) Establish standards of professional and technical accomplishment by engineers and technicians working in cable television and related industries and to afford public or private recognition of those standards and their achievement.

b) Establish local and regional divisions of Society members primarily to train members in cable television and broadband communication technologies and secondarily to promote any other purposes of the Society.

c) Encourage, sponsor, promote and hold local, regional and national meetings, seminars, trade shows and training meetings.

d) Encourage, sponsor, promote and award technical scholarships.

e) Promote communication on issues of technical and/or mutual concern between cable television and broadband communication industries and:

1) various related agencies (both public and private).

2) the radio, television and similar broadcast industries.

3) the television viewing public.

4) the users of cable television and broadband communications systems.

f) Develop and publish recommended practices for equipment installation, performance and testing.

Article III

MEMBERSHIP

Section 1: Eligibility: Any person, firm or corporation shall be eligible for membership in this Society who is:

a) Employed full or part time in the cable television or broadband communications industry, OR

b) Employed full or part time in radio or television broadcasting, OR

c) Employed full or part time in a field closely allied to one of the above, OR

d) A member of a regulatory agency or legislative branch of federal, state, regional or local government concerned with the technical operation of cable television or broadband communication systems, OR

e) Sincerely interested in the development and furtherance of cable television or broadband communications technologies.

Section 2: Grades: Membership grades and their qualifications shall be:

a) Active Member--shall be open to any person who has an interest in the purposes of the Society and who is employed, full or part time, in the engineering or technical operations, cable television, broadband communications or broadcasting systems at the time of application and acceptance.

The Board of Directors of this Society may designate categories of Active Membership with differing dues.

b) Senior Member--is the highest professional grade for which application may be made. It is open to members who have demonstrated technical competence, participated actively in Society and industry affairs, attained a degree of seniority and maintained a high standard of professionalism.

Specific requirements are:

Seniority--A minimum of 10 years electronic experience, five years of cable television or broadband communications experience and five years of Active or Charter membership in the Society. No candidate shall be considered whose Active or Charter Membership has lapsed at any time during a period of three years prior to application. Industry and CATV experience may be established by submission of a verifiable resume.

Professionalism--Supporting nominations from at least three existing Senior or Fellow members must be secured and submitted.

Industry Affairs--Candidates must submit evidence of qualification under at least three areas from the following list:

* National SCTE officer or director for at least one term.
* Chapter SCTE officer or director for at least one term.
* Active contributor to an SCTE committee.
* Technical presentations related to CATV presented at three national or regional technical panels.
* Technical presentations related to CATV presented at 10 Chapter meetings.
* Three CATV-related papers published in national technical journals.
* Membership in the NCTA Engineering Committee for one year.
* Membership in a technical subcommittee of EIA, SMPTE, IEEE or other organization dealing with CATV-related issues for one year.

Technical Competence--As a minimum, candidates must be registered participants in the BCT/E Certification Program. Certification must have been obtained in at least four Engineering or five Technician subject matter areas, at least one of which must be Category VII: Engineering Management and Professionalism. Any of the following may be substituted for one of the subject area certifications, except for Category VII:

* Significant involvement in development of a new cable television technical product or procedure.
* Holder of at least one cable-related patent.
* Holder of Senior or Fellow membership grade in a related technical organization.
* Holder of FCC General Radiotelephone license.

Applications will be reviewed by the Senior Member Committee which will recommend to the Board of Directors those candidates that they deem to have met the qualifications. Upgrades to Senior Member status will be granted upon confirmation by the Board.

c) Charter Member--is a person who evidenced sincere and sufficient interest in the purposes of the Society by submitting membership application at the original time of the Society's formal organization.

d) Sustaining Member--is open to any person, firm or corporation choosing to demonstrate support of the purposes of the Society.

e) Student Member--is limited to those attending any college, university, technical or recognized trade school and not holding full-time employment. Student membership is limited to four years.

f) Fellow Member--Fellowship is granted only at the pleasure of the Society. It is intended that this be conferred on those few Senior Members who have made outstanding contributions to the broadband communications industry. In that light, there should be no expectation that any certain number of members will be elevated in any given year. In order to avoid dilution of the recognition due a Fellow Member, the total number of active Fellows will be limited to no more than one percent of the total membership in the Society. Retired Fellow Members will not be including in counting active Fellows for the purpose of setting the ceiling on Fellowships.

Candidates may be nominated by any current member of the Society. The nominator is responsible for filling out a form identifying the candidate's outstanding achievements and qualifications. He is also responsible for obtaining the endorsements outlined below.

The requirements for attaining Fellow status, although less specific, are intended to be considerably more stringent than those for Senior membership.

Seniority--As a minimum, successful candidates should have acquired 12 years of electronics experience, including seven years of broadband communications experience and five years of membership of any grade in the Society.

Professionalism--Supporting endorsements are required from at least three persons who can attest to the candidate's qualifications and who are qualified to serve on the Fellow Member Committee, but who are not currently members of that committee, the SCTE Board of Directors or headquarters staff.

Technical Competence--Candidates should be fully accredited by the Society as Broadband Communications Engineers. The Fellow Member Committee may, however, consider other evidence of broad technical knowledge of the industry to be equivalent to not more than two subject certification areas. Every candidate must be certified in Category VII.

Industry Contributions--The primary criteria for judging Fellow candidates will be outstanding technical contributions to the industry. Possible areas of contribution include:

* Developing or directing the development of significant new products.
* Developing innovative technology to improve the efficiency, quality or reliability of broadband systems.
* Developing technology that opens new markets for broadband system operators.
* Developing programs that have a major positive influence on the technical competence level of industry personnel.

Each candidate will be rated by the Fellow Member Committee as: Extraordinarily Qualified, Highly Qualified, Qualified, Qualified with Minor Reservations or Not Yet Qualified. The Board of Directors may choose to elevate to Fellow Membership any candidate(s) receiving one of the three highest recommendations from the Committee.

The Board may act upon recommended candidates with a roll-call vote at any of its scheduled meetings. If any member of the Board or the Fellow Committee is nominated, the member will abstain from participating in any decisions regarding himself.

g) Retired Member--Any current

Fellow, Charter, Senior or Active Member who has been an SCTE Member in good standing for 10 years may apply for Retired Member status. Upon approval by the SCTE Board of Directors, the word Retired will be placed after their membership grade and the annual dues reduced to 50% of the normal annual dues.

The requirements for Retired Member status are the attainment of 60 years of age and a cessation of full-time employment in the broadband industry. Fully disabled persons are also eligible, regardless of age.

h) Honorary Fellow Member--The title Honorary Fellow Member may be conferred by the Society on those persons who fall outside the normal boundaries of eligibility for Society membership, but whose activities and contributions in the broadband communications field are comparable to those expected of Fellow Members.

Candidates must be nominated by a member of the Board of Directors and approved by a two-thirds roll-call vote of the Board in accordance with the SCTE Bylaws.

i) Installer Member--is limited to individuals who have not held Active, Senior or Charter Membership in the Society and are enrolled in or have completed the Installer Certification Program. Installer Membership is limited to three years.

Section 3: Application: Any individual, firm, corporation or other entity desiring Society membership shall make application to the Society business office as prescribed by the Board of Directors. The Secretary of the Society or his designee will process all applications received with proper payment of dues.

Section 4: Acceptance: All persons must be approved for membership by the Society Board of Directors or board-designate in accordance with regulations set forth in these bylaws. Upon determination of qualification and acceptance the applicant will be notified and provided with emblems, written material, and evidence of membership approved and ordered by the Board of Directors. Upon receipt of written acceptance the applicant becomes eligible for all privileges for his grade of membership.

Section 5: Privileges: Nothing herein shall be construed to prohibit any properly qualified individual from applying for membership in any grade by reason of that individual's employment or association with a firm, company or corporation which itself may be eligible only for the grade of Sustaining Member.

a) Active, Senior, Charter and Fellow Members--shall be eligible for any national, regional, state, local or divisional elected or appointed Society office, including the office of Director, and shall be eligible to vote on any and all matters coming before the national Society or any of its divisions of which they are members.

b) Student, Sustaining, Installer and Honorary Fellow Members--shall be eligible to attend meetings and other Society activities, but shall not be eligible to vote in any matters, nor to hold any elective Society office in any division. Appointive office may be held by a Student, Sustaining, Installer or Honorary Fellow Member with majority approval of the cognizant Board of Directors for the Society division to which the appointive office reports.

Section 6: Dues/Fees: The Board of Directors shall determine the amount of initiation fee, if any, and annual dues payable to the Society by members of all grades and categories.

a) Payment: Dues shall be payable in

advance on each member's Society anniversary date.

b) Suspension and Termination of Membership: Any member whose dues have not been paid prior to his Society anniversary date shall automatically be temporarily suspended from the Society. Sixty (60) days after the member's Society anniversary date, if his dues remain unpaid, he shall be automatically moved to the inactive member list. Two (2) years after the member's Society anniversary date, if his dues remain unpaid, he shall be automatically terminated for continual membership purposes and must apply for membership as a new member. Members on the suspended or inactive list may automatically reinstate their membership for continual purposes by paying all back dues.

Section 7: Termination: Upon termination of membership, all rights and privileges of membership in this Society shall cease. No refund of dues will be made upon any termination of membership.

a) Voluntary: Any member may voluntarily terminate membership by written notice to the Secretary. Such termination will become effective on the date specified in the notice or upon receipt if no date is specified.

b) Suspension/Expulsion: Any member may be suspended temporarily or permanently expelled from the Society for violation of its bylaws or for conduct prejudicial to the Society. Any such action shall require a two-thirds (2/3) vote of the Board of Directors. At least thirty (30) days before any vote may be taken, the member shall be notified in writing of the particulars of the charges and reasons for suspension or expulsion, and the time and place where the vote is to be taken. The member shall be entitled to present any defense prior to the vote of the Directors.

Article IV
GENERAL MEMBERSHIP MEETINGS

Section 1: Annual Meetings: There shall be at least one (1) general membership meeting each calendar year (on a day designated by the Board of Directors) to receive the annual reports of officers, directors and committees, and for the transaction of other business. Notice of the meeting shall be provided through regular membership communication channels at least six (6) months in advance of the meeting. Individual notice of the meeting shall be mailed to the last recorded address of each member at least forty-five (45) days and not more than ninety (90) days before the time appointed for the meeting. All meeting notices shall clearly show the place, date, time and purpose of the meeting.

Section 2: Special Meetings: Special meetings of the general membership may be called by the Board of Directors at its discretion. Upon the written request of two percent (2%) or greater of the active voting membership the Board of Directors shall call a special meeting to consider a specific subject. Individual notice of the meeting shall be mailed to the last recorded address of each member at least fifteen (15) days before the time appointed for the meeting. No business other than that specified in the meeting notice shall be transacted at any Society special general membership meeting.

Section 3: Quorum: The presence in person or by proxy of twenty percent (20%) of the Society members eligible to vote shall be required for the transaction of business.

Section 4: Proxies: Every member of the Society entitled to vote at any general membership meeting may vote by proxy. A proxy shall be in writing and revocable at the pleasure of the member executing it. Unless the duration of the proxy is specified, it shall be invalid eleven (11) months following its execution date.

Article V
ELECTIONS

Section 1: Board of Directors: shall be elected by mail ballot according to the following schedule and rules:

a) The Board of Directors shall appoint the Nominating Committee (Article VIII, Section 2) no later than Sept. 15 of each calendar year.

b) The Nominating Committee shall forward its nominations to the Secretary no later than Dec. 15 of each calendar year.

c) Independent nominations for director can be made. Written endorsement by not less than thirty (30) voting Society members shall be required. The written consent of the nominee to serve shall be required. Independent nominations shall reach the Secretary prior to Dec. 1 of each calendar year or they shall be void.

d) The Secretary or his designee shall prepare and mail election ballots no later than Jan. 15 of each calendar year.

e) The ballot shall clearly state that it must be returned postmarked on or before March 15 of that year and if not received on or before March 28 of that year it shall be void.

f) The ballots shall be counted and the results communicated to the membership no later than April 15 of that year.

g) Newly elected Directors shall take office at the Board meeting prior to the annual general membership meeting or May 1 of that year, whichever comes first.

h) The Board may prescribe rules and procedures in order to insure a fair and timely election.

Section 2: National Mail Ballots: shall be mailed directly to the address of and counted by an independent accounting or auditing firm employed by the Society. This section shall apply to all national mail ballots of any kind whatsoever including mail ballots or polls of the Executive Committee or Board of Directors.

Article VI
BOARD OF DIRECTORS

The Board of Directors shall be responsible for the policy and supervision of the Society.

Section 1: Duties: The Board of Directors shall:

a) meet a minimum of four times each calendar year.

b) prescribe the procedure for admission of members and approve all evidence and emblems of membership.

c) cause to be prepared, approve and monitor an annual budget for the Society.

d) determine a staggered election procedure to implement Article VI, Section 6 of these bylaws.

e) designate the number and geographical area of the Society's regions.

f) designate the eastern and western division of the United States and possessions for the purpose of electing the Eastern and Western Vice Presidents.

The Board of Directors may:

a) hold meetings at such times and places as it deems proper, subject to Section 6 of this Article.

b) suspend or expel members by written ballot in accordance with these bylaws.

c) appoint committees on particular subjects from members of the board or from members of the Society at-

large.
d) print and circulate documents and publish articles.
e) correspond and communicate with Congress, The Executive Branch, any other governmental bodies, and other associations or any entities interested in matters of concern to the Society.
f) invest and deal properly with the funds and assets of the Society, including, but not limited to, the buying, selling, receiving and delivering of stocks, bonds, money market funds, commercial paper and the like.
g) employ agents.
h) set fees for any Society activities or publications at a level sufficient to recover the Society's actual costs and to provide adequate funding to perpetuate the Society's various activities and purposes.
i) plan and carry out other measures or actions it deems proper and expedient to promote the purposes of the Society and to best protect the interests and welfare of its members.

Section 2: Number: The Board of Directors shall consist of three (3) Directors-At-Large and one (1) Regional Director from each Region.

Section 3: Eligibility: Each Board member must be a Charter, Senior or Active member. Regional Board members and nominees shall have a residence of record in the region represented.
Section 4: Election: One Regional Director shall be elected from each region by the members who are residents of record in that region. Three (3) Directors-At-Large shall be elected by all Society members eligible to vote.

Section 5: Term: All Directors shall serve a two (2) year term or until their successors are elected. Terms will be staggered, as nearly as possible, to cause election of one-half (1/2) of the Board every calendar year. No person may serve more than three (3) consecutive terms on the Board of Directors.

Section 6: Meetings: A regular meeting of the Board of Directors shall be held within the seven (7) days before the annual general membership meeting. The Board shall meet at least three (3) other times during the calendar year in addition to the meeting prior to the annual general membership meeting. Notice of all regular Board meetings, signed by the Secretary or his designee, shall be mailed to the last recorded address of each Board member at least twenty-one (21) days before the time appointed for the meeting. The President, when he deems necessary, may issue a call for a special meeting of the Board. Ten (10) days notice shall be required for such special meetings. Attendance at any meeting shall constitute a waiver of any required notice thereof.

Section 7: Quorum: Fifty percent (50%) or greater of the Board of Directors shall constitute a quorum for the transaction of business. No proxy votes shall be permitted.

Section 8: Absence: Should any member of the Board of Directors absent himself from two (2) consecutive meetings of the Board of Directors without sending a written communication within ten (10) days of the missed meeting to the President or Secretary stating his reason for so doing, his seat on the Board may be declared vacant by action of the Board. The Board may immediately fill the vacancy in accordance with Article VI, Section 9 of these bylaws.

Section 9: Vacancies: Whenever any

vacancy occurs in the Board of Directors by death, resignation or by any other cause, it shall be filled without undue delay by a majority written ballot vote of the remaining members of the Board at a regular or special board meeting which may be called for that purpose or by mail ballots. The election shall be held within sixty (60) days after the occurrence of the vacancy. The person so chosen shall hold office until the next annual meeting, or until his successor shall have been chosen at a special meeting or by mail ballot of the Society members.

Section 10: Removal of Directors: Any one or more of the directors may be removed either with or without cause, at any time, by a vote of seventy-five percent (75%) of the Society members present at any special general membership meeting called for that purpose.

OR

Upon the written request to the Secretary of two percent (2%) or greater of the active voting membership a mail recall election shall be held for the named Director. The ballot shall allow a member to vote for or against recall. At least seventy-five percent (75%) of the members voting shall be required to recall a Director. At least sixty (60) days shall be allowed from the actual date of ballot mailing for ballot return. Should a Director be recalled his position shall be filled in accordance with Article VI, Section 9.

Section 11: Action Without Meeting: Any action which could be taken by the Board of Directors at a meeting may be taken upon unanimous written consent of the directors.

Section 12: Liability: The Society will indemnify officers, directors and staff for debts, obligations or liabilities of the Society or for their actions on behalf of the Society except any person may be held liable in cases of their personal fraud or their personal bad faith.

Section 13: Immediate Past President: may attend all regular and special Board of Directors meetings and shall be notified of same. He shall act in an advisory capacity only unless otherwise elected to a regular voting position.

Article VII
OFFICERS

Section 1: Number: The Society officers shall be a President, Western Vice President, Eastern Vice President, Executive Vice President, Secretary and Treasurer. The Eastern and Western Vice Presidents shall represent, as nearly as possible, the eastern and western portions of the United States and its possessions. Such division may be determined by the Board of Directors.

Section 2: Election: The officers, except the Executive Vice President, shall be elected by the Board of Directors for a term of one year or until their successors are elected. All officers, except the Executive Vice President, shall be chosen by such procedures and for such time as prescribed by the Board. Election of officers shall be the first order of business at the Board of Directors meeting held immediately before the annual general membership meeting. Eastern and Western Vice Presidents shall be elected by the Board members who represent the Society's Eastern and Western divisions respectively, as determined by the Board. Directors-At-Large represent both Eastern and Western divisions.

Section 3: Commencement of Term: The term of office for officers shall commence immediately following election to office.

Section 4: Duties and Powers:
a) President--shall preside at all meetings of the Executive Committee, Board of Directors, and at the annual membership meeting of the Society. The President shall be a member ex-officio, with right to vote, of all committees except the Nominating Committee. At the annual membership meeting of the Society and at such other times as he deems proper, he shall communicate to the Society and to the Board of Directors such matters and make such suggestions as may in his opinion promote the prosperity and welfare and increase the usefulness of the Society. He shall perform such duties as are necessarily incident to the office of the President.
b) Executive Vice President--shall be the principal staff employee of the Society, responsible for daily operations of the Society. He shall supervise, manage and control all policy implementation, financial, and other aspects of the Society in accordance with the policy and procedures set by the Board of Directors and these bylaws.
c) Vice President, Eastern and Western--shall assist the President as he may request. They shall act on behalf of the President in accordance with the Parliamentary Authority of Article XII. The Eastern Vice President shall act as First Vice President when he is elected during even calendar years and, likewise, the Western Vice President shall act as First Vice President when he is elected during odd calendar years.
d) Secretary--shall take and keep minutes of all Society general membership meetings, and Board of Director meetings. The Secretary or his delegate shall cause to be taken and keep on file a record of all committee meetings; shall conduct all correspondence and carry out all orders, votes and resolutions not otherwise committed; shall keep a list of the members of the Society; shall collect the fees, annual dues and subscriptions and deposit them with the Treasurer; shall notify the officers and members of the Society of their election; shall notify members of their appointment to committees; under the direction of the Board of Directors, shall prepare an annual report of the transactions and condition of the Society; and shall generally devote his best efforts to forwarding the business and advancing the interests of the Society.
e) Treasurer--or his delegate shall keep an account of all monies received and expended for the use of the Society. He shall make necessary disbursements subject to the dollar limitation placed by the Board of Directors. Any disbursement over the limit specified by the Board shall require the signature of the Executive Vice President and any two (2) other officers. He shall deposit all sums received in a bank, credit union, or trust company approved by the Board of Directors and make a report at the annual meeting and when called upon by the President. The funds, books and vouchers in the Treasurer's hands shall at all times be under the supervision of the Board of Directors and subject to its inspection and control. At the expiration of his term of office, he shall deliver over to his successor all books, monies, and other property. In the absence of a Treasurer- elect or Secretary/Treasurer-elect the President shall act as Treasurer until one is duly elected.

Section 5: Vacancies: in any office shall be filled by the Board of Directors without undue delay and within sixty (60) days of such vacancy.

Section 6: Compensation: The Executive Vice President shall receive such salary or compensation as the Board of Directors determines. No other officer shall be compensated but reimbursement may be made for reasonable expenses incurred. Any Society member may be reimbursed for reasonable expenses which are both directly related to furthering the purposes of the Society and approved by the cognizant board. Such reimbursement shall be by voucher on a form approved by the Board of Directors and the accountant/auditor referenced in Article VIII, Section 1. No monies nor any special benefit shall accrue to any officer of any Society division except as provided specifically in these bylaws. This section shall apply to all Society members and divisions of any kind without exception. Nothing in this section shall be construed to prevent the Society from employing paid staff members, who may or may not be members of the Society, under the supervision of the Executive Vice President.

Section 7: Removal: Any officer may be removed by a seventy-five percent (75%) vote of the elected directors. Officer removal can be done at any regular board meeting or special board meeting called for that purpose or by mail ballot.

Article VIII
COMMITTEES

Section 1: Executive Committee: shall consist of the President, Eastern and Western Vice Presidents, Immediate Past President, Secretary, and one other member of the Board of Directors (excluding the Treasurer) who shall be elected by the Board annually. The Executive Committee may act on behalf of the Society in any matter when the Board of Directors is not in session. The Executive Committee shall report all their actions in writing within fifteen (15) days of all meetings or at the next full board meeting, whichever comes first. The whole Board shall ratify or rescind all Executive Committee actions. Four members of the Executive Committee shall constitute a quorum for the transaction of business. Meetings may be called by the President or by four (4) members. The Executive Committee shall have the Treasurer's accounts audited at least once each calendar year by an accountant/auditor and shall report the results of the audit to the Board of Directors.

Section 2: Nominations Committee: Each year, the Board of Directors shall appoint a Nominating Committee of five (5) members, only two of whom may be members of the Board, whose duty it shall be to nominate candidates for directors to be elected at the next annual elections. The committee shall obtain in writing the consent of each nominee to serve if elected to the post. The committee shall notify the Secretary in writing of the names of such candidates. The nominating committee shall nominate no more than three (3) candidates for each director position. Nominating committee members shall not be eligible for nomination to any director position during the election year they so serve.

Section 3: Senior Member Committee: The Senior Member Committee shall be composed of four current Senior and/or Fellow members. Members will be asked to serve a two-year term and be limited to no more than three consecutive terms. Appointments will be staggered and the Board of Directors will replace half the Committee members each year at the first meeting of the Board after the election of new Board members. The Board will attempt to select members so as to achieve a geographically diverse committee, and shall select two each from the eastern and western regions.

The duty of the Senior Member Committee is to review applications for Senior Membership and to recommend to the board for approval those candidates deemed qualified for that advancement.

Section 4: Fellow Member Committee: The Fellow Member Committee shall be composed of six current Fellow members, except that until the General Membership Meeting in 1995, members may also include existing Senior Members who are also Fellows of the IEEE or SMPTE, SCTE Member of the Year recipients or NCTA Vanguard Award Recipients in Science and Technology. Members will be asked to serve a two-year term and be limited to no more than three consecutive terms. Appointments will be staggered and the Board of Directors will replace half the committee members each year that the first meeting of the Board after the election of new Board members. The Board will attempt to select members so as to achieve a geographically diverse committee, and shall select three each from the eastern and western regions.

The duty of the Fellow Membership Committee is to review nominees for the Fellow member grade, to grade them in accordance with the Fellow Member guidelines, and report those evaluations to the Board of Directors.

Section 5: Standing Committees: At the first meeting of the Board of Directors after its election the President shall, subject to Board approval, appoint such committees as seems advisable to the President and the Board. The members of such committees shall hold office until the appointment of their successors.

Section 6: Special Committees: The President may, at any time, appoint other committees on any subject for which there are not standing committees and for which the committee duration is expected to be less than one year.

Section 7: Committee Quorum: A majority of any committee shall constitute a quorum for the transaction of business, unless any committee shall by a majority vote of its entire membership decide otherwise. Committee business may be carried out by mail or telecommunications when appropriate.

Section 8: Vacancies: The President shall have the power to fill vacancies in the membership of any committee.

Article IX
CHAPTERS AND OTHER DIVISIONS

Chapters and other divisions of the Society may be organized subject to these bylaws by any group of members.

Section 1: Meeting Groups: Prior to recognition as a Society Chapter members shall form a "Meeting Group." Meeting Groups shall:

a) apply to the Society business office and receive permission to form a Meeting Group.

b) provide their members a minimum of forty (40) hours of technical education in the initial eighteen (18) month period.

c) provide all required meeting and financial reports to the Society business office.

d) follow the requirements of the current edition of the Chapter Development Guide approved by the Board.
e) disband if they have failed to attain Chapter status within twenty-four (24) months.
f) include the national SCTE Executive Vice President's signature on all bank accounts.

Section 2: Chapters: After an initial period of not less than nine (9) nor more than twenty-four (24) months a Meeting Group may apply for Chapter status. Application shall be made to the Board of Directors via the Society business office according to the current edition of the Chapter Development Guide. At a minimum the application must show compliance with the mandatory requirements of this Article and the current Chapter Development Guide. Chapter bylaws must be included for approval or the application must state that the Chapter will use these bylaws. Chapters will:
a) provide their members a minimum of thirty (30) hours of technical education in each consecutive twelve (12) month period.
b) provide all required meeting and financial reports to the Society business office.
c) follow all requirements of the current Chapter Guidelines as approved by the Board.
d) include the national SCTE Executive Vice President's signature on all bank accounts.

Section 3: Bylaws Applicability: These bylaws shall be binding upon all meeting groups, chapters and other divisions of this Society except as follows:
a) There shall be no initiation fee for any division of the Society other than national.
b) Dues for any Society division shall be less than the current national dues and may be levied only by the most local division. Divisions are not required to levy dues.
c) Only the national Board of Directors may accept, suspend or terminate Society members nationally. Only the divisional Board of Directors may accept, suspend or terminate their divisional membership.
d) The area covered by any Society division shall be determined by the members of that division. Should two (2) divisions claim the same area or should other jurisdictional conflict occur the national Board of Directors shall resolve all disputes. Two (2) divisions may agree to represent or cover the same area.
e) Upon dissolution of any Chapter or Meeting Group any and all excess funds and assets shall be remitted to the national Treasurer under the following conditions:
1) Transfer of assets will only occur in the event of chapter failure, disbandment as a result of not fulfilling the requirements as stated in "A Guide To SCTE Chapter Development" or financial irregularities.
2) All assets will be held in escrow by the national Treasurer for one year and will only be used to pay any outstanding debts incurred by the chapter or to act as "seed money" during efforts to start a new meeting group in the geographic area.

Article X
ASSETS

No officer, director, member, chapter, meeting group or employee of the Society shall have any individual right, title or interest in any of the assets or funds of the Society. All assets and funds of the Society shall be held exclusively for the benefit of the Society as a whole. At its sole discretion, the Board of Directors shall have the right to review and audit at any time the books, assets and funds of any chapter or any other division formed pursuant to these bylaws. Regular financial reporting as prescribed by the Board (quarterly, at minimum) and full cooperation with all audits as prescribed by the Board of Directors are required to maintain chapter or other divisional status. Upon dissolution of the Society or any division thereof no funds or assets shall accrue to any individual member.

Article XI
DEFINITIONS

1) Board of Directors--shall refer to the national Board of Directors of this Society, unless otherwise stated.
2) His/He--shall refer to both masculine and feminine gender.
3) Division--shall refer to any and all divisions of the Society, national, regional, state, local and any other division except as specifically excluded. Division shall include meeting groups, chapters and all other divisions not specifically excluded.
4) Residence of Record--shall be the member's address on the Society's membership roster. A member may designate his residence of record to be his home or business address at his election. A member may change his residence of record no more than once in any consecutive twelve (12) month period. A member may request that Society mailings be sent to an address different from his residence of record.

Article XII
PARLIAMENTARY AUTHORITY

The rules contained in the current edition of "Robert's Rules of Order Newly Revised" shall govern the Society in all cases to which they are applicable and in which they are not inconsistent with these bylaws and any special rules of order the Society may adopt.

Article XIII
AMENDMENTS

These bylaws may be amended by mail vote by a majority of the total number of members responding. Amendments may be proposed by the Board or by written request of two percent (2%) of the Society voting membership. No later than thirty (30) days after receipt of any valid amendment request the Secretary or his designee shall prepare a ballot setting forth the proposed change to the bylaws. The ballot shall be sent to the last recorded address of all voting members. At least sixty (60) days shall be allowed from the date of mailing until the date required for return of the ballots. Results of the vote shall be communicated promptly to the membership.

Article XIV
SEVERABILITY

Should any part of these bylaws be found invalid for any reason all other parts shall remain in full force and effect.

Note: *Members wishing to comment on the bylaws should contact their regional director from the following list:*

President and Region 8 Director
Jack Trower
WEHCO Video Inc.
P.O. Box 2221
Little Rock, Ark. 72203
(501) 378-3524
(serving Alabama, Arkansas, Louisiana, Mississippi and Tennessee)

Eastern Vice President and Region 7 Director
Victor Gates
Metrovision
14525 Farmington Rd.
Livonia, Mich. 48151
(313) 422-2810
(serving Indiana, Michigan and Ohio)

Western Vice President and At-Large Director
Richard Covell
General Instrument-Jerrold Division
511 Burland Dr.
Bailey, Colo. 80421
(303) 838-2728

Secretary and Region 5 Director
Wendell Woody
Anixter Cable TV
1500 N.E. 49th Terrace
Kansas City, Mo. 64118
(816) 454-5421
(serving Illinois, Iowa, Kansas, Missouri and Nebraska)

Treasurer and Region 1 Director
Pete Petrovich
Petrovich and Associates
56 Clover Leaf Circle
Brentwood, Calif. 94513
(415) 634-5926
(serving California and Nevada)

Region 2 Director
Ron Hranac
Jones Intercable
9697 East Mineral Avenue
Englewood, Colo. 80112
(303) 792-3111
(serving Arizona, Colorado, New Mexico, Utah and Wyoming)

Region 3 Director
Ted Chesley
CDA Cablevision Inc.
108 Indiana
Coeur d'Alene, Idaho 83814
(208) 667-5521
(serving Alaska, Idaho, Montana, Oregon and Washington)

Region 4 Director
Leslie W. Read
Sammons Communications
P.O. Box 15216
Dallas, Texas 75201
(214) 742-9828
(serving Oklahoma and Texas)

Region 6 Director
Bill Kohrt
Kohrt Communications Inc.
4123 7th Place N.W.
Rochester, Minn. 55901
(507) 288-5137
(serving Minnesota, North Dakota, South Dakota and Wisconsin)

Region 9 Director
Jim Farmer
Scientific- Atlanta
Dept. ATL 30-B
P.O. Box 105027
Atlanta, Ga. 30348

(404) 925-5422
(serving Florida, Georgia and South Carolina)

Region 10 Director
Wendell Bailey
NCTA
1724 Massachusetts Ave., N.W.
Washington, D.C. 20036
(202) 775-3637
(serving Kentucky, North Carolina, Virginia and West Virginia)

Region 11 Director
Pete Luscombe
TKR Cable Co.
P.O. Box 4247
Warren, N.J. 07060
(201) 356-1110
(serving Delaware, Maryland, New Jersey and Pennsylvania)

Region 12 Director
Robert Price
BradPTS
P.O. Box 739
Schenectady, N.Y. 12301
(518) 382-8000
(serving Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont)

At-Large Directors
Robert Luff
Jones Intercable
9697 E. Mineral Ave.
Englewood, Colo. 80112
(303) 792-3111

Dave Willis
Tele-Communications Inc.
Regency Plaza One, Suite 600
4643 South Ulster St.
Denver, Colo. 80237
(303) 721-5500

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Reader Service Number 41.

CableLabs

(Continued from page 25)

services, in addition to traditional scheduled transmission for real-time consumption, are included 1) delivery on demand of specific items (sometimes called interactive video or information retrieval); 2) downloading into memories at the point of use, such as by VCRs, computers and frame stores, both standing alone and integrated into TV sets, as in XPress services, and 3) frequent, repetitive delivery such as proposals for "near video on demand."

It is also useful to distinguish non-publishing information services from publishing services. They include interactive transactional services such as required in banking, retailing, home security and other businesses. Carriers are authorized to provide such services. Cable will increasingly need such services to efficiently operate its own business, particularly for the demand distribution of information, audience research and demand program guides. Clearly cable should develop interactive capabilities to expand its own media businesses. Operators may be tempted additionally to offer such transactional services to other businesses as a contract information provider in competition with telcos. While interactive capabilities need to be developed to service cable's own transactional needs, it is doubtful that such services can presently be offered competitively with telcos with their more universal distribution.

In this article, I have suggested what I believe are the most important goals for CableLabs and which technical areas should not place demands on its limited budget. In a subsequent issue, I will discuss the *process* of technological change in our society and how CableLabs might best manage its resources to harness burgeoning information technologies to benefit the business of cable. The challenges are huge.

Dick Leghorn, who was owner and operator of nine cable systems in five states, has consistently advocated an R&D consortium for the industry. He finally achieved success when he made a significant grant to Rand Corp. to review other R&D consortia (such as Bellcore, EPRI and MCC) and to lay out issues and options for an analogous cable effort. The National Cable Television Association set up an R&D committee chaired by Tele-Communications Inc. President and CEO John Malone. And voila —Cable Labs, was born. Leghorn played a major leadership role in the organization of Cable Labs; he temporarily served as its founding president.

Upon graduation from the Massachusetts Institute of Technology in 1939 with a degree in physics, he joined Eastman Kodak Co. and eventually became European Division manager. He served as a U.S. Air Force combat pilot and reconnaissance group commander in in Europe during World War II.

In 1957, he founded Itek Corp. of Lexington, Mass., a high technology company specializing in electronic and photographic services. In 1963 he became president of Dasa Corp. of Andover, Mass.

Today he is president and principal shareholder of Eidak Corp., which has introduced copyright protection services for pay-per-view. Recently, with Dr. Jerome Wiesner (former president of MIT and science advisor to Presidents Kennedy and Johnson), he organized Magnascreen Corp., which is developing flat, active matrix screens for future high definition TV systems.

"If you look at some time near the year 2000, then digital will have been perfected and will be a very viable alternative."

Technically Speaking

(Continued from page 20)

sary for eventual HDTV transmission but also to give better NTSC pictures, the MSOs are definitely going to be paying for that and possibly translate that into higher subscription fees. That's out of my control. I think the MSOs are going to take the first bite to improve their systems to make them more reliable, to make the performance better and to make them compatible with HDTV. The second phase is at the consumers' discretion. If they feel HDTV is worth the extra $2,000-$4,000, then they will pay for it.

CT: What are some of the projects that Jerrold is getting involved in for the future of CATV?

Wachob: We are heavily involved with the FCC ATV committees and also some of the proponents to ensure that whatever system is chosen—HDTV and also IDTV—is deemed compatible with cable. We're not a proponent and don't want to be. We do want to make sure as an industry that whatever system is chosen works not only going forward with the technology but also is compatible with the old variety of converters, amplifiers and systems that are not going to be changed overnight. The costs of doing an overnight change would be incredible.

We're also heavily involved in fiber to improve system performance and to get it ready for HDTV and eventual wider band delivery. We see that as the key point of subject. Digital Cable Radio, an offshoot of cable TV itself but nonetheless a good business opportunity, we think the subscribers will accept very rapidly; it will be very successful.

Beyond that, eventually interactivity will appear. In the last 20 years for a variety of reasons it hasn't been as successful as the original people thought. There's a big push on the Prodigy between IBM and Sears. There's a lot of muscle there, a lot of marketing support and a lot of dollars being suggested. It's just a question of time, not whether it will happen.

CT: Let me bring you back to the Digital Cable Radio. When do you plan to actually get that up on satellite?

Wachob: In very early 1990, I believe. We're looking to do beta tests around mid-year, maybe a little bit earlier; I'd say the second or third quarter.

CT: Have you gotten good response from the MSOs who are planning on offering digital radio?

Wachob: They've been very, very receptive. I believe there are over 1 million potential subscribers already signed up. And without seeing the receiver, that's pretty impressive as a start. We view it as an extension of the compact disc revolution. People want CD quality music and they're willing to pay for it.

CT: Doesn't the digital signal use up a lot of bandwidth?

Wachob: As a matter of fact it does not; that's one of the advantages. It can indeed be placed in a video channel. In the system we've been working with, it turns out you can put it in selective spots within the FM band depending on where there might be an ingress problem.

We've tried to make the technology as flexible as possible so it wouldn't eat up a video channel. We're also looking at an adaptation of our system so you can see where you can put it at the end of your system where it's not as sensitive to noise.

CT: Another product recently announced that some MSOs have purchased in large quantities is the on-premises device. How do feel about the on-/off-premises issue vs. the MultiPort?

Wachob: I see on- and off-premises devices as different solutions to the same problem (i.e., the consumer interface problem). They've all got their pluses and minuses, and we're trying to explore all of them.

Different MSOs have different views on how to solve the problem. Obviously you couldn't monitor to a total IDTV world because you've got so many sets that couldn't use it even if there were millions of IDTV converters out there.

We're looking at a concept now we call the "R path" where we're able to bypass the signal around the converter and return the cable-ready features to the set as another alternative. So, the converter could stay in the home. There's a lot of different solutions to the same problem, and we just want to explore all of them.

CT: How do we rationalize this kind of forward-thinking (maybe "blue sky" to some people) when we have so many pressing problems in our systems right now?

Wachob: Certainly what's most visible are the neat things of the future. The stuff that's going on behind the scenes—the system improvements, the switch to fiber (which will help solve two problems at once—leakage isn't an issue in a system that uses light, plus the quality and reliability will improve).

In systems dealing with the FCC in cumulative leakage index (CLI) there's a lot of behind-the-scenes stuff going on at the system level to improve the signal that gets to the home. Once you've gotten rid of that, you've gotten rid of a lot of the consumer complaints. You still have the consumer interface issue; that's why we're looking at the on-premises, off-premises and IDTV. As you probably know, we agreed two years ago to support the IDTV product and have had an active program since then. We're one of the first hardware manufacturers to decide it's not up to the converter business. It's a solution to the problem that MSOs have and subscribers have, and we want to provide the solution.

So I think there's a lot of neat things coming, but there's also a lot of system work being done to improve the picture they get to the home.

CT: Do you see the United States being able to reassert its position in the world technology market? Or do you see us slipping behind Japan once the U.S. HDTV standard is set, with Japan going right to work and supplying us with receivers?

Wachob: I'm not for sure that we're slipping behind technologically. There's still a lot of technology we're ahead of and will continue to be. The question is whether the United States can apply that technology in the market. Certainly the way it's looking now, the FCC will most likely vote on some HDTV system that has some U.S. components and some activity in a U.S. company. It could be a U.S. company with foreign manufacturing or a foreign company with U.S. manufacturing. Somehow the United States will be involved in this.

I think there's still a question as to whether the subscribers want HDTV. That's getting a lot of focus lately; I think new work and much more work needs to be done in that area. I'm quite certain that the technical issues will be resolved, but the question is: Is there a market for it? Right now it's still a big question.

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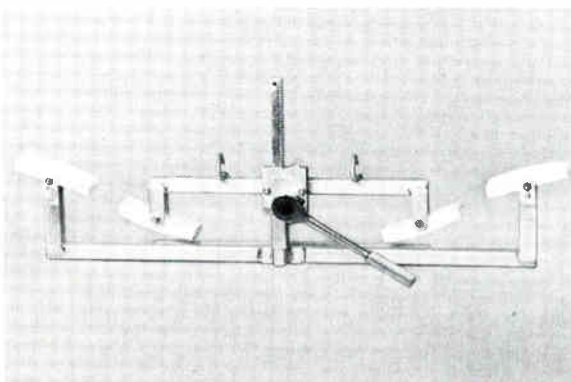

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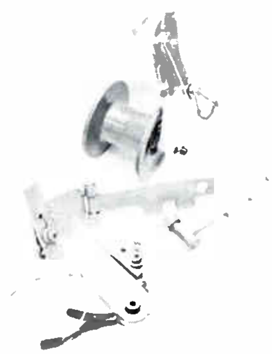

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Small systems

(Continued from page 42)

"The more widespread CATV service becomes, the better for our industry in general —but keep the standards up."

In terms of cost to the cable system we will assume that Service A costs us 1.4 times as much as basic service does because of the program license fees, but we will try to sell it to subs at twice the rate we get for basic service. Assume that Service AA costs us 1.8 times as much as basic but we will try to sell it for 2½ times the basic rate. (These figures are entirely arbitrary and were selected merely for purposes of discussion.)

In our earlier discussion we assumed that the monthly revenue objective was $3,000. We equated this to a system cost per sub for the basic service of $20 per month. But remember that this figure covers operating costs, return of capital and a return on investment. Now we are going to increase the system cost per sub for the two higher grades of service to cover the program fees for these services. We assumed that the increases would be 1.4 times basic for Service A and 1.8 times basic for Service AA. Then, Service A costs us $20 × 1.4 = $28 per sub; Service AA costs us $20 × 1.8 = $36 per sub, with basic service still costing us $20 per sub per month.

For 50 subscribers in basic at a system cost per sub of $20, the system cost is $1,000. For 50 subscribers in Service A at a system cost of $28 per subscriber, the system cost is $1,400. For 50 subscribers in Service AA at a system cost per subscriber of $36, the system cost is $1,800. Now the monthly system revenue objective is $1,000 + $1,400 + $1,800 = $4,200, not the earlier revenue objective of only $3,000.

Suppose we drop the monthly basic rate to $18 per month. Then 50 basic subs generate $900 in monthly revenue. But we will charge twice this amount (2 × $18 = $36) for Service A, and 50 subscribers generate $1,800 in monthly revenue. Now we will charge 2.5 times the basic rate (2.5 × $18 = $45) for Service AA, and 50 subscribers generate $2,250 in monthly revenue. Total monthly revenue now is $900 + $1,800 + $2,250 = $4,950. This is well over the monthly revenue requirement of $4,200.

If we wanted to be more competitive (that is, more attractively price all services) we could drop the basic rate even further and consequently the higher grade rates also, and still meet the monthly objective. For example, suppose we drop the basic rate for a sub to $16 per month. Then 50 basic subs generate $800 per month in revenue. But we will charge twice this amount (2 × $16 = $32) for Service A and 50 subscribers generate $1,600 per month. Now we will charge 2.5 times the basic rate (2.5 × $16 = $40) for Service AA and 50 subscribers generate $2,000 per month. Total monthly revenue is now $800 + $1,600 + $2,000 = $4,400. This is still comfortably above the monthly revenue requirement of $4,200, which provided capital recovery, met all operating expenses, paid program license fees for the higher grades of service and produced a respectable return on invested capital.

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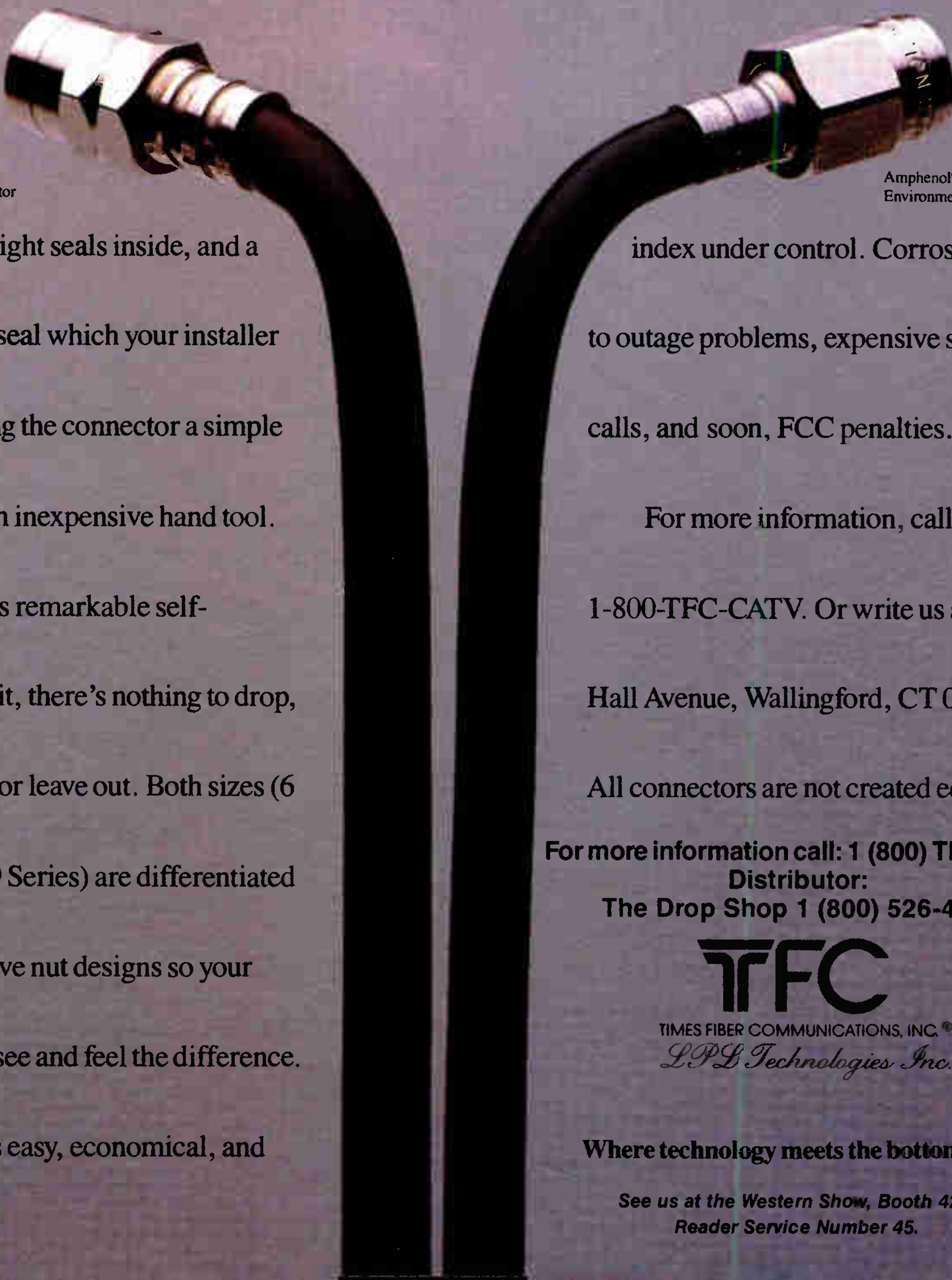

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grades of service then we should have a fairly high level of confidence in the entire venture. Any performance above these levels in subscriptions received would be very welcome "icing on the cake."

Now you have to (or ought to) play a little "what if." What if you charge less for basic service and more for either or both of the higher grades? Is it likely that basic subscriptions would increase in proportion to the other subscriptions? If so, by how much? Does this change your earlier estimate significantly?

What if you only established one higher grade of service rather than two? Would this change total subscription numbers or the proportion between the two service grades? What should or could the rates be with only two services? What's best, a very low basic rate with higher extra service grade rates or the reverse? What has been the industry experience in other communities? Are these comparable communities in average income, etc.?

Any of these scenarios can be analyzed and evaluated by following the same basic process we have used here. Since all costs were available as separate increments, it is fairly simple to make several evaluations of a single application.

Reasonable rates, the key to success

We have presented a lot of figures here; any or all of these may be challenged quite legitimately. But our objective was to develop a logical method for quickly estimating and evaluating any number of different sized systems, not to present precise costs or firm service charge recommendations. We suspect that many readers may have extensive technical CATV experience but have never had to consider the business aspects at all before. It was these people to whom this effort was addressed.

We hope this has been interesting, not too confusing and helpful. For those of you actually pursuing such activity or those of you who may now take up the challenge, we wish you well. We believe that the more widespread CATV service becomes, the better for our industry in general—but keep the standards up. In the final analysis, good service at reasonable rates is the key to success in any system and this can be achieved in even the smallest installations if they are designed, constructed and operated in a professional manner.

We welcome any discussion or inquiries you may have. You can reach Bill Grant at (518) 234-7405 and Lee Haefele at (607) 589-6903. ∎


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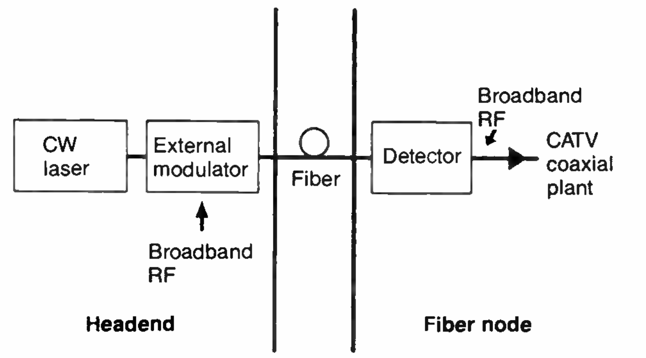
Figure 4: Fiber trunking



Fiber backbone

(Continued from page 40)

advantages of offering high transmission quality and almost infinite repeatability as its binary codes can be recovered and regenerated as necessary. It is likely to become widespread in CATV supertrunking as large urban systems interconnect hubs with redundant routing to improve reliability. Costs for the electronic components required for digital video transmission will continue to drop. Nevertheless, the cost of converting to AM-VSB will limit the depth into the CATV network to which digital modulation will be economically practical.

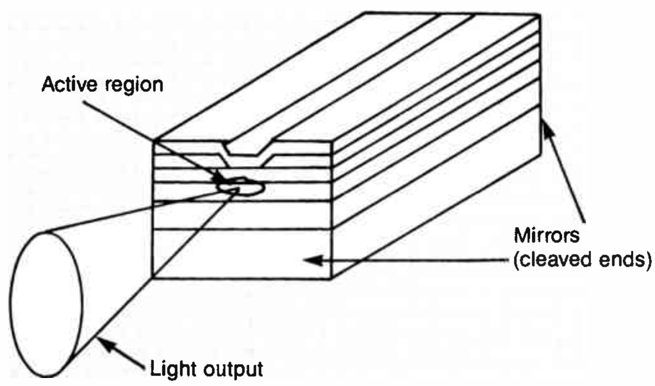
It is apparent that each modulation scheme has its advantages and potential points of application in a CATV system. In a hybrid fiber/coax system, it can be assumed that there will be a significant cost for the conversion interface between the optical and RF portions of the system. It also can be assumed that there will be a significant cost for conversions in the type of modulation used. In addition, it is assumed that there is a potential role for different modulation schemes and for both optical and coax RF transmission. The cost/benefit trade-offs will determine how far into the network both non-AM-VSB and optical transmission should extend, since there is a strong economic motivation to limit the number of conversion points for both the transmission medium and the modulation and since AM-VSB signals within a broadband RF spectrum are assumed to be the required final product.

Figure 3 shows a plot of relative system improvements as the coaxial portion of a CATV system is shortened and the number of amplifiers in cascade is reduced. These benefits include an improvement in both system reliability and transmission quality arising from the use of fewer active components in series, as well as the ability to deliver more channels. There is a direct relationship between cascade reduction and relative performance improvement. Also in Figure 3 is an estimate of the cost per home involved in the reduction of cascades through the extension of passive fiber plant closer to the home. This curve rises exponentially, since tree-and-branch architecture dramatically increases the number of conversion points required as the system approaches the home. The point of diminishing returns is difficult to pinpoint precisely, but it appears that the optimum balance between fiber and coaxial plant in a hybrid system comes with a maximum amplifier cascade between two and five trunk amps.

Optical components in AM video fiber systems

It is apparent that in a hybrid fiber/coax system, it would be

Figure 5: Fabry-Perot laser diode



highly desirable to maintain AM-VSB throughout. If this could be accomplished, the only signal conversion required outside of the headend would be that from optical to RF at the end of each optical trunk. This approach greatly simplifies the electronics needed at each conversion point, since it should be possible to directly detect the intensity modulation of the light on the fiber, with the resulting detected output being the broadband RF spectrum, a complex waveform complete with all the original channel information, scrambling, data carriers, etc. Such a conversion point could be contained in a small weatherproof housing, directly powered off the coaxial portion of the CATV system. Because AM-VSB is relatively fragile, however, this approach is technically quite challenging. The price paid for the bandwidth efficiency of AM-VSB is a low level of immunity to noise and intermodulation in performance.

Figure 4 shows a simple block diagram of a straightforward approach to optical trunking. At the headend, the broadband AM-VSB signal, containing all of the cable channels, is used to directly modulate a laser. This information is transmitted optically through the fiber to a conversion point deep in the cable system, where it is reconverted using a simple detector. In the last year, substantial progress has been made on the components necessary to effect such a system. The laser used must have a high degree of linearity and add very little noise to the signal. While there is room for improvement in detectors to ensure the lowest possible noise contribution and highest sensitivity, it is the semiconductor lasers used in these systems that dominate system performance. Because this technology is critical to the implementation of practical AM fiber backbone systems, it is worth examining these components more closely.

Fabry-Perot lasers: F-P lasers are constructed as a P-N diode. Recombination of electrons with holes releases energy in the form of photons. The diode junction is structured with several layers of different material composition and is made to allow photons to propagate along the junction surface (Figure 5). The chip is cleaved perpendicular to the photon propagation path and the cleaved surfaces act as a partial mirror. The laser diode now has the amplifying medium (junction) and the feedback mechanism (mirrors) essential for oscillations (lasing) to exist.

In semiconductor lasers, the distance between the laser mirrors defines the possible wavelengths of light amplified in the cavity. Only an integer number of half-waves can oscillate. We call this list of possible wavelengths the "Fabry-Perot modes." There is an infinite number of these modes but within the cavity only a limited bandwidth is amplified. Normally, 10 to 15 Fabry-Perot modes are within the amplification band and they create the cluster of wavelengths we see in F-P lasers (Figure 6).

All laser diodes have a threshold phenomenon, where up to the threshold current the laser behaves like a light emitting diode and emits very low light levels (Figure 7). Above the threshold current, the laser becomes very efficient with a high conversion ratio of current to light. At threshold, the response characteristics are highly non-linear and very noisy. Lasers are usually operated above threshold to avoid this problem. At certain levels above the working point, the laser may show saturation or complete breakdown and operation must be restricted to avoid this region. The threshold current is strongly dependent on temperature and servo controlling of a proper working point must be administered in order to achieve stable operation.

Laser noise is directly related to the bandwidth of the emitted light and to the number of modes. When several modes exist, a phenomenon of competition between the modes gives rise to excess noise. When only one mode is being amplified in the

Figure 6: Fabry-Perot modes

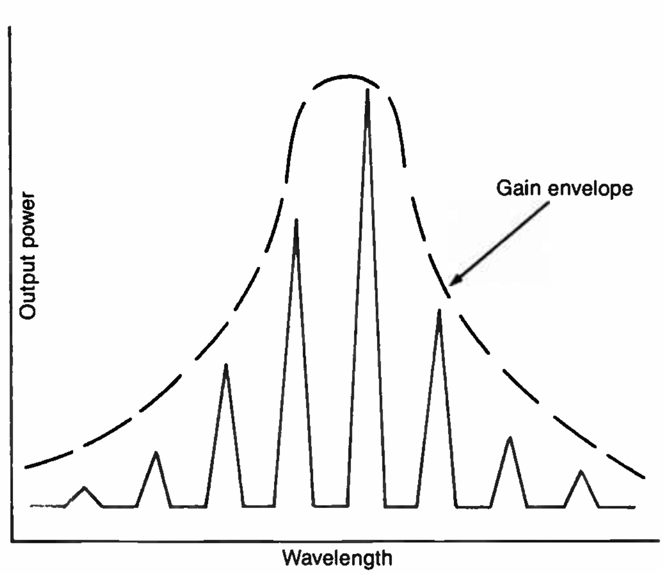
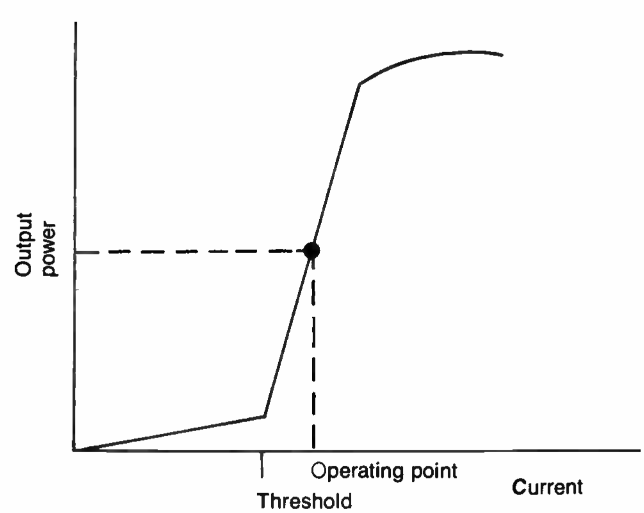


Figure 7: Laser threshold phenomenon



laser oscillator, the noise is linearly dependent on the line width. The narrower width has less noise. The reason for this is that spontaneous emission of light is amplified in the laser only if its wavelength matches the lasering wavelength and is absorbed otherwise. It would be useful, then, to create a laser with just one Fabry-Perot mode, and to make this mode as narrow as possible. There are several ways to reduce the number of modes developed into the laser.

Distributed feedback (DFB) lasers are the most common means of achieving a single mode of operation. The laser is fabricated with a corrugated grating structure along the cavity (Figure 8). This structure acts as a reflector, where light is partially reflected from each corrugation. If the wavelength of the light matches the structure's wavelength, all of the reflections from the structure are summed coherently and the light continues to travel in the cavity and to be amplified. If the wavelength does not match the grating, the reflections cancel out. Single-mode operation is achievable in DFB lasers (Figure 9).

The best noise and intermodulation performance observed to date in our testing has been in DFB lasers. An important element in maintaining low noise operation of DFB lasers appears to be limiting the amount of reflected light re-entering the laser from the transmission medium. External reflections that have less than −40 dB of attenuation appear to cause a rapid increase in the laser's relative intensity noise (RIN). In order to achieve useful performance in a multichannel CATV system, where carrier-to-noise ratios of 53 to 55 dB or better are desirable, RINs approaching −160 dB/Hz appear to be required. It is, therefore, critical that external reflections be controlled. Success has been observed with both external Faraday rotation isolators and with systems that utilize careful splicing of geometrically matched fibers, incline-ground connectors and inclined detector faces to minimize reflections.

DFB lasers are relatively expensive, since there are two diffusion steps in their fabrication; also yields are relatively low in each step. Nevertheless, DFB structures hold out great promise for AM fiber backbone systems for the CATV industry.

Quantum well lasers are a new technology and are not commercially available. In these lasers, the area where electrons combine with holes is made very thin, on the order of the electron wavelength. This confinement of the electrons makes the quantum behavior more strongly pronounced, and the combination of electrons and holes can now be achieved only in discrete energy levels. There are several ways to build a laser having

Figure 8: Cross-sectional view of DFB laser

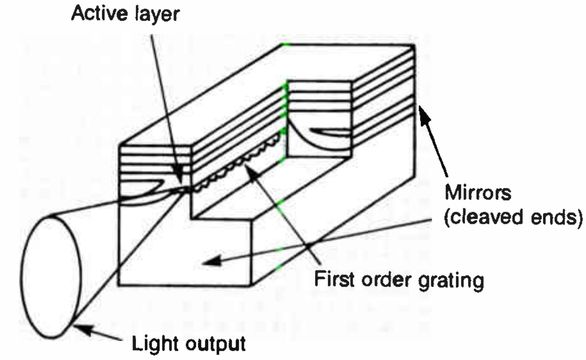
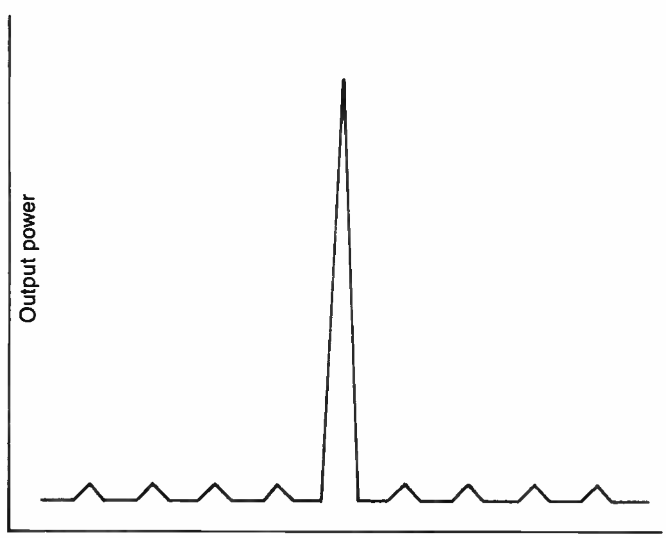


Figure 9: Single-mode operation of DFB laser



quantum wells and usually a single mode of operation is achieved, with a line width narrower than that of current DFB lasers. Another benefit of quantum well structure is a very low threshold current, enabling operation of the laser with less external electronics.

Quantum well construction may be used in an F-P cavity laser, with the promise of better performance and lower prices than existing DFB lasers. Quantum well structures may also be combined with a DFB cavity to create still better performance, but at a premium price. Quantum well semiconductor laser technology is expected to develop over the next several years and holds out the promise of dramatic improvements in noise performance for optical links used in AM fiber backbone systems.

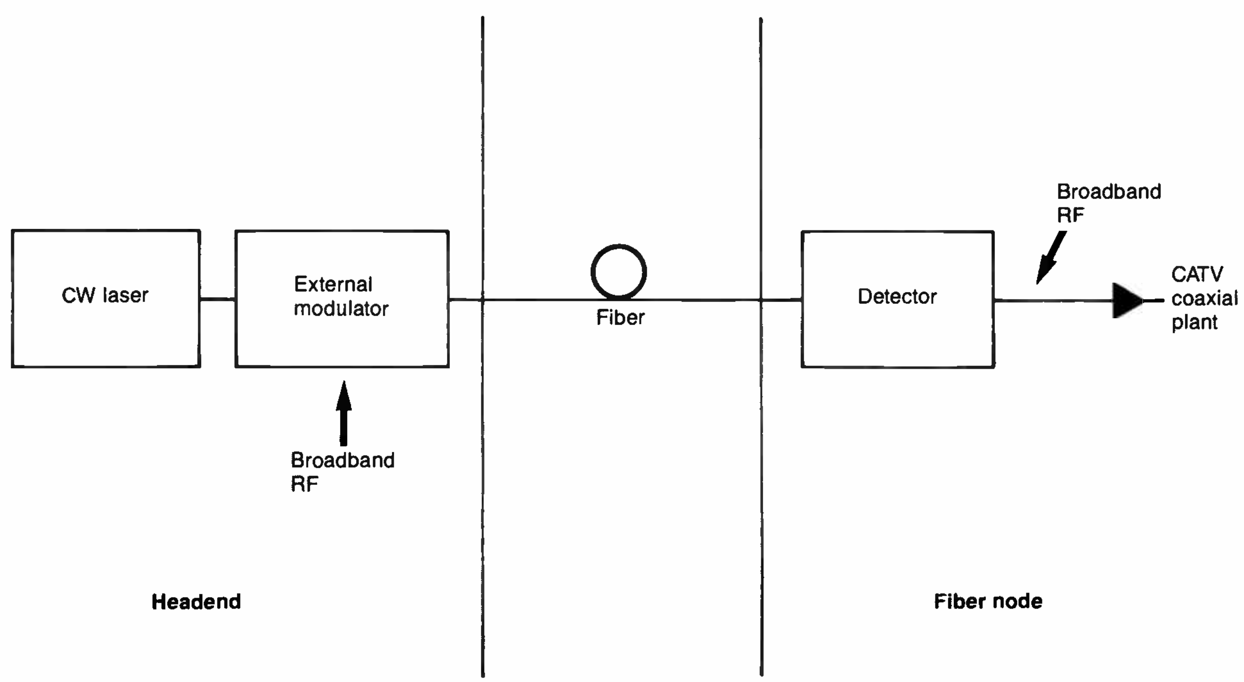
External cavity lasers: In these lasers, the semiconductor laser cavity is optically coupled to a second cavity. This cavity usually includes a passive optical element that is highly wavelength selective. Only photons that match the selected wavelength may propagate in the cavity and be amplified. There are many different structures possible, but the main idea is to fabricate a device that enables the creation of an extremely narrow line width and a corresponding decrease in noise. External cavities may be combined with DFB and quantum well laser structures, as well as basic F-P structures.

Today external cavity lasers exist only in the laboratory. The main development problems to be overcome relate to physical stability with respect to vibration and temperature change. The possibility of an external cavity integrated on the same substrate with the laser is being explored and holds great promise. The commercialization of these lasers, with the potential for very high performance at low cost, may be five to 10 years away.

External modulators: Another promising line of development work involves the generation of low noise, high power light using a constant-output continuous wave (CW) laser, feeding an external modulator; this is illustrated in Figure 10. This allows the generation of substantially more optical power than is possible in practical, directly modulated lasers. The external modulators available today are of the Mach-Zehnder inferometer type. These devices split the optical input and allow it to follow two paths through the device. One leg is entirely passive but the other allows variable delay through the application of an electrical field. If this field is varied, the delay will vary, and the output of the device, where the legs are recombined, will vary through signal addition and subtraction caused by the relative phasing of the light through the two paths.

The primary drawback to Mach-Zehnder devices is that the modulation process is inherently non-linear. The change in

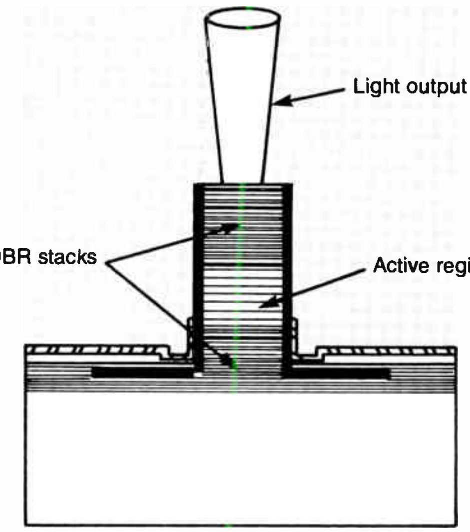
Figure 10: External modulation method



intensity at the output of the device is related to the change in input voltage by $\cos^2$ function. Non-linearity in a broadband multichannel device creates severe problems in the form of intermodulation products, but the fact that the Mach-Zehnder modulator has a precisely predictable characteristic opens the possibility that either pre-emphasis, feedback or feedforward techniques can be used to produce overall system linearity. It is possible that practical, externally modulated optical transmitters will be realized with high enough output levels that they can be used in relatively long-haul applications, or that their outputs can be split to feed a number of conversion points in an AM backbone system, allowing the relatively high cost of the transmitter to be shared over several links.

Vertical cavity lasers: The latest development in diode laser structure is a vertical cavity construction. (See Figure 11 from Reference 6). The light propagates in the laser perpendicularly to the chip surface. Two mirrors are defined parallel to the surface by multilayer coating of dielectric materials. Between the layers, several layers of quantum wells are defined. The laser operates and behaves like a quantum well laser and light is emitted from the top mirror. This structure has many practical benefits. The size of the laser may be made to be on the order of 10 microns, much smaller than conventional structures. In that way, more lasers may be made on a wafer. On the other hand, the size of the emitting area may be made to almost completely fill the physical size of the laser, making it much larger than the size of the emitting area of a conventional laser. This means the size of the emitting area will better match the diameter of a single-mode fiber, and the coupling to the fiber will be more efficient and make fewer demands on the dimensional stability of the laser-fiber relative position. Also, lower concentration of light intensity at the laser's emitting facet will increase laser life and reduce risk of damage to the facet. Having lasers made with vertical emission will enable testing of the laser properties while on the wafer, in contrast to conventional lasers where each one must be mounted and tested individually. The yield of the mounting operation will increase dramatically.

Figure 11: Vertical cavity surface emitting laser



While significant progress has been made in optical links for use in an AM backbone system, it is the authors' opinion that the price/performance point that has been achieved is still some-

what short of that required for widespread proliferation of AM fiber backbone technology in CATV system rebuilds and upgrades. We continue to believe that the achievement of the goals illustrated in Table 1 will spark massive adoption of this technology by the CATV industry when combined with a cost between $5,000 and $10,000 per link. Nevertheless, development by optical component manufacturers are the key element in achieving these goals and it is clear that component technology has many promising avenues to explore.

Table 1: Desired performance

Channels	60-80
C/N	55 dB
CTB	65 dB
CSO	65 dB
Cross-modulation	65 dB
Power budget	10 dB (20 km or 12 miles)
Equipment cost (per node)	$8,000

Table 2: Performance to date

		System specifications				
		#1	#2	#3	#4	#5
C/N	(dB)	49	52	54	52	52
CTB	(dB)	62	65	67	66	69
CSO	(dB)	62	66	65	67	>73
Budget	(dB)	5.4	5	5.7	7.2	7.1
Channels		42	42	42	42	42

Current system test results

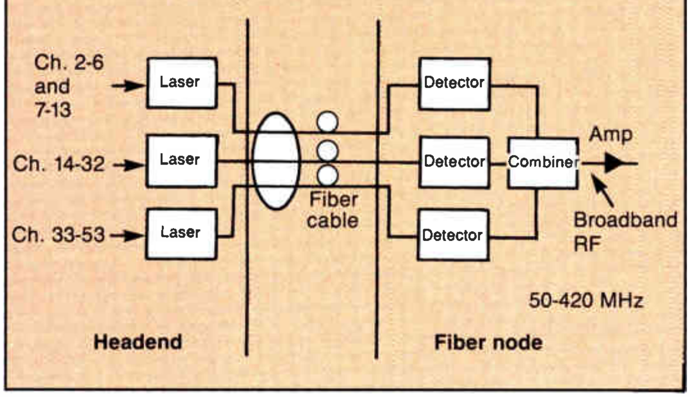
Table 2 illustrates the results of ATC's most current system tests. These results are conservative but repeatable and are made with CW carriers from a matrix multichannel signal generator. Multichannel systems with asynchronous video modulating signals will yield somewhat better results. It can be seen that the goals set by ATC are being approached relatively closely by some of these systems. While the pricing of these systems is relatively high, there has been delivery of a significant number of links in 1989.

It should be noted that decreasing the channel loading of AM optical links has a relatively dramatic impact on performance. First, noise performance improves by 3 dB each time the number of channels is halved. Secondly, the available power budget also increases dramatically as the number of channels is decreased and the modulation index per channel increases correspondingly. Intermodulation performance also improves. This has led to the commercial development of an AM transmission system of the type shown in Figure 12. These multifiber/multilaser systems are capable of carrier-to-noise ratio performance in the high 50s, with power budgets of 10 dB and more. While their cost is high and they make relatively inefficient use of optical fiber, they are clearly useable in some applications. ATC has constructed and tested multifiber AM supertrunks in several of its systems using this technology, and Jones Intercable has announced the construction of such a fiber backbone hybrid system in an upgrade currently under way in Broward County, Fla.[7]

Fiber/coax hybrids for the future

1988 was the year when the true potential for integrating optical fiber into its systems began to dawn on the CATV industry.

Figure 12: AM fiber transmission scheme



1989 is the year when the commercialization of practical systems is beginning to hit its stride, and field deployment has begun. Current prices run from $25,000 to $50,000 for an 80-channel (550 MHz) link (using two fibers and two sets of lasers and detectors) with useful performance levels. There are applications where such systems are cost-effective but their number is limited. In 1990, it is expected that the system architecture and economics originally predicted by ATC will be realized and that subsequent years will bring further improvements in both performance and price, and that the number and type of applications will increase dramatically. We believe that the typical CATV system of the mid- '90s will be a hybrid fiber/coaxial network achieving levels of reliability, signal quality and channel capacity once thought unattainable.

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This article updates a scenario for the integration of optical fiber transmission technology into existing cable TV networks first presented in the "1989 NCTA Technical Papers."


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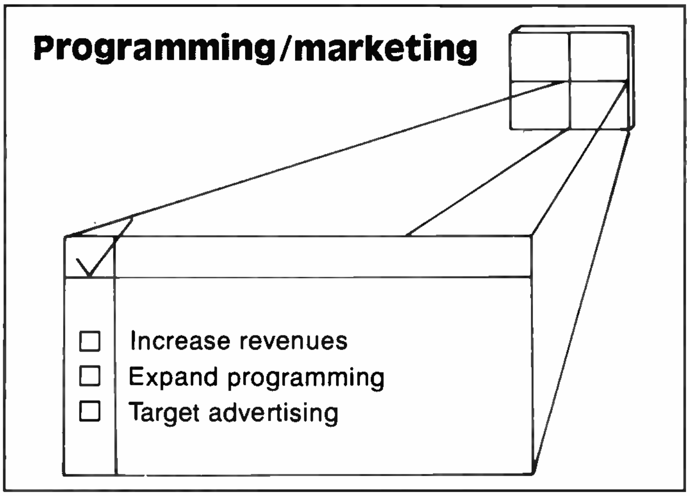
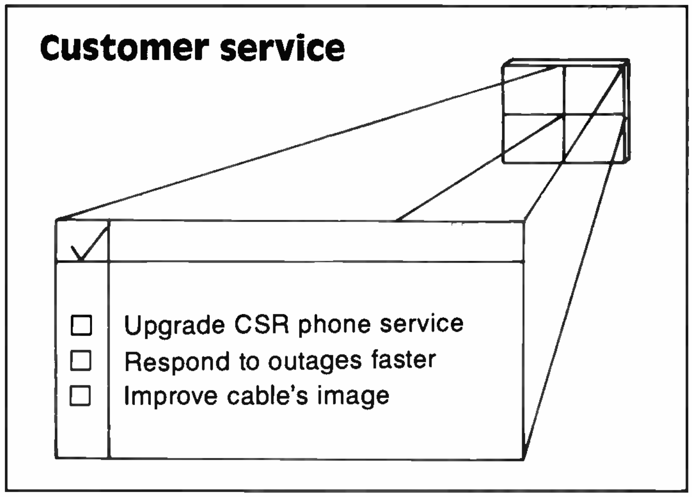




Customer service

(Continued from page 34)

approximately 500 to 2,500 homes. When failures do occur they affect more confined service areas, simplifying diagnostics and facilitating early repair. Operators are able to do the following:

- reduce the number of subs affected by an outage,
- reduce the manpower and expenses involved in outages (truck rolls) and
- manage ongoing maintenance costs associated with outages.

The costs to maintain a fiber plant can be minimal compared to the time and expense of maintaining amplifier cascades to serve an equivalent area. Recent articles have detailed improved cost and performance levels when comparing traditional coax and other technologies to fiber. Current fiber architectures being deployed offer better network control, so operators can manage their systems proactively and maintain high quality signals while planning for growth in system extensions and channel capacity.

Marketing and programming: Achieving marketing and programming goals in harmony with technical and operation targets has been a difficult task in the past. With fiber, the ability to add more channels, improve picture quality and utilize pay-per-view (PPV) technology enables marketers to increase both the number of subs and average sub revenues in certain areas.

With smaller service areas both programming and advertising can be targeted more toward specific community needs. This "narrowcasting" can dramatically improve the value of programming and perceived service to local subs, franchise officials and advertisers alike. Once a system uses narrowcasting and marketing more in tune to local needs, operators can expand ad revenues by selling targeted advertising to both local establishments and national firms.

In addition to delivering better signal quality and more targeted programming and advertising, fiber allows operators to develop alternate revenue opportunities. Fiber's superior ability to transmit video, voice and data enables operators to offer high quality service alternatives to businesses and institutions in their franchise areas.

Customer service: A critical goal for many operators in the '90s is developing a comprehensive customer service plan that works. Though a customer service plan must involve all aspects of the operator's business, the benefits of fiber architecture can be a key contribution to the customer service solution.

Since system problems can be segmented to a fiber node, outages that previously triggered hundreds of calls to CSRs can be reduced to more manageable levels. With fewer calls CSRs can now handle complaints accurately, professionally and in a timely manner, often pinpointing specific problems before dispatching a service call. By controlling service requests service technicians can respond faster to system outages as well as to individual customer service visits.

Enhancing cable's image

The 1990s will bring many new technical, operations, programming, marketing and customer service challenges to the cable industry. By optimizing new technologies, these challenges will be met. As fiber expands into cable architecture, operators can take advantage of improved quality and reliability, thus raising the level of value customers place on services and enhancing the image of cable in the United States.

Fiber evolution

(Continued from page 36)

ple headend configuration with the headends interconnected via fiber. Multiple headends make economic sense when large geographical and/or population areas are served by a common operator. Otherwise, amplifier cascades would become extremely long in reaching outlying subs, resulting in unacceptable end-of-line picture quality.

As MSOs move toward regional system consolidation, the interconnection of headends makes even more sense. Regionwide local advertising, for example, then becomes easy to deploy.

A multiple-headend configuration allows operators to cluster relatively expensive and bulky reception electronics in one location, preferably with low real estate rates. Today's fiber systems also allow centralization of stereo encoders. Breakthroughs now occurring in video scrambling will allow operators to centralize scramblers and addressable control computer hardware in one master headend, with remote headends becoming hubs. This reduces capital costs and maintenance requirements and costs.

Relatively transparent transmission links are required to deliver the high performance headend quality signals needed at the remote hub sites. A video signal-to-noise (S/N) ratio of greater than 60 dB is needed typically, with little tolerable intermodulation distortion.

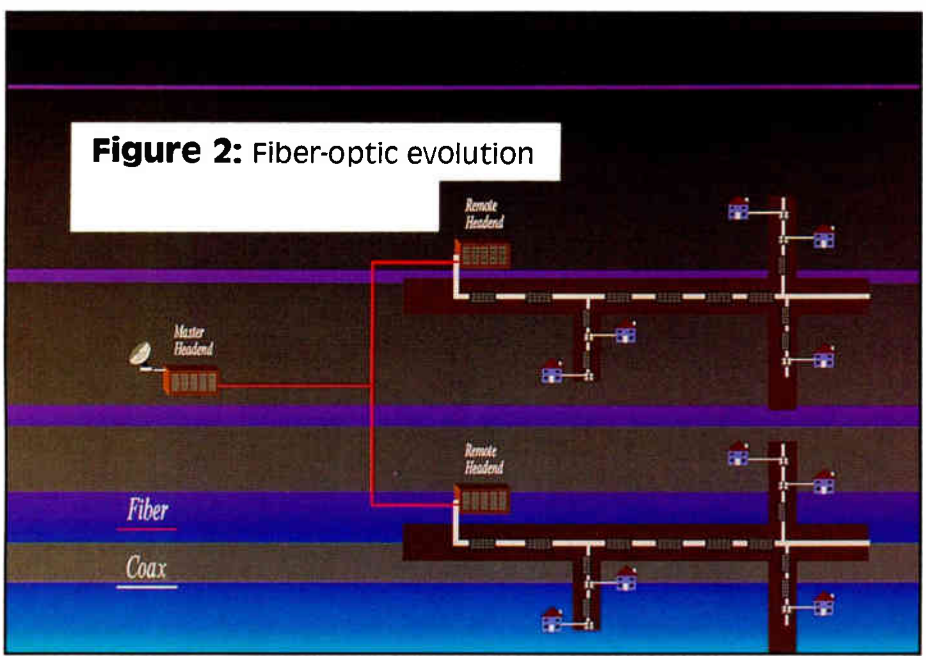
FM carriers transmitted optically at the 1,310 nm wavelength window are today's norm for fiber supertrunks. EIA RS-250B medium-haul broadcast specifications, including 60 dB S/N, are maintained at link distances exceeding 25 miles with 16-channel loading per fiber and 40 MHz bandwidth spacing per channel. Typical terminal equipment costs for a point-to-point link are $4,000 to $5,000 per channel. A problem for FM supertrunks was their inability to transparently transmit all commonly used scrambling systems. Laboratory studies indicate that scrambling transparency will become a useful FM product as early as 1990.

Unlike the relatively mature FM technology, digital modulation shows promise for rapid advancement and cost reductions in the 1990s. It is possible to digitally transmit excellent picture quality over unlimited distances with repeaters. The problem to date has been economics. Part of that is due to digital's bandwidth hunger —over 100 Mbps (megabits per second) per channel. Seven-bit digital systems today are cost equivalent to FM for supertrunking. Unfortunately they provide inferior performance. At an "apples to apples" comparison, today's digital terminal equipment costs are roughly $7,500-$10,000 per channel.

Advances will probably be made leading to cost-effective deployment of nine-bit digital modulation product for supertrunking applications in the early 1990s. Digital is unlikely to make FM obsolete in that time frame but may begin to supplant FM in the longest link applications as early as 1992. Other supertrunk advances projected for the early '90s include more widespread use of the 1,550 nm optical window for long links and amplitude modulation (AM) for the shortest links.

Electro-optic devices are less efficient at 1,550 than at 1,310 nm, but the lower

Figure 2: Fiber-optic evolution



Courtesy Jerrold/General Instrument

fiber attenuation at 1,550 nm (<0.40 dB/miles vs. <0.65 dB/mile at 1,310 nm) is projected to more than compensate as 1,550 nm devices advance in performance and drop in price. As advances in increasing output power and improving linearity of AM light sources proceed, AM transmission will be used for short links to remote headends serving relatively short resultant amplifier cascades. Very low, sub-octave channel loading for supertrunking will be required to avoid AM problems with intermodulation distortions.

Phase 2: Backbone

Fiber is just now being tried for the first leg of distribution—the trunk or backbone. Figure 3 shows a fiber backbone overlay linking selected trunk amplifiers. The number of amps remains the same but the cascades are reduced. In essence, the cable plant becomes a collection of smaller cellularized coax plants linked to the headend with fiber. Demand trends and rapidly advancing AM lightwave technology will lead to volume deployment beginning in 1990 and universal acceptance for new-builds and rebuilds by the middle of the decade.

Consumer demand for improved picture quality spells the end for traditional end-of-line system design criteria such as 43 dB video S/N. Epitomized by high definition TV but more tangible with today's large screen NTSC and improved definition TV sets, consumers will need better performing cable distribution plants to fully benefit from consumer electronics advances of the 1990s. Goals of 49-52 dB end-of-line video S/N for the mid-'90s seem reasonable.

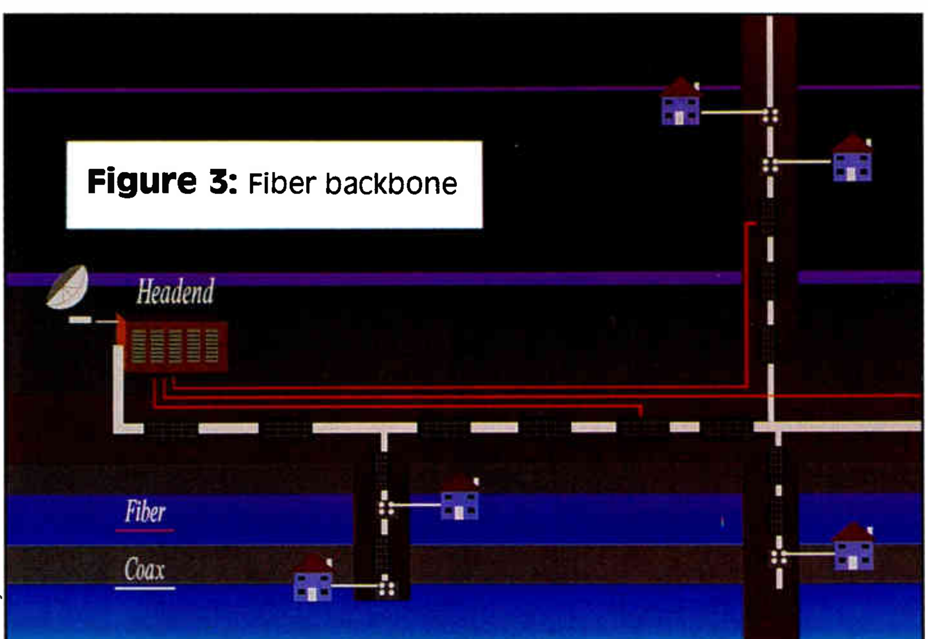


Figure 3: Fiber backbone

Courtesy Jerrold/General Instrument

Fiber backbones will complement the introduction of 1 GHz electronics in the continuing evolutionary bandwidth expansion to provide additional channels of video, data and other residential communications services. With cable plants extending beyond original design areas and a need to improve service reliability, fiber backbones soon will become necessities.

AM transmission is ideal for the backbone. Its compatibility with existing plant, bandwidth efficiency and low costs will prove most beneficial as light source technology improves. With AM, fiber-optic receivers can plug into existing electronic amplifier stations. No significant additional headend equipment is required other than the light source transmitter.

To date, the major limiting factor of AM backbones has been light source performance. Field tests and trials during 1988 and 1989 typically carry 40-60 channels over six- to eight-mile links. Link video S/N is just over 50 dB and composite triple beat (CTB) and second order (CSO) distortions are approximately 60 dB (measured according to National Cable Television Association recommended practices with carriers from a multichannel signal generator). Direct-modulated distributed feedback (DFB) 1,310 nm lasers generally serve as the light source. Lower cost Fabry-Perot lasers are unsuitable for most longer AM links because of a phenomenon termed "mode partition noise." Still, today's DFB lasers were originally designed for digital telephony applications and not optimized for AM cable TV.

Laboratory breakthroughs in DFB lasers designed specifically for AM backbones are projected to yield higher power, lower noise, more linear devices and systems in 1990 volume production. We project pigtailed transmitter output powers exceeding 4 mW. This makes backbone link distances of eight to 12 miles possible. This compares to 1 mW (in early 1988) and 2 mW (the norm for 1989's low volume production). Video S/N exceeding 55 dB will be possible for 10-mile links, with CTB and CSO both exceeding 65 dB. Due to laser linearity constraints, at least two fibers—each handling 40-60 channels—are considered necessary for each backbone link.

"It will require many technology breakthroughs and major cost reductions to take fiber beyond the backbone trunk."

Further improvements, perhaps using a scheme known as *external modulation*, may be possible later in the '90s. With external modulation the lasers need not be linear. We can use high power lasers made from materials other than gallium arsenide (GaAs) like yttrium aluminum garnet (YAG) or erbium-doped fiber. Laser output powers in excess of 100 mW are possible. Unfortunately this power must be coupled through an external modulator (with little distortion) into a transmitter pigtail. For example, lithium niobate Mach-Zehnder modulators cannot reliably handle these types of output powers and linearity is poor (particularly CTB). Lesser concerns are polarization sensitivity of the external modulator and low frequency noise of certain high-power lasers. Although further out commercially, the promise remains real for possible practical advancement beyond direct modulated DFB lasers sometime in the next decade.

The 1,550 nm wavelength also shows promise for AM backbones in the 1990s. The shorter links and lower loss budgets of backbones relative to supertrunks make it more difficult to overcome the lower efficiency of lasers at 1,550 nm. However, as laser manufacturers become experienced producing units specific to CATV's needs and more comfortable with the newer 1,550 nm wavelength devices,

Figure 4: Fiber to the tap

Courtesy Jerrold/General Instrument

expect 1,310 technology to be transferred to 1,550 nm.

Future cost reductions

In today's AM fiber-optic product infancy, typical terminal equipment costs already are as low as $500-$1,000 per channel. An 80 percent experience curve is likely for terminal equipment, meaning that for each volume doubling of AM laser production, for example, a 20 percent cost reduction is possible. Use of higher output power lasers will allow for more use of optical splitters thus further conserving headend costs. As thousands of backbone links are constructed by MSOs in the early 1990s, the cost descent can proceed.

Fiber and passive-component manufacturers also will have to reduce their prices as volumes increase and installers must become more efficient to allow the evolution to proceed at full force. Costs will likely not drop by half in any year, for example, but will evolve lower as volumes evolve higher. Including all construction costs, AM backbones will be deployed with investments of less than $100 per sub beginning in the early 1990s. For all its immediate benefits and future expansion capability, this investment in the fiber backbone should prove to be prudently popular.

Phase 3: To the tap

The further out one looks, the murkier the crystal ball gets. It will require many technology breakthroughs and major cost reductions to take fiber beyond the backbone trunk. Figure 4 illustrates fiber extending to the sub's tap. This is the final phase of the evolution of the 1990s, since deploying fiber all the way to the sub's home would entail severe cost penalties with little usable bandwidth advantages over the typical existing coax drop cable. Provided a number of technology and economic improvements occur, fiber to the tap should begin during the mid- to late-1990s.

Today's two-way 550 MHz coax tree-and-branch addressable system with impulse ordering capability can be constructed for generally less than $500 per sub (in aerial applications). Broadband fiber distribution must approach this type of efficiency to become a viable option for something other than laboratory tests, field trials and political fodder. Therefore, a continuing evolutionary advancement of the cable operator's efficient hybrid fiber/coax AM distribution plant is projected for the 1990s.

No switched-star broadband integrated services digital network (B-ISDN) is projected as viable for large volume residential deployment in the 1990s. Although many among the telephone industry would disagree, the realities of consumer demand, technology and economics for residential broadband communications services provide clear evidence. The switched-star mesh architecture is best for telephone and real-time interactive narrowband data services requiring the universal coverage of the telco network. The cost penalties of the home-run fiber deployment cannot be justified for broadband video, audio and other residential consumer services. These are better served by today's point-to-multipoint tree-and-branch cable TV systems.

Technically, digital modulation today works for fiber distribution but it is far too expensive. The B-ISDN concept of compressing NTSC video channels to 45 Mbps each does not go far enough in overcoming the bandwidth hunger and costs of broadband video distribution. However, don't count digital out. Major cost reductions through advanced compression technology (perhaps on the order of 10 to 1 ratios) may make digital cable TV distribution economically possible in the late 1990s. Coincident technology advances, perhaps in optical heterodyne tuning ("coherent systems"), may be required if digital video is to succeed in distribution during the 1990s.

AM requires further performance improvements to reach the sub's tap with fiber. Yet it has the best chances of yielding low costs and easing evolutionary, consumer-friendly advances in the 1990s. Light sources need to improve, with output power levels being even more important than in the backbone.

Performance and costs of optical splitters, couplers, wavelength division multiplexers and taps also must improve dramatically. A point-to-multipoint broadcast-type architecture will help minimize the amount of fiber and related installation costs, which is absolutely critical if fiber distribution is to succeed. As a major part of distribution costs fiber cable installation prices must also come down significantly. For instance, cable TV needs new fiber cable designs to speed splicing. Use of the 1,550 nm window is probable. Optical amplifiers and optical heterodyne tuning are other technologies with close, cost-effective analogs used in broadband electronic distribution systems today. Laboratory breakthroughs in some of these areas will occur in the early 1990s with resulting volume product later in the decade.

In summary

The three phases of fiber evolution that have been projected as viable for cable TV volume deployment in the 1990s are as follows:

Phase	Description	Timing
1	Supertrunk	Begun
2	Backbone	1989-1990
3	To the tap	1995-1999

The early 1990s will be characterized by a laboratory focus on technology performance advances, with volume production for fiber supertrunk and backbone applications. The focus of the mid- and later 1990s will be to reduce the costs of laboratory advances of the earlier 1990s to provide cost-effective, volume production and deployment of fiber cable TV distribution systems in that decade and into the next century.

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Explanations, You Need Po

Your power supply gives you a choice: you can keep trucks in the field servicing equipment or you can roll them out to make new installations. Power Guard is designed to eliminate costly repair hours, so your technicians can be producing revenues.

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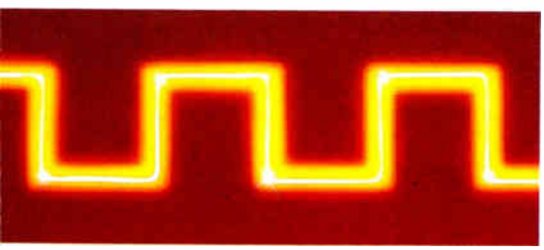
From the wiring harness to the circuit boards, Power Guard is completely modular. Every component is designed for fast plug-in replacement in the field, so there's no need to remove and reinstall housings with Power Guard. Getting back on the air



even if lightning damages your wiring will take only a matter of minutes.

The normal power supply weighs only 40 pounds, the standby power module only 30 pounds, so the man in the field can pull a damaged module quickly, safely and restore power in a few seconds. That is what Power Guard is all about, keeping you on the air.

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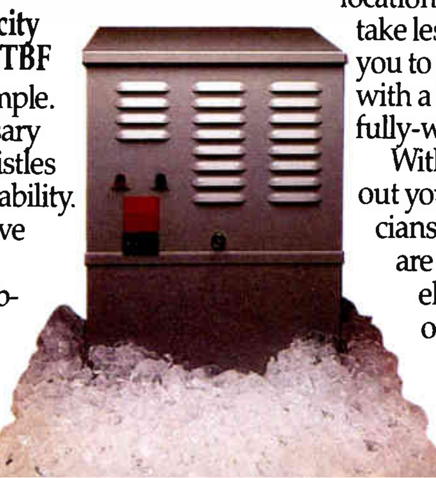

features to give you the maximum mean time between failures and the minimum down time in case of a failure.

We build a quality product with a powder-coated, all-aluminum housing that will withstand the most severe weather conditions for years of trouble free service. That's why we can give you the longest warranty in the CATV industry today.

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Our small, highly efficient modular design allows us to Retro-Fit virtually all of our competitors' power supplies, standby and non-standby, while using your existing housings in their current locations. Retro-Fits cost less and take less time to install. They allow you to standardize your entire syste with a 90% efficient, totally modula fully-warranted supply.

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e Installations, Not
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The Beast Guards Your Connections

The beauty of this apartment box is that it ends theft of service and signal leakage due to tampering...and reduces truck rolls so your technicians can make more hookups, less unproductive audits and repairs.

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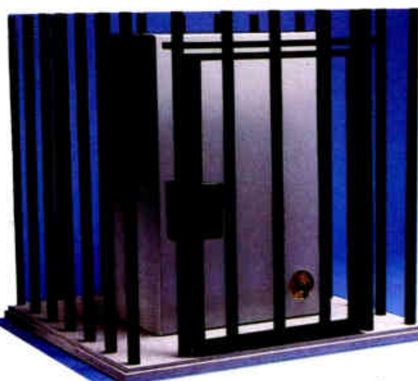

We caged the Beast in a box-in-a-box. Stainless steel arc welds eliminate rust and prevent prying. Our 16-gauge aluminized steel remains corrosion-free and outlasts galvanized steel five to one. Coatings withstand high impact for years of use without chipping or cracking.

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The key to the Beast cannot be reproduced. You control the access to all Beast apartment boxes, simply by logging in and out all keys you distribute to your service technicians.

The key must be in the locked position in order to be removed, so it is impossible to leave the Beast unlocked without detection.

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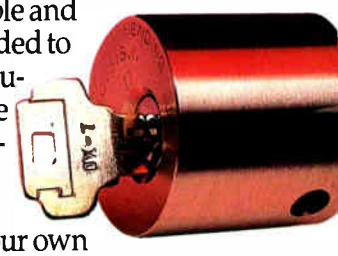
A Pack Of Protection

Swinging Beast, Beast, Lock Box and Beast II–choose the Beast that's best for you. Cable Security Systems offers a choice of four models to meet your cost and security requirements.

The new Swinging Beast has a non-removable, hinged lid that makes servicing quicker, safer and more convenient. No more lost lids.

Our original model, the Beast, is the industry standard for durability and security in all conditions.

The Lock Box™ is adaptable to almost any locking system. It offers durability and serviceability that's affordable and may be upgraded to maximum security at any time without rewiring. It can be keyed to the Beast™ with our own 2″ solid brass padlock.



The Beast II has a sliding, retained lid with a self-locking, solid brass lock that can also be keyed to the Beast. The Beast II is a durable system for areas where high security is required.

Reliance Makes Compliance Easy

Meeting new government regulations to prevent signal leakage is critical to keeping your license–and your customers. Many operators have been spending a lot on costly truck rolls to audit their apartment boxes to detect tampering and theft, which is also a major cause of signal leakage.

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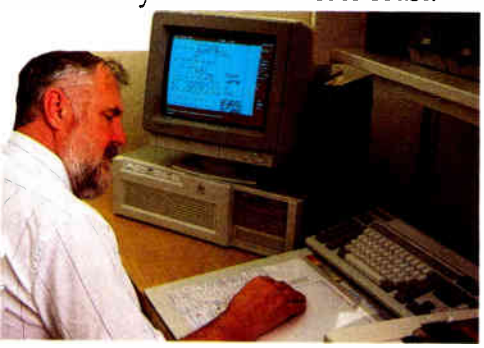

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For pricing and information on the Beast, write: **Cable Security Systems, Inc.,** 801 Fox Trail, P.O. Box 2796, Opelika, Alabama 36801. Or telephone toll-free 1-800/288-1506 or for local calls telephone 205/742-0050.

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"If PPV is to survive and grow with all these new approaches, the cable industry must be involved in the HDTV standard-setting process."

Friendly IPPV

(Continued from page 28)

nology has changed. More than 80 percent of all new TV receivers can tune cable channel frequencies and virtually all deluxe receivers are cable-compatible. In light of current sales statistics, probably at least 60 percent of subs have cable-compatible TV receivers.

Placing the addressable converter atop the TV receiver effectively makes the receiver a monitor and the sub is denied many features of the TV set. Some systems that have gone from traps to addressability have seen their satellite pay service subscriptions drop as much as 20 percent. That type of decline is a classic symptom of the unfriendly converter.

There are many solutions to the problem, including addressable on-premises traps and off-premises pole-mounted interdiction. Some companies offer baseband interface decoders.

The MultiPort is an addressable decoder that conforms to an Electronic Industries Association standard developed jointly by the EIA and National Cable Television Association that defines a baseband interface for the decoder and TV receiver. When a MultiPort decoder is used with a MultiPort TV receiver the two function as an addressable decoder and the customer's TV set retains all of its advanced cable-compatible features. Addressability becomes transparent to the subscriber.

That's important to the future of PPV. In the past year a significant change occurred: Single-event revenues exceeded movie revenue on PPV. Some attribute this turnaround to the fact that new movies are being released to video stores before they're available on PPV, perhaps because video stores are a bigger market than the 6 million PPV subscribers.

An obvious solution is to increase the number of subs capable of receiving PPV and use the lure of an expanded market in an appeal to movie companies to move up release dates for PPV. The transaction technology is here, and so is the market. Out of 40 million subscribers, only 12 million are addressable.

The not-so-friendly competition

Cable competes against other delivery means too. Today, the battle against over-the-air broadcasters is essentially won with 56 percent of TV households wired for cable. The real battle is other media—videocassette rentals, for example. There's a very realistic possibility that a vertically integrated supplier could produce and sell its own programming on 8mm cassettes for as little as $5.

New transmission proposals are dominating the news. The Japanese high definition TV (HDTV) system MUSE is a direct broadcast satellite (DBS) system. Initially proposed as a DBS system in the United States, it is now being modified for cable and broadcasting. If PPV is to survive and grow with all these new approaches, the cable industry must be involved in the HDTV standard-setting process to prevent creation of a standard that makes cable non-competitive. HDTV programming is important for PPV. It is important that the new HDTV standard allow a conditional access system for cable if HDTV services are to be revenue sources, especially for PPV. [ ]

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Reader Service Number 72.


1GHz

Integrated view

(Continued from page 26)

ventional over-the-air broadcast TV. Fiber, of course, will only be a transparent delivery method to the home. What happens inside the home will be the real story about CATV in the '90s.

Technologies that took root in the '80s will bloom in the '90s. This evolution of significantly improved in-home services will start with cable operator control via addressability. Addressable control, based outside the home, will give cable operators the ability to handle a number of subscriber services. It will also remove crucial electronics from the home and make them more accessible to operators.

Subscribers, on the other hand, will taste the delights of cable without the consumer-unfriendly drawbacks. The added emphasis on consumer friendliness, via such existing technologies as the EIA MultiPort interface, cable-compatible home electronics and impulse technology, will be joined by new devices such as smart remote control units.

On-premises addressability also will be part of the evolution of impulse technology. Eventually, the consumer friendliness of the on-premises device will meld with the existing impulse converter into an outside-the-home control center for in-home communications.

Integration of in-home services

Finally, the '90s will see an increasing integration of in-home subscriber services. Digital audio, already gaining a foothold, will encroach on broadcast radio in much the same way cable programming affected broadcast TV. Video itself will enhance its value with more programming and better quality pictures.

At the same time, we will see the continued consolidation of in-home services until a single unit in the home—a wireless telephone—controls all the subscriber services. As the decade progresses, subs will be able to control home appliances, alarm systems, audio systems, telephones and, of course, televisions, using this control center. Outside the home, the interface device will allow cable operators to read water meters and monitor electric loads.

Looking beyond the '90s, the integration of in-home services will continue. In the long term, there will probably also be an integration of delivery methods. Until then, though, these parallel systems will become essentially transparent to a subscriber who needs only one device to control everything. □

A switch for syndex

By Doug Greene
Staff Engineer, Jones Intercable

Now that syndicated exclusivity is on our front doorstep, we must begin thinking about syndex equipment—if you haven't already—and how it will impact our headends. The syndex dilemma can be resolved by using three different methods of switching: intermediate frequency (IF), baseband and radio frequency (RF). Most of the cable industry is already familiar with the baseband and IF methods of switching. Recently, the use of RF switching has been reintroduced in local area networks (LANs) and has been spilling into our industry. The following information may be helpful during the installation and setup of your syndex switching equipment.

IF switching

The use of IF switching is probably the most common and easiest method. It is very economical; most equipment manufacturers provide IF switching as an option or built into their products. In most cases, all that is required is a contact to ground or open collector-type circuit to provide switching. Some manufacturers even provide an IF input to a solid-state relay for switching.

An example of a simple IF switching configuration for syndex is the use of a character generator to feed a modulator that has an IF output. This output is then split with directional couplers to feed the IF relays of the channels to be switched. This configuration requires only a controller with open collector outputs to control the appropriate relay at the correct time.

"IF switching...is very economical; most equipment manufacturers provide (it) as an option or built into their products."

When implementing IF switching, isolation becomes a factor in the quality of the output signal. Look for switching equipment that provides good isolation at IF frequencies (preferably greater than 65 dB). If you are using several IF signal sources, it is a good idea to leave as much space between feedline runs as possible. Use a well-shielded cable such as a double-shielded headend cable. This will help to eliminate interference from signal ingress of other nearby IF sources. Make sure that connectors are tight not only on the outside of the equipment but also inside the chassis.

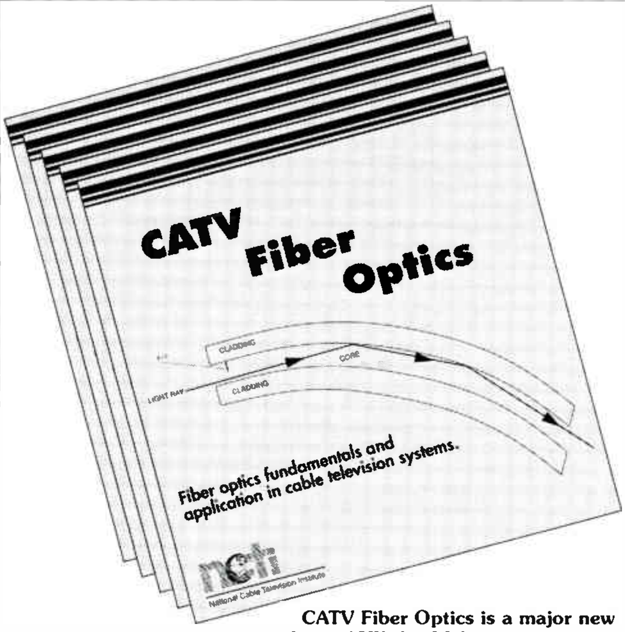
When using IF switching, levels from one manufacturer's equipment may not be compatible with other manufacturers' equipment. Refer to the user's manual to find the optimum operating level for injection of the external IF source. The use of an amplifier or pad may be needed to optimize the injection level. Try to avoid the use of an amplifier, but if it is necessary make sure it is well shielded.

When using IF switching on a processor or modulator in the aeronautical band, be sure that the output frequency still meets the ± 5 kHz tolerance required by the Federal Communications Commission. When an alternate IF source is activated—for example, in a double conversion processor—the output frequency is a function of not only the IF and the second local oscillator but also the input frequency of the off-air and the first local oscillator. You should measure the output frequency with the alternate IF activated and it should be within ± 5 kHz of the desired aeronautical offset frequency for the processor. If you have made the proper offset for the off-air station on the input converter (assuming the station needs to be offset), the processor will have the correct IF frequency.

One advantage that IF switching has over baseband is that both the audio and video components are mixed into one signal, thus reducing the complexity and amount of wiring required. Let's discuss baseband a little more.

Baseband switching

In the past baseband switching was commonly found only in the broadcast industry. However, over the past decade more CATV manufacturers are providing equipment to handle baseband switching for headends. Modern headends demand baseband switching because of all the video and audio sources, such as satellite receivers, commercial insertion equip-



CATV Fiber Optics is a major new course from NCTI. Its 22 lessons cover virtually all aspects of fiber optics and its use in cable TV.

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CATV Fiber Optics, can bring you into the age of optics. It provides you with a thorough understanding of fiber concepts from transmission and attenuation to bandwidth and dispersion. It will bring you up to speed with the application of fiber from cabling basics and types of lasers, to amplifiers and splicing. Finally, it will complete your knowledge of fiber use in cable television systems with a review of fiber architectures, modulation techniques, RF interfaces, components, testing and monitoring, construction and maintenance.

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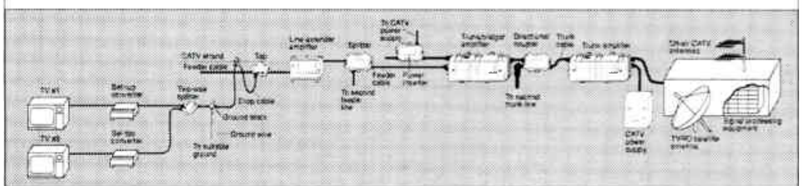

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ment and channels from supertrunks requiring demodulation.

A baseband signal does not require as much isolation as does an IF signal due to its lower frequency. However, it is still a good idea to use high quality cable such as headend or double-shielded video cable. The broadcast industry has standardized video levels to 1 volt peak-to-peak, causing less work and confusion when dealing with baseband signals. Baseband signals also can be looped through high impedance networks called "video bridging," resulting in less wiring and no need for amplification. When using video loop-through, be sure to terminate the last piece of equipment in the chain.

Unfortunately, when implementing baseband switching, it does require two separate wires to be run per channel: one for video and the other for audio. Often, larger subscriber headends require smooth switching without vertical rollover or tearing. This requires a baseband switcher with vertical interval switching capability. A switcher with this feature will only switch during the video signal's vertical interval. (Remember that the vertical interval portion of the TV signal is the time when the electron beam is blanked out and returns to the top of the screen of the television to scan again; this is the same time when switching occurs, thus appearing to be transparent to the viewers.)

RF switching

The last method—RF switching—is seldom used in headends; there are several reasons why. First, most headend RF signals are at a high operating level, making them prone to ingress and egress. The switcher must be well-shielded to prevent signal leakage. Even with a switcher providing 90 dB shielding it is hard to control a signal being switched at +60 dBmV. Second, RF switchers need good isolation between ports, due to the high frequencies being switched. Poorly isolated switches can cause interference from one port to another. Last, the RF switchers often have a good return loss and if not, the signal that is being switched will be degraded by reflections.

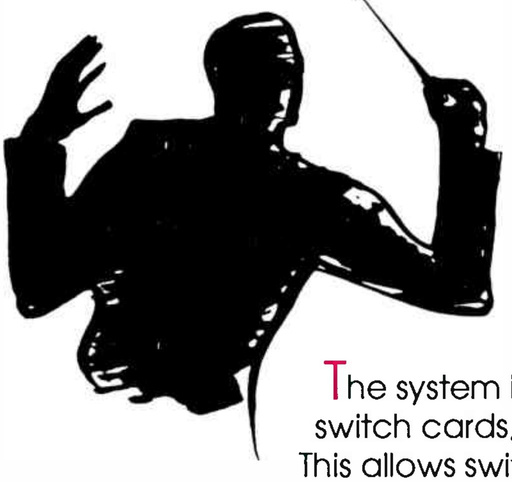
Due to the high frequency nature of CATV signals all of these requirements make RF switching more difficult and costly for the cable operator than IF or baseband. For these reasons I recommend that RF switching be avoided when possible.

If you follow these recommendations and precautions, you will find that switchers can provide your headend with a high quality signal for syndex.

I N T R O D U C I N G

Orchestrator I

Syndex Switcher



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The system is user-friendly with up to 16 two-position switch cards, addressable from a common buss, available. This allows switching in an independent SPDT arrangement.

Rack mounted assembly communicates with a remote PC for scheduling updates and switching of video or RF signals and associated audio. Flexibility in the system allows switching orders to be carried out without requiring the PC to be on-line.

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Both the switch units and the computer are the latest solid state technology.

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Telcos and FTTH activities

By Lawrence W. Lockwood
President, TeleResources
East Coast Correspondent

Telephone companies are acutely aware of the significance of FTTH (fiber to the home) for their future business and many are conducting experiments in this area. Recently there have been two excellent review articles on FTTH[1,2], from which much of the data in the following has been drawn.

A thorny problem in the telephone companies' considerations on this issue is that their present copper pair plant can adequately handle all current POTS (plain old telephone service) and anticipated data devices for the residential market. Therefore, until the installation costs of fiber systems come down to below that of copper systems, even new housing and/or business developments will not justify fiber installation rather than copper for POTS alone. Richard Snelling, executive vice president of networks for Southern Bell, has predicted that the crossover point in costs where FTTH will equal or be less than copper will occur in 1992. There are many who think it will take longer. However, if Snelling proves right it means only that *new* installations will be cost justifiable. It does not address the real world of the huge installed present telephone network. More than POTS will have to be offered to justify such a huge replacement cost. And there's the rub for the CATV business because the most obvious addition to be offered as the cost justification is television to the home over the fiber.

"Telephone companies are acutely aware of the significance of fiber to the home for their future business."

The big question for the telcos remains: Should the delivery of video on FTTH be digital or analog? Until recently the telephone view was firmly that it must be digital—and there is no question that it is technically feasible but the problem of economic justification is formidable.

Table 1: CCITT Rec. G.702 asynchronous digital hierarchies (in Mbps)

Level	N. America	Europe	Japan
1	1.544 (DS1)*	2.048	1.544
2	6.312 (DS2)	8.448	6.312
3	44.736 (DS3)	34.368	32.064
4	—	139.264	97.728

*DS stands for digital signal

There are many in the telephone camp who feel that perhaps an analog delivery may be a reasonable temporary methodology until digital schemes become economically feasible.

Digital standards

A brief review of the current and proposed standards for digital transmission

Table 3: Telco fiber to the home activities

Holding company	Operating company	Developer	Cable TV company	Time frame
BellSouth	Southern Bell	Heathrow Development Corp.	Heathrow Telecommunications	9/89 (integrated voice & video)
BellSouth	Southern Bell	Genstar Southern Development Inc.	Hunter's Creek Cablevision, Genstar and Scientific-Atlanta	1986 (CATV began, upgrades continue)
BellSouth	South Central Bell	Boyle Investment of Memphis	POTS only	11/88
BellSouth	Southern Bell	—	POTS only	Began 8/89
BellSouth	Southern Bell	—	POTS only	4th quarter 1989
BellSouth	Southern Bell	—	POTS only	Began 8/89
BellSouth	Southern Bell	—	POTS only	Began 8/89
BellSouth	Southern Bell	—	POTS only	8/89
BellSouth	Southern Bell	—	POTS only	1st quarter 1990
BellSouth	Southern Bell	—	POTS only	1st quarter 1990

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*DMS-100, ESS, 2EAX and BT are all electronic switching systems (digital).
**SLC stands for subscriber loop carrier; TPON stands for telephony passive optical network.

is in order. In the '60s, before fiber, AT&T established data rate transmission standards that were incorporated into CCITT (International Telegraph and Telephone Consultative Committee) standards with slightly different versions in Europe and Japan. (See Table 1).

A new hierarchy of high speed data transmission standards for fiber (Table 2) were initially proposed in February '85 by Bellcore called SONET (synchronous optical network)[3]. Based on the SONET concept and work performed in the T1 Standards Committee in the United States, the CCITT adopted a set of bit rates for a new synchronous digital hierarchy (SDH) for transmission on single-mode fiber. The lowest SDH rate is 155.52 Mbps (STM-1 or synchronous transmission multiplex Level 1), followed by 622.08 Mbps (STM-4) and 2.488 Gbps (STM-16). The probable next higher SDH level of approximately 10 Gbps, or STM-64, has yet to be standardized. In the United States, the 51.84 Mbps SONET rate carries the 45 Mbps DS3 rate of the North American digital hierarchy. Recently CCITT Study Group XVIII has been investigating broadband interfaces at about 150 and 600 Mbps, which will evolve into a broadband integrated services digital network (B-ISDN) standard.

An example of a conceptualization of a fiber network using the asynchronous transfer mode (ATM) or B-ISDN[1] is shown in Figure 1. It is a double-star local access network using B-ISDN. In the central office, digital signals belonging to a variety of service offerings are merged into 155 Mbps bit streams that can be synchronously multiplexed into 2.5 Gbps feeder signals for transmission to a remote terminal (RT). At the RT, data streams from demultiplexed 155 Mbps signals are merged to conform to the service requirements of a particular end user. Proposed services contained in the 155 Mbps data streams may include, for example, a flexible combination of 16 kbps meter reading and home monitoring data and one or more 45 Mbps data or NTSC video signals. A 155 Mbps data stream may contain a high definition TV (HDTV) signal encoded around 130 Mbps. Up to four HDTV

Table 2: Levels of the SONET signal hierarchy

Level*	Line rate (Mbps)
OC-1	51.84
OC-3	155.52
OC-9	466.56
OC-12	622.08
OC-18	933.12
OC-24	1244.16
OC-36	1866.24
OC-48	2488.32

*OC stands for optical carrier

Location	Number of residences	Switch*	Electronics supplier	Transmission sys./equip**	Transmission mode	Cable & fiber supplier/type	Notes/ services
North Orlando, Fla.	55 now, 256 targeted	Northern Telecom DMS-100	Northern Telecom	LEDs and laser diodes	Single-mode digital	Northern Telecom for central office to residences; Optical cable Corp. within homes	
South Orlando Fla.	250	—	Scientific-Atlanta	LEDs	Single- and multimode	AT&T SM 48-fiber cable from headend to selector node; 5 multimode 144-fiber cables	
Riveredge, Tenn.	54 so far, 99 targeted	AT&T 1A-ESS	AT&T System SCC-5 system and terminal	FT-series 1.7 Gbps transmission system	Single-mode digital, analog for POTS	1 single-mode fiber	Same technology is installed in Memphis telephone system
Governor's Island, Lake Norman, N.C.	42 targeted	AT&T 5-ESS	AT&T	AT&T Series 5 SLC	Single-mode digital	1 single-mode fiber	
Lakeview Terrace, Charleston, S.C.	100	AT&T 5-ESS	AT&T	AT&T Series 5 SLC	Single-mode digital	1 single-mode fiber	
The Landings, Skidaway Island, Savannah, Ga.	192	AT&T 5-ESS	AT&T	AT&T Series 5 SLC	Single-mode digital	1 single-mode fiber	
Hunter's Creek II, Orlando, Fla.	117	AT&T 5-ESS	AT&T	AT&T Series 5 SLC	Single-mode digital	1 single-mode fiber	
Coco Plum, Miami, Fla.	45 initially, 300 eventually	AT&T 5-ESS	AT&T	AT&T Series 5 SLC	Single-mode digital	1 single-mode fiber	
The Summit, Columbia, S.C.	285	AT&T 5-ESS	AT&T	AT&T Series 5 SLC	Single-mode digital	1 single-mode fiber	
Morrowcroft, Charlotte, N.C.	50 now, 90 eventually	AT&T 5-ESS	AT&T	AT&T Series 5 SLC	Single-mode digital	1 single-mode fiber	

video signals, multiplexed together with other services, may be transmitted to a customer at 622 Mbps.

All this detailed activity more than just indicates that telephone entities here and abroad are very serious about the businesses involving digital transmissions via fiber. Much work has been done to incorporate video transmission in these standards, even though as previously noted, they might use analog initially for any television or FTTH.

FTTH trials

More than 4 million fiber kilometers (2.5 million miles) have already been installed in the public telecommunications network in the United States alone. A number of FTTH experiments are being conducted by various phone companies here and abroad (see Table 3). As is shown in the table most of these FTTH experiments are POTS only but a few incorporate television delivery to the home as well.

Hunter's Creek: At Southern Bell's Hunter's Creek near Orlando, Fla., the earliest U.S. FTTH test bed, a star architecture implemented by AT&T provides two 45 Mbps standard (NTSC) TV signals (out of 36) on two multimode fibers to customers—thus representing the first digital video distribution system. In addition to 251 homes presently served on fiber, 166 homes are served on coaxial cable. A high degree of customer acceptance has been found for the reliable and high-quality digital video service.

Heathrow: This trial, also performed by Southern Bell near Orlando, involves a star network architectue for the combined transport of POTS, ISDN and video services on two single-mode fibers. As part of this trial, Northern Telecom International will connect a total of about 3,200 homes by the early 1990s. The project includes, for the first time, residential ISDN services using 5.12 Mbps transmission in the 890 and 780 nm wavelength regions for downstream and upstream directions, respec-

"Large scale fiber backboning (by the CATV industry) would provide a great first advantage in any possible contest."

Table 3: Telco fiber to the home activities

Holding company	Operating company	Developer	Cable TV company	Time frame
GTE Corp.	General Telephone of California	Existing community	—	2nd quarter 1990
				2nd quarter 1990
				2nd quarter 1990
GTE Corp.	General Telephone of California	Existing community	POTS	1989
GTE Corp.	General Telephone of California	Existing community	Apollo Cablevision is leasing bandwidth	Main Street and pay-per-view 2nd quarter 1990
Contel	Contel Service Corp.	—	POTS only	4th quarter 1988
Ameritech	Illinois Bell	—	POTS only	Late 1989
Bell Atlantic	New Jersey Bell	Rieder and Sons	POTS only	8/88
Bell Atlantic	Bell of Pennsylvania	Rehab	Helicon	1st quarter 1989
Southwestern Bell	Southwestern Bell Telephone	Cedar Creek Properties Inc.	—	10/89
Southwestern Bell	Southwestern Bell Telephone	—	POTS only	1989
Southwestern Bell	Southwestern Bell Telephone	—	Sammons	4th quarter 1989
USWest	Northwestern Bell	—	POTS only	2nd quarter 1989
USWest	Mountain Bell	—	POTS only	1990
British Telecom	British Telecom	—	Single-line telephony passive optical network (TPON); voice only	Start 9/90
British Telecom	British Telecom	—	—	Start 9/90
British Telecom	British Telecom	—	—	Start 9/90
British Telecom	British Telecom	—	Broadband distributed star; voice, TV and other services	Start 3/90
Nynex	Raynet	—	POTS only	1989

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*DMS-100, ESS, 2EAX and BT are all electronic switching systems (digital).
**SLC stands for subscriber loop carrier; TPON stands for telephony passive optical network.

Location	Number of residences	Switch*	Electronics supplier	Transmission sys./equip.**	Transmission mode	Cable & fiber supplier/type	Notes/ services
Cerritos, Calif.	705 targeted; 600 for POTS only, 100 for Stell TV, and 5 for "jukebox video"	—	American Lightwave Systems	—	Analog video, digital POTS	36 video channels and POTS over fiber-optic supertrunk; hybrid video/voice/data over single-mode fiber	
Cerritos, Calif.		—	GTE Labs	—	Digital	1 single-mode fiber	Switched video/ video on demand
Cerritos, Calif.		—	AT&T Network Systems	—	Digital	1 single-mode fiber	Voice, no TV
Cerritos, Calif.	Existing network	GTE 2EAX	—	—	Analog	Twisted pair	
Cerritos, Calif.	250-300 targeted now, potentially 16,000	—	GTE Services Corp.	—	Digital	Coaxial cable	
Ridgecrest, Calif.	100 targeted	AT&T 5-ESS	AT&T Phoenix, Ariz.	AT&T Network Systems	Single-mode digital	Single-mode fiber	House wiring as it normally is
Chicago's northwest suburbs	300	—	—	—	Digital	2 single-mode fibers	Fiber-optics set up in "active pedestal" format to get cost down to POTS
"Princeton Gate," South Brunswick, N.J.	50 so far, 104 targeted	AT&T 5-ESS	AT&T Network Systems	Laser diodes	Digital	Single-mode fiber	4 dual lines per residence
Perryopolis, Pa.	80-100	Alcatel analog	Alcatel N.A.	—	Analog video; digital voice over multimode	62.5/125 micron multimode fiber	
Cedar Creek, Olathe, Kan.	260	—	—	AT&T Series 5 SLC	Digital	Single-mode fiber	Fiber-to-the-pedestal
Leawood, Kan.	50-100	AT&T AESS	AT&T DDM-1000 time-division multiplexer	Laser diodes	AT&T digital subscriber loop carrier, digital/ analog	AT&T single-mode fiber/twisted-pair copper "mixed" cable	
Mira Vista, Ft. Worth, Texas	80	—	American Lightwave Systems	American Lightwave Systems	ALS FM analog video and POTS	2 single-mode fibers	Fiber-to-home switched video
Mendota Heights, Minn.	97 targeted	AT&T 5-ESS	AT&T Network Systems	—	—	Single-mode fiber	
Desert Hills, Scottsdale, Ariz.	102 targeted	AT&T 5-ESS	AT&T	AT&T Series 5 SLC	Digital	Single-mode fiber	
Bishops Stortford, U.K.	128 customers	BT	British Telecom	BT passive WDM (TPON)	Single-mode digital	1 single-mode fiber	
Bishops Stortford, U.K.	125 business customers	BT	British Telecom	BT passive WDM (TPON)	Single-mode digital	1 single-mode fiber	Business TPON; voice only
Bishops Stortford, U.K.	128 customers	BT	British Telecom	BT passive WDM (TPON)	Single-mode digital/copper	1 single-mode fiber	Single-line street TPON; voice only
Bishops Stortford, U.K.	125 residential customers	BT switched star	British Telecom	BT passive WDM (TPON)	Single-mode digital	1 single-mode fiber	Similar to Westchester cable TV network in U.K.
Lynnfield, Mass.	100	—	—	—	—	85/125 micron multimode fiber	Fiber-to-the-curb

tively, using Northern Telecom's DMS100 switching system.

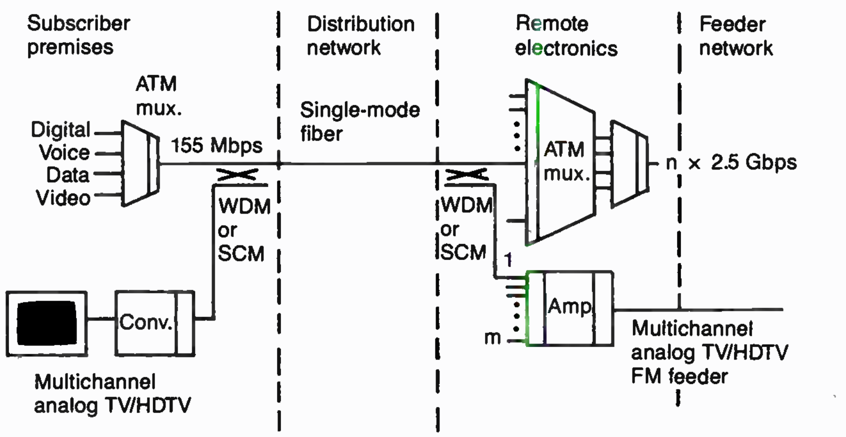
Up to four CATV channels (selectable from 64 offered) are simultaneously transmitted at 1,300 nm within a 435 Mbps downstream channel. Channel selection is performed with a 5.12 Mbps upstream control signal (also operating at 1,300 nm). The inclusion of HDTV as part of the services offerings is being studied. This trial also will include business and commercial customers as well as residential.

Perryopolis: In this town, Bell of Pennsylvania is offering POTS and CATV service with multimode fiber/LED technology supplied by Alcatel. Out of a total 90 subscribers, 60 will receive both POTS and CATV service, and 30 POTS service only. In this trial, two video channels are subcarrier-multiplexed, with one as an AM vestigial sideband signal at 38.9 MHz and the other as an FM signal at 20.7 MHz. Voice, data and signaling are subcarrier-multiplexed below 10 MHz. Perryopolis is the first location where POTS and CATV were offered on fiber simultaneously.

Cerritos: Here, General Telephone of California is installing a CATV system for up to 5,000 customers using both optical fiber and coaxial cable. Some of the fibers carry POTS as well as broadcast and switched video for 28 channels of pay-per-view programming. For a video-on-demand trial service to five customers, GTE is planning to provide 20 simultaneous digital video channels using subcarrier multiplexing techniques on fiber (in the 2 to 6 GHz frequency band).

Mira Vista: In this community of Fort Worth, Texas, Southwestern Bell, in cooperation with American Lightwave Systems, supplies about 100 homes with four analog FM video channels (out of a total of 61 channels offered) and two digital voice channels. Both voice and video services are subcarrier-multiplexed in a 200 MHz signal. The voice capabilities include both standard POTS and narrowband ISDN services. The trial offers impulse pay-per-view and is compatible with stereo and HDTV transmission. The upstream signal (on a separate fiber) carries two digital voice channels.

Figure 1: Schematic of broadband integrated services digital network with analog overlay



SCM stands for subcarrier multiplexing
WDM stands for wavelength division multiplexing

Conclusions

It is apparent from the extent of the work by the telephone companies in research and development, standards activities and FTTH trials and experimentation that although they are not ready to jump immediately into large scale FTTH they are seriously investigating all possibilities and that most definitely includes television to the home. If the CATV industry is equally serious about protecting its business then a large scale fiber backboning would provide a great first advantage in any possible contest.

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[1]"Fiber-to-the-home," P. Kaiser and P. Shumate, *Optic News* (Optical Society of America), October '89.
[2]"Special Report—Fiber in the Loop," S. Salomone, *Lightwave*, October '89.
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Counting to 6,000

By Jack Trower
President, Society of Cable Television Engineers

We are winding down what has to be considered a very successful year for the SCTE. Recently we announced that the number of members in the Society had passed the 6,000 mark. This indicates that we have increased our membership by 1,000 since the end of 1988. I do not expect this to be the final year-end number.

This tremendous growth is the result of a lot of hard work by dedicated volunteers who felt the need to spread both theoretical and practical technical knowledge of cable TV and broadband communications to as many people who wanted and needed that knowledge. It was made available to anyone who needed it—Society member or not.

Expanding exposure to non-members has resulted in the successful chapter/meeting group programs. We now have a total of 53 groups, and with this increase in membership we have seen the emergence of many new names and faces.

With all these new faces come many new ideas, which are what keeps any organization active and growing. But even with new goals and ideas we can't forget those tried-and-true methods that have been developed over time and have made the Society the success that it is. We cannot forget the ideals of that handful of individuals who, against a lot of odds, created this great organization.

One of the advantages (or disadvantages) I have as president of the Society is hearing from the "new idea" people and the "tried-and-true" people. It is challenging to me because I was a member of the Society when it was a struggle to get programs started, since only a few people were willing to do the work. I now know how much easier it is to get new programs started, and I marvel at the number of people now willing to be a part of the effort. The most challenging part will be blending all of these tried-and-true and new ideas for the good of the Society and this industry.

To try to meet this challenge the board of directors has approved a committee to review existing programs, policies and procedures for the purpose of making recommendations for changes, continuation or even deletions. At the same time this committee is to look into what new programs, policies or procedures the Society should adopt for the future.

Another committee also was appointed by the board to review all of the financial plans of the Society and to make recommendations for new programs and what modifications may be needed for existing ones. These committees have been asked to look at these goals in one-, three- and five-year plans, so that a map for the future of the Society can be laid out. I would urge all Society members to make any recommendations you have to your region director, the director at-large or to the national staff. Your suggestion may be one of the most important to the Society.

I would like to thank all of you for the support I have received in my first six months as president and to send from my wife Kelly and myself our wish for a joyous holiday season for all of you. Happy Holidays.

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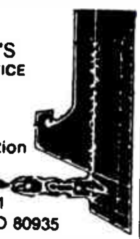

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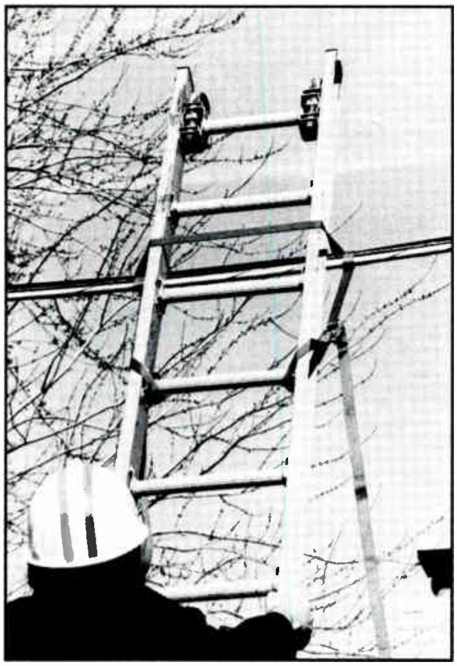

Strand tie

Independent Technologies is offering the Sky-Hook strand tie, which secures a ladder against aerial strand while preventing lateral movement and slide. The company also recommends it for tying off the top of a ladder against a pole.

The product, part of the company's Safe-Tie family of ladder safety products, is made of nylon 66 material and corrosion resistant hardware. Setup is said to be less than 60 seconds with take-down being faster. A carrying case is included.

For further information, contact Independent Technologies, 11414 W. Center Rd., Omaha, Neb. 68144, (402) 330-3045; or circle #137 on the reader service card.

Connector integrity

According to PECA, its Conn-Tact provides three points of contact and two points of tension to ensure drop connector integrity. The product is said to attach easily to new or existing cable drops to prevent a connector from becoming loose. Long-term exposure to vibration, wind-induced cable movement, and expansion and contraction make F connectors vulnerable to working loose.

The product's design takes advantage of the forces produced by properly installing an F connector. The tension is sufficient to secure the connector's mechanical integrity. If a connector works loose under extreme conditions, the tension is sufficient to ensure RF integrity.

For more details, contact Professional Electronic Component Assembly, 592 Winks Lane, Bensalem, Pa. 19020, (215) 245-1550; or circle #112 on the reader service card.

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BATTERY VOLTAGE						
BATTERY VOLTAGE (10min)						
AC OUTPUT VOLTAGE (10min)						
RETURN TIME TO LINE MODE						
WATER LEVEL						
CLEAN TERMINALS						
INITIALS						

CATV cards

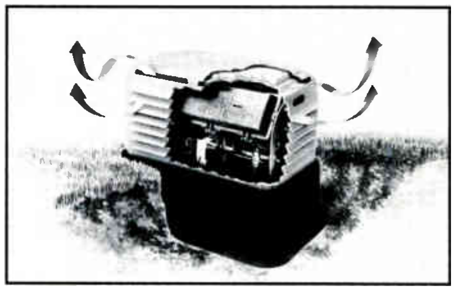
Altair announced a line of weather resistant CATV maintenance cards laminated with 5 mil plastic that (according to the company) provides protection from extreme temperatures and moisture. The cards have strapping holes for affixing to modules, wiring harnesses, handles, etc. Trunk amplifier, line extender and standby supply cards are currently available. Specialty cards are available on request.

For additional details, contact Altair, P.O. Box 460803, Aurora, Colo. 80015, (303) 699-1634; or circle #121 on the reader service card.

1 GHz cable

The T10 line of drop and semiflex cable was introduced by Times Fiber. The drop cable will be swept tested to 20 dB SRL to 1 GHz on RG-6 and RG-59 cables; the semiflex cable will be swept tested to 30 dB SRL to 1 GHz for virtually all types of semiflex cable including the company's TX series.

For further details, contact Times Fiber Communications, 358 Hall Ave., Wallingford, Conn. 06492-0384, (203) 265-8500; or circle #135 on the reader service card.



Heat dissipation

Channell Commercial announced its Series 5 heat dissipation covers for use with the company's plastic enclosures for CATV equipment. The insulated, dual cavity covers are said to be 75 percent more efficient than metal in reducing temperature extremes in amplifiers (especially on the IC boards and power supplies).

The covers do not need painting and each comes with a ground skirt that acts as a foundation support system for active equipment and allows for storage of excess cable. Also included are hot-dipped galvanized bracketry, the hardware necessary for mounting equipment without modification and the applicable security device.

For more details, contact Channell Commercial, 27040 Ynez Rd., Rancho California, Calif. 92390, (800) 423-1863; or circle #129 on the reader service card.

Modulator

ISS Engineering announced its third

Reader Service Number 75.

generation frequency agile modulator. According to the company, the Series III features a 10 dB improvement in in-band carrier-to-noise and a 20 dB improvement in out-of-band C/N. The unit allows the use of a 70-channel cable system without filtering and is said to run cooler because of a higher level of integration than previously available.

For more information, contact ISS Engineering, 1047 Elwell Ct., Palo Alto, Calif. 94303, (415) 967-0833; or circle #113 on the reader service card.

LAN switches

According to CaSaT Technology, its APS-2220 family of local area network protection switches for IEEE 802.3, 802.4 and proprietary broadband networks automatically connect alternate (redundant) backbones in the event of primary LAN backbone failure. They can be used with networks operating from 50 to 500 MHz and feature automatic self-diagnostics, alarm threshold adjustability and front panel alarm indication.

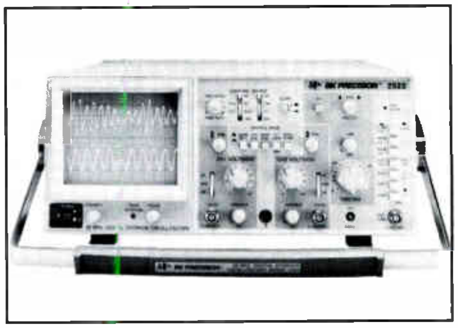
An audible warning to notify LAN administrators that automatic backbone switching has taken place is available. A front panel key switch enables the user to override the automatic function of the APS for diagnostic and setup operations.

More information is available from CaSat Technology Inc., 10 Northern Blvd., Amherst, N.H. 03031, (603) 880-1833; or circle #136 on the reader service card.

Tool kit

Jensen Tools announced its Model JTK-87 professional field engineer's kit, available in over 23 case styles and sizes. All kits have two removable pallets with deep model cases featuring a gate-swing style that allows easy access to additional tools or equipment carried in the bottom of the case.

For more information, contact Jensen Tools, 7815 S. 46th St., Phoenix, Ariz. 85044, (602) 968-6241; or circle #127 on the reader service card.



Oscilloscope

According to B&K-Precision, the Model 2522 portable digital storage/analog oscilloscope offers 10 megasample/second real-time sampling on each channel, 20 megasample/second repetitive sampling and permits display of single-shot events to 1 megasample/second equivalent time sampling. The product is said to provide full 20 MHz dual trace analog scope operation by touching a button. It also features up to 1 mV per division vertical sensitivity and V-mode for viewing two signals unrelated in frequency.

With the product in the digital mode, the user can freeze a waveform or expand stored waveforms by X10 for closer examination as well as using "dot joining" for linear interpolation between samples. In analog operation, the user can select from 20 calibrated sweep time ranges with full variable adjustment between calibrated ranges. A X10 magnifier is provided with the analog operation.

For more details, contact B&K Precision, 6470 W. Cortland St., Chicago, Ill. 60635, (312) 889-1448; or circle #115 on the reader service card.

FDDI adapter

Fotec announced that its Model A251 FDDI adapter allows direct usage of the company's fiber-optic instruments with the new industry standard FDDI connector. When being used with the adapter, Fotec instruments can test all FDDI cable plants and nodes directly without hybrid adapter cables.

According to the company, the adapter system can be used on both meters and sources to adapt instruments to over 60 different connectors and bare fibers. The unit's design is said to incorporate accurate placement of the FDDI ferrule, retain the FDDI snap-in feature and allow rotation of the entire adapter to provide full access to instrument controls. It is slightly larger than a standard FDDI bulkhead connector.

For further information, contact Fotec, 529 Main St., Box 246, Boston, Mass. 02129, (617) 241-7810; or circle #128 on the reader service card.

CLI software

Trilithic introduced its CLICS cumulative leakage index computing software that allows multiple entry modes for μV/m, dBmV and dB referenced to 20 and 50 μV/m. Real-time, on-screen displays are updated with each entry for leaks per mile, CLI of infinity, CLI 3000, leak level and leak fix categories. A report generator provides Federal Communications Commission logs, repair worksheets and other summaries.

For more details, contact Trilithic, 3169 N. Shadeland Ave., Indianapolis, Ind. 46226, (317) 545-4196; or circle #125 on the reader service card.

AD INDEX

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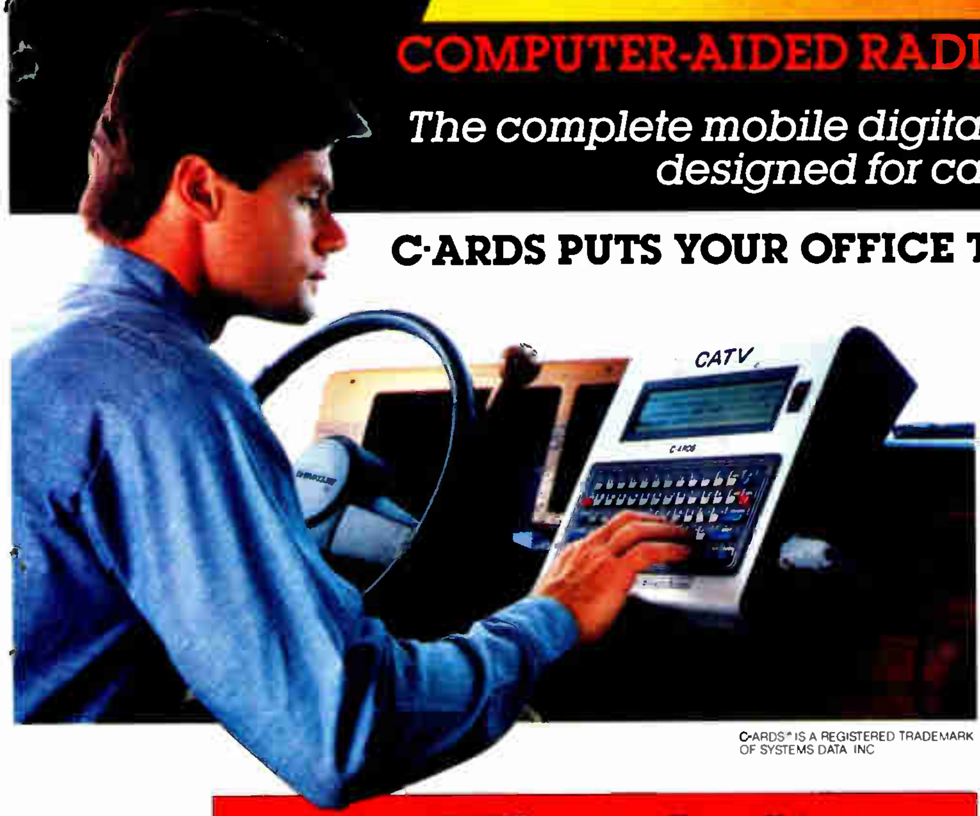
The complete mobile digital communications system designed for cable television companies.



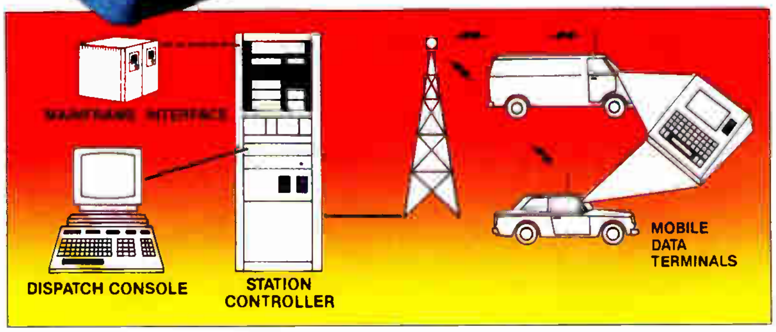
C-ARDS® IS A REGISTERED TRADEMARK OF SYSTEMS DATA INC

C-ARDS PUTS YOUR OFFICE TECHNOLOGY ON WHEELS.

C•ARDS puts all the information available at the office within easy reach of your field personnel. Data is transmitted through two-way radios between a dispatch center and vehicle-mounted mobile data terminals. Voice communication is replaced with faster, more efficient digital communication.

Within seconds, work order and account information from your billing system is sent directly to mobile data terminals. And orders are updated in your billing system as soon as they are completed in the field.

C•ARDS allows field personnel to initiate an automated call before going to their next stop. This feature reduces "not homes" thereby improving productivity and customer satisfaction. And since your existing radio system can be utilized, C•ARDS is a cost-efficient answer to greatly improved communications.



The C•ARDS System—the dispatch console includes a microcomputer which houses specially-designed software, terminals, keyboards and printers. The station controller contains equipment which interfaces the microcomputer to your billing system and existing radio base station. Mobile data terminals in each vehicle enable operators to communicate with the dispatcher, send information and access data stored in the microcomputer or a host computer.

C•ARDS gives you these immediate advantages:

- ***Reduced Paperwork***
- ***Enhanced Communications***
- ***Faster Response Time***
- ***Improved Customer Satisfaction***
- ***Pinpoint Management Control***
- ***Direct Link to Your Billing System***
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How did it all start?

By Archer S. Taylor
Senior Vice President of Engineering
Malarkey-Taylor Associates

If Ed Parsons and John Walson and Martin Malarkey and Bob Tarlton had not started CATV in 1948-49, someone else would have had to do it. It is truly amazing that the TV professionals failed to respond to the burgeoning public demand to see Milton Berle and Red Buttons, on television, live. But let's go back to the beginning—way back.

The origins of TV broadcasting

In March of 1925, a Scotsman named John Logie Baird showed TV images in a London department store, produced with a Nipkow disk providing only eight scanning lines and a total of 400 pixels per frame. Three months later, Charles Jenkins of Ohio gave a public demonstration in Washington, D.C, with 48 scanning lines. The British Broadcasting Co. (BBC) actually started experimental broadcasting in 1929 with 30-line images. Six years later, RCA demonstrated to the Radio Manufacturers Association a fully electronic system with 343 lines, and the pressure was on for industrywide standards.

Acting upon the recommendation of the National Television System Committee (NTSC), the Federal Communications Commission (FCC) in April 1941 adopted the standards that are still in service today, nearly half a century later. It specified 525 lines per frame, 60 interlaced fields per second, 6 MHz channels to include the vestigial sideband AM (amplitude modulated) visual carrier with 4 MHz video and FM (frequency modulated) aural carrier, five VHF channels at 54-88 MHz and seven more at 174-216 MHz, and the synchronizing format still in use. It is all there. Only the color has been added.

Several experimental TV transmitters were in operation in July 1941, when the new standards became effective. Five months later, the entire industry was brought to a screeching halt by the World War II freeze on non-essential technology. By the end of the war in 1945, the enormous potential of television had been recognized, not only by radio broadcasters and receiver manufacturers but by the public as well. Radio broadcasters feared for their commercial lives unless they could get on board. Receiver manufacturers foresaw an exploding market as the public rushed to purchase the new picture radios.

Applications for new TV station permits literally inundated the FCC, forcing it in September 1948 to reimpose the war-time freeze it had only recently lifted. The 12 VHF channels allotted for television in 1941 could not even begin to accommodate the apparent demand. When the post-war freeze was lifted in April 1952, 70 new channels were made available in the UHF band with the hope and expectation that eventually all television would be transmitted at UHF.

Into the midst of this confusion in 1949 the president of RCA, General Sarnoff, tossed the prospect of compatible color TV. The battle between the giants, RCA and CBS, over color TV standards still further complicated the post-war development of TV broadcasting but also served as an additional stimulant to the public excitement over television.

Meanwhile, however, the TV receiver manufacturers were tooling up for the coming boom. Seven million TV sets were being produced each year, even during the freeze, to be shipped to appliance stores and mail order houses. By 1949, the second year of the post-war freeze, the growth of TV broadcasting stalled with only 100 operating TV stations. The great majority of people who did not live near one of these stations could only envy those who did.

"It is perhaps speculative to suggest that cable TV would not have happened but for the war-time and post-war freeze periods."

The origins of cable TV

Relentless pressure was generated by the manufacture of 7 million TV receivers every year, stimulated by a flood of news stories about the new radio with pictures that might even be in color. In December 1948, three months after the freeze was reimposed, Ed Parsons, a radio station operator and electronics hobbyist in Astoria, Ore., found a hot spot near his home where he could receive signals from KRSC-TV, which had just gone on the air in Seattle 125 miles away. To accommodate his neighbors, he ran some coaxial cable from rooftop to rooftop until the fire department forced him to move his wires to the telephone poles.

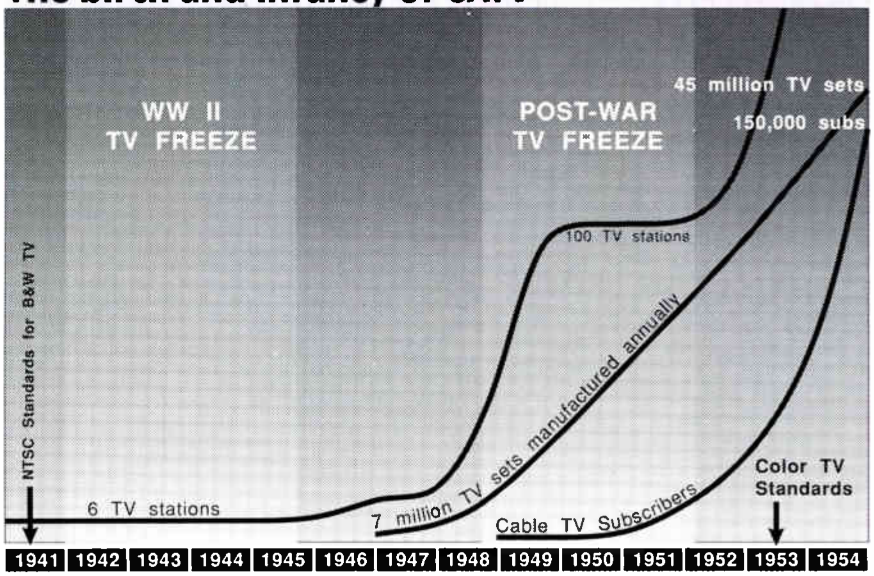
Thus was born the community antenna TV (CATV) industry.

At about the same time, John Walson, an appliance and service merchant in Mahanoy City, Pa., was trying to find a way to sell a consignment of TV receivers. He discovered a hilltop outside of town where television could be received from Philadelphia. He nailed twin-lead to tree trunks and fence posts and brought the signals into town. The first rainstorm short-circuited the twin-lead and forced him to change to coaxial cable. Community TV was under way on the East Coast.

By 1949, Jerrold had adapted its master antenna TV (MATV) amplifiers to build a CATV system for Bob Tarlton in Lansford, Pa. At the same time, the RCA Antennavision MATV amplifier was adapted to CATV for Martin Malarkey's music store in Pottsville, Pa., so that he could sell TV sets as well as radios and musical instruments.

Until the freeze was lifted in April 1952,

The birth and infancy of CATV



CATV distribution systems were confined to places like Astoria and Mahanoy City, where television could only be received by means of a shared community antenna. This was "classical" CATV, and subscriber counts frequently reached 80 to 90 percent (or more) of homes passed. As the number of TV stations increased, at an average pace of about 30 new TV stations a year, CATV became recognized as a means for receiving any programming not otherwise available. Where several TV broadcast programs could be received directly over the air without cable, subscriber counts were likely to be only half of the homes passed, more or less, depending on how much new programming was available on cable.

It is perhaps speculative to suggest that cable TV would not have happened but for the war-time and post-war freeze periods that denied the service to so many people, while stimulating both the public excitement and the manufacture of TV receiver sets. A look at the accompanying figure suggests that there must have been an impact from putting 7 million new TV sets on the market every year during the very period when the availability of TV programming was limited to 100 TV stations. Something had to happen. While the FCC struggled with its problems, hopeful would-be TV broadcasters could only wait patiently. Meanwhile, manufacturers kept sending out TV sets to an excited public.

Broadcasters didn't think of it and later kicked themselves for not doing so. Telephone companies claimed invasion of their territory but did nothing about it—and now would like to take over. So, it was the amateurs, hobbyists, electronic repairmen, appliance dealers and other small business people who did the job. For some, it was an entrepreneurial venture that paid off handsomely; for most it was community service that provided its own reward.

Three years in passing

By Walter S. Ciciora, Ph.D.
Vice President of Technology
American Television and Communications Corp.
Stamford, Conn.

This is my 33rd consecutive monthly column. In addition, I have written several longer pieces over the last 2½ years. Slightly more than three dozen of my articles have been published in *CT*; this is something I have enjoyed doing. I have found this to be most rewarding, particularly when readers have commented on something I've written. I'd like to review the past three years of columns.

Advanced television (ATV)

By far the most space has been devoted to ATV and high definition TV. This has been the high energy topic of the last few years and will continue to be important for some time to come. It has significant strategic as well as operational ramifications for cable. Politics and regulation will play important roles.

We've discussed what it is, what it is not, how it impacts cable, what the telcos are doing and the implications of consumer electronics. There have been a number of myths put forth. Some have been out of ignorance, some are self-serving and others are probably generated by maliciousness. The myths spawned by ignorance include: the "open architecture TV," the hope that it might be possible to have fully NTSC-compatible HDTV in the same 6 MHz as the NTSC signal, that cable may have true HDTV without the need for bandwidth expansion or signal quality improvement, and the belief that computer manufacturers will displace TV manufacturers. Anyone familiar with the margins of the two businesses has to laugh at this last notion. The self-serving myths have to do with overly optimistic predictions of rapid penetration. Malicious myths center on claiming that only telcos can deliver ATV and only via digital techniques over fiber.

I am very comfortable that cable is in the best position to deliver HDTV when subscribers want it. It is certainly not clear that they want it now. It is also not clear that they will have a strong taste for it when they learn the costs. However, eventually it will happen and will be an important part of our business.

Our ATV priorities must include 1) preserving our technical ability to compete with other media, 2) carrying the broadcasters' ATV signals in a quality and cost-effective manner, 3) continuing to serve the NTSC population of receivers for the foreseeable future and 4) accommodating cable's unique needs (such as addressability, scrambling, consumer electronics friendliness, etc.).

As technologists, the rest of our careers will be influenced by ATV and HDTV.

"Cable is in the best position to deliver HDTV when subscribers want it. It is certainly not clear that they want it now."

Consumer electronics interface

The second largest amount of space in this column has been devoted to the consumer electronic interface with cable. To some extent this topic captivates me because of my 17 years with Zenith; but that's not the only reason. When I go home and watch cable TV, I do it through the consumer electronics products I own. I am like all the other subscribers, subject to the same frustrations and inconveniences. The major difference is that I'm convinced the cable industry and consumer electronics industry can do something about this. I think progress has been made but much work remains. Only by working together on common goals striving toward common objectives can we make progress.

A lot of progress has been made on the MultiPort and on other interface aspects such as direct pickup reduction, and tuner capacity and performance. Work has begun on a method of program identification to make VCR usage much easier. The way is being paved for truly cable-ready ATV receivers.

Telephone companies

Because of the sensitivity of this topic, it has been approached with caution. Myths about the integrated services digital network (ISDN) and its broadband cousin, B-ISDN, have been explored and, I hope, exploded. Fiber to the home has been discussed for the massively expensive undertaking that it is. The recurring rumors of video over twisted pairs have been considered. Both analog and digital approaches come up from time to time. The "Paperback Movies" project at the Massachusetts Institute of Technology is a related subject. Movies on compact discs and downloaded by the telcos also are related topics. While the telco threat is a serious one, I hope things are now in better perspective.

Strategic views of technology

In all that I've written, I've tried to take a strategic viewpoint. A couple of columns dealt with the "S-Curve," which describes the introduction, maturation and obsolescence of technologies. Using this kind of thinking, we can better understand how the technologies that impact our businesses can be best managed.

Well, enough for now. I've enjoyed it and I hope that you have found some of this useful. I also hope to see you at some conference or meeting soon!