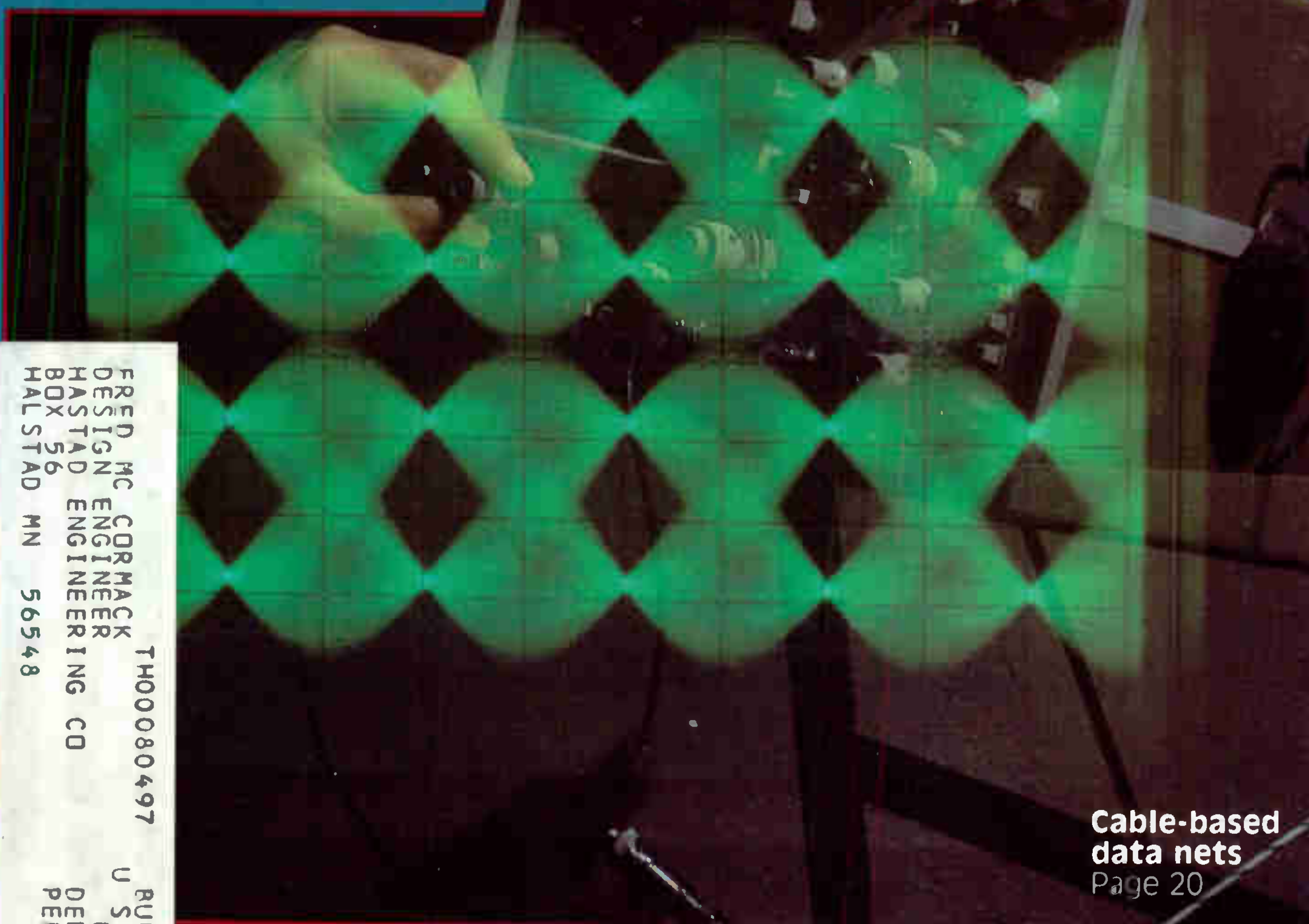
COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers



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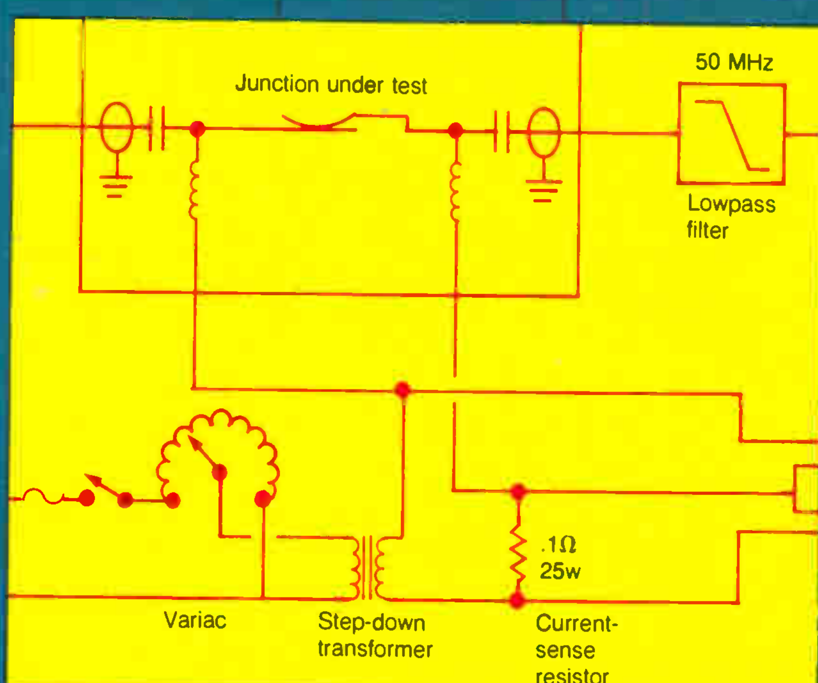

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Mr. customer
we hear you.

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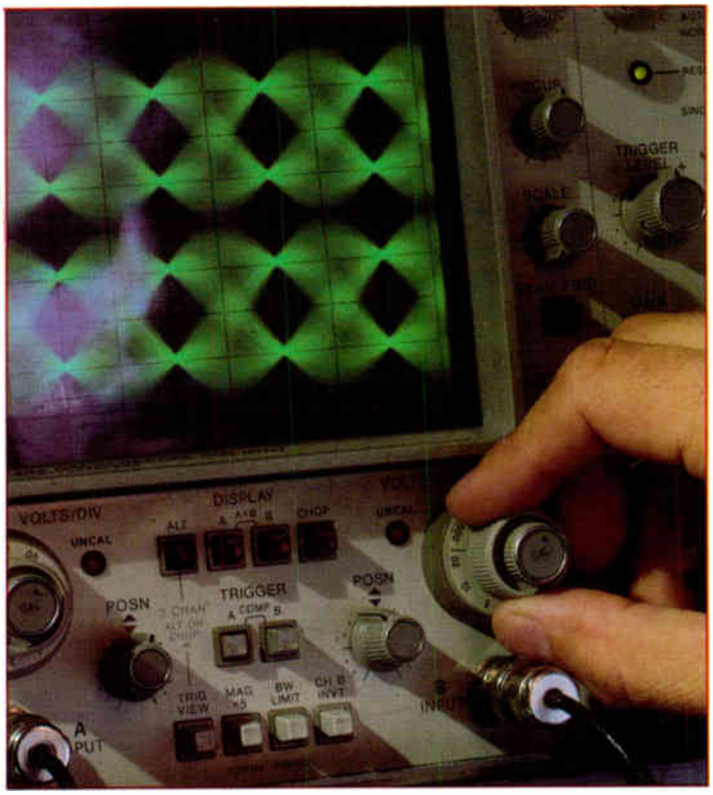

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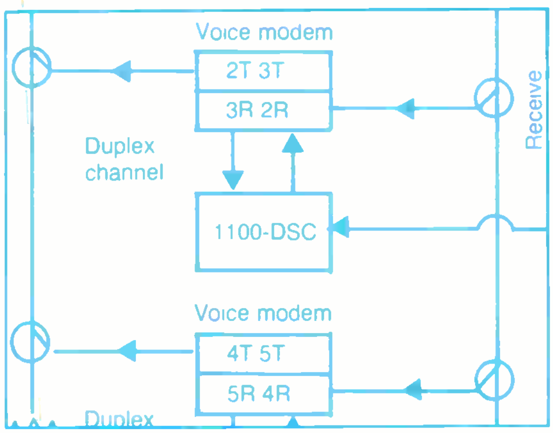

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Features

 Communications Technology is published monthly by Communications Technology Publications Corp., 7600 E. Arapahoe Rd., Suite 305, Englewood, Colo. 80112—or—P.O. Box 3208, Englewood, Colo. 80155. November 1984, Volume 1, Number 9.

Baseband or RF? Tough question. But Jerrold gives you an answer you'll be able to live with comfortably tomorrow, no matter which you choose today.

You see, our new STARCOM® V Advanced Baseband Converter and STARCOM® 450 RF Converter are compatible and can be used interchangeably within your system. So you can give subscribers a choice of cable services and operating conveniences.

Both converters bring you exceptional value, with these important features in common:

- ☐ Potting of sensitive circuits—prevents tampering.
- ☐ Dynamic trimode scrambling—prevents signal theft by changing scrambling modes on a pseudo random basis.
- ☐ Upgradeability to two-way IPPV.
- ☐ 256 tags, 2 million addresses.
- ☐ A/B switch option.
- ☐ Built-in self test—for easier servicing.
- ☐ Programmable time-out.
- ☐ Optional cordless remote control.
- ☐ Direct channel entry and AFT.

Now here's a brief overview of the other features of each converter.

The STARCOM V.

The STARCOM V 550MHz Addressable Baseband Converter offers 82- or 164-channel capacity, selectable by an internal switch. With both video and audio scrambling. And more downloading parameters than any other converter. Here's a sampling:

- ☐ Flexible barker channel location—changeable at any time. Even different barker channels for different subscribers.
- ☐ Programmable output channel—cable operators can simplify inventory by stocking only one model for all systems.
- ☐ Custom channel assignment—lets you maintain off-air channel numbers.
- ☐ System ID code—prevents converter from being used on another system.

Subscriber features are equally notable. Some of the principal ones: volume control on the remote control; last channel recall; favorite channel scan; electronic parental control by both channel and rating.

There's a lot more you should know about, of course. See our STARCOM V brochure.

The STARCOM 450.

The STARCOM 450 Addressable RF 450-MHz Converter, as noted, has many of the same operator and subscriber features as the STARCOM V. It's state-of-the-art all the way. The fact is, the STARCOM 450 is probably the best buy in its class.

Check out these other important features:

- ☐ 66-channel capacity—internal A/B switching for expansion to 132 channels.
- ☐ Easy-to-use keyboard, on both the remote and on the converter, itself.
- ☐ Parental control.

Our STARCOM 450 brochure will give you complete information on this versatile, high performance converter.

Where to go from here.

Baseband or RF? The decision can be easy enough, if you decide on Jerrold. Because you not only get an open-ended choice, you get the technical support and after-the-sale backup of the major supplier in the industry.

For literature on the STARCOM V and STARCOM 450, you have only to call or write. Jerrold Division, General Instrument Corporation, 2200 Byberry Road, Hatboro, PA 19040. (215) 674-4800.

Jerrold.
First in cable TV.

GENERAL INSTRUMENT

Jerrold advances the state of the art: Baseband and RF converters you can use in the same cable system.

Where do we go from here?

The cable industry has reached a point where we now have a glut of satellite programs. Certainly there will be shake-outs of programming: changes, additions and deletions. But, technologically speaking, has the cable industry reached an impass? No way!

We now have reached one of the next phases of cable technology—actively pursuing data and security applications. While we've "wet our feet" with this technology, we still have a long way to go before aggressively realizing its profits and rewards.

In the following pages of this issue are five features to help shed some light on the intricacies of data and security technology. Topics range from developing a plan for implementation to specialized applications and joint venture operations.

Keeping an ear to the track

On another front, it's critically important that the cable industry stay aware of the impending monopoly of cable and telephone services by the Bell Operating Companies. As reported in the Sept. 24 issue of *Communications Week*, Wisconsin Bell became the first urban telco to win the necessary licenses to build a cable system in its own telephone service area. Hopefully, this will not be an omen of things to come.

Tom Burka, regional sales manager of AM Cable was so incensed by the article he asked us to print his letter to the editor on this subject. Here it is:

"Sadly, I must admit that many cable television system operators have still not fully comprehended the value of their broadband communications networks they already have in place. True, many are still only interested in providing an entertainment function rather than both an entertainment as well as a utilitarian function.

"But I must strongly object to the concept of a 'natural monopoly.' I wonder whether the blatant stifling of potential competitors in the telecommunications marketplace was the intention behind the AT&T divestiture. I am amazed that the telephone industry would want to 'put itself on its back' for making 'sure that a cable television system will never be a competitive threat in Brookfield (Wis.).'

"Because the technology to provide the ancillary services is already here via coaxial cable, the telephone industry, with their obsolete twisted-pair plant, is putting up one roadblock after another whenever a cable television operator wants to provide any services but television channels.

"For example: excessive make-ready changes (in a lot of cases to clean-up existing violations) and lethargic make-ready labor, exhorbitant pole rental fees that are continuously overturned and brought down to reasonable levels, to the filing of restraining orders and suits against cable operators by telephone companies every time the cable operator wants to transmit data or provide some other non-entertainment service via coaxial cable.

"The concept of 'natural monopoly' is history. Those of us who are awake in the cable industry will not allow the telephone industry to have anything of the sort. If we can provide ancillary services such as data transmission, security, panic alarm, load-shielding, meter-reading, electronic mail, etc., at a lower cost to the user than other technologies then we'll have a long and healthy future. But it's about time the operators of the cable system 'wake up' before we get gobbled up by 'natural monopolies.' "

(The above remarks by Tom Burka do not necessarily reflect those of management at AM Cable TV Industries Inc.)

Lastly, but importantly, our heartfelt congratulations to SCTE's new Executive Vice President Bill Riker. He has done an outstanding job at NCTA and we're positive he will be an invaluable asset to the SCTE and the industry as well.

Toni I. Barnett


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Official trade journal of the Society of Cable Television Engineers

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Atlantic Show tech agenda

ATLANTIC CITY, N.J.—This year's Atlantic Cable Show boasts a top technical lineup thanks to the efforts and guidance of John Kurpinski of Cable Services Co. and a SCTE director. The show—sponsored by the Maryland/Delaware, New Jersey, New York and Pennsylvania cable TV associations—will be held here Oct. 30-31. The technical sessions have been prepared and will be hosted by the Society of Cable Television Engineers and the Delaware Valley Chapter of SCTE.

Oct. 30

1:30-3 p.m.—Headend Maintenance

Automated testing and logging, video baseband testing techniques, control of spurious signals, and automatic switching.

Moderator: Charles Cerino, staff engineer, Comcast Cablevision. *Panelists:* Jim Demetrius, system engineer, Manhattan Cable; Tom Saylor, system engineer, Caltec Cablevision; Mike Nelson, operations manager, Media General Cable of Fairfax.

3:30-5 p.m.—Feedback, Feedforward, March!

Amplifier improvements for longer cascades and less distortion, including hybrid applications.

Moderator: Joe Majczak, vice president-engineering, NewChannels Corp. *Panelists:* Frank Ragone, vice president-engineering, Comcast Corp.; Don Dworkin, NYT Cable; Steve Ramundi, director of engineering-east, United Artists Cablesystems Corp.

Oct. 31

9:30-11 a.m.—Will Your TVRO Be Spaced Out

Impact of 2 degree satellite spacing and the new non-adjacent "birds."

Moderator: Steve Biro, president, Biro Engineering. *Panelists:* Harry Perlow, vice president-engineering, Domesticom Satellite Communications; Bill Riker, executive vice president, SCTE; Bob Tenton, vice president-engineering, Manhattan Cable.

11 a.m.-12:30 p.m.—Microwave Systems: Care and Feeding

Installation and maintenance techniques, both in-house and contracted.

Moderator: Jack Warner, vice president, Service Electric Cable. *Panelists:* Terry Snyder, district engineer, Group W Cable; Mark Dzuban, vice president-engineering, Cross Country Cable; Cliff Paul, CATV specialist.

2-3:30 p.m.—System Design: Making It Easier

Computer aided design (CAD) for broadband cable plant, plus multiple-dwelling considerations.

Moderator: Tom Polis, executive vice president, RT/Katek, and secretary/treasurer, SCTE. *Panelists:* Almis Kuolas, American Cablesystems; Caywood Cooley, president, Cooley Associates; John Buckett, sales engineer, Scientific-Atlanta.

4-5:30 p.m.—Managing Addressability (or vice-versa)

Operational and budgetary aspects for maintaining control of addressability and profiting from the experience.

Moderator: John Kurpinski, turnkey sales, Cable Services Co., and at large director, SCTE. *Panelists:* W.A. Devereaux, vice president-engineering, American Cablesystems; Tom Bird, vice president-engineering, Rollins Cablevue; Jerry Cruzan, vice president-engineering, Cablevision Systems.

Nov. 1

1-2:30 p.m.—Open Forum (bring your questions)

Practical answers by hands-on experts to your technical queries.

Moderator: Tom Gimbel, staff engineer, Comcast Cablevision. *Panelists:* Tom Staniec, field engineer, NewChannels Corp.; Mark Dzuban, vice president-engineering, Cross Country Cable; John Nichols, vice president-engineering, Cablevision Industries; Alan Hahn, president, Stern Telecommunications.

1-2:30 p.m.—Test and Maintenance Exposed

Newest and best test equipment provided by suppliers, with hands-on demonstrations and instructions.

Moderator: Jim Emerson, AM Cable/E-Com, and president, SCTE. *Panelists:* Bruce Furman, NCS Industries, and president, SCTE Delaware Valley Chapter; Ron Adamson, director of technical services, Texscan Corp.; Diana Riley, sales engineer, Jerry Conn Associates.

Riker

Riker fills SCTE executive VP slot

WEST CHESTER, Pa.—The Society of Cable Television Engineers announced the appointment of William Riker as executive vice president. In his new position, Riker is responsible for directing the activities of the headquarters staff and coordinating the SCTE's future educational programs and technical workshops, including its annual national cable engineering conference, the Cable-Tec Expo, to be held March 4-6, 1985, in Washington. He also will coordinate the introduction of the Society's Professional Certification program, which is designed to promote technical excellence and replace the FCC's recently cancelled practice of issuing engineering licenses.

SCTE President James Emerson said of Riker's appointment: "Bill was selected by a unanimous vote of the Society's board of directors. We are very pleased to have someone with his diverse background in the cable industry to assist in shaping the future direction of the Society." Riker most recently served as director of engineering for the National Cable Television Association in Washington. Prior to joining the NCTA, he was director of engineering at Showtime Entertainment in New York. He also has served in various technical capacities with MSOs including TCI and Maclean-Hunter. Riker is a 10-year veteran of the cable television industry, has been an active SCTE member since 1977, and has served on a number of the Society's committees. He succeeds Stephen Cox, who was SCTE's interim executive vice president.

Society encourages new meeting groups

WEST CHESTER, Pa.—The Society of Cable Television Engineers is encouraging the development of new local meeting groups to better serve the membership with the dissemination of technical information. Many new groups have successfully formed and operated over the past year and are now up for full chapter status. These meeting groups and chapters have filled the void for technical information to the system level technicians and installers.

The SCTE national headquarters provides a guide book at no charge and will aid you in starting an active meeting group in your area. Your area's regional director also will provide you with aid every step of the way.

If you are interested in starting a meeting group in your area or want information on existing meeting groups or chapters, please contact: SCTE National Headquarters, P.O. Box 2389, West Chester, Pa. 19382, (215) 692-7870.

SCTE issues call for papers

WEST CHESTER, Pa.—The Society of Cable Television Engineers has issued a call for papers for a national technical seminar on "Stereo Television," to be held Jan. 22-23, 1985, in Concord, Calif.

This seminar is intended to provide technical personnel in the cable industry with thorough coverage of the issues and developments in the rapidly changing field of video-related audio. The emphasis will be on broadcast stereo television: what cable *must* do to accommodate it and what cable *can* do to benefit from it. Also covered will be cable-exclusive stereo television channels and stand-alone premium audio services. Topics will include:

- An analysis of the FCC-approved broadcast television multichannel sound system and its limitations.
- Reports of early field experience with cable carriage of multichannel broadcast television sound.
- Status and interpretation of the FCC ruling on must-carry of broadcast multichannel sound on cable.
- Progress reports by manufacturers of headend, microwave, converter and scrambling systems on providing stereo and multichannel sound capability.
- Alternate technologies for carrying stereo and high quality audio through cable television systems.
- Discussion of the various cable-exclusive stereo program material.

Finished papers should be 20-25 minutes in length and should *not* be product commercials, although technical discussion of significant product developments related to the topic of multichannel sound will be considered.

Authors should submit brief abstracts to: SCTE, % David Large, Gill Cable TV, 234 Gish Rd., San Jose, Calif. 95112.

NCTA opposes must-carry multichannel TV sound

WASHINGTON—The National Cable Television Association urged the Federal Communications Commission not to expand the must-carry rules to require cable operators to carry multichannel television sound (MTS). NCTA maintained that the cable operator must have the option to choose whether an acceptable signal can be carried on a system, and the technical means by which the signal is to be distributed.

The association estimated "staggering" costs for the industry to retrofit existing equipment to carry MTS—costs that may exceed $700 million and that cable subscribers ultimately will pay regardless of whether they receive or want MTS services.

NCTA filed its comments in the FCC's proceeding on the use of subcarrier frequencies in the aural baseband of television transmitters. The association said that cable operators previously stated to the FCC that they welcome the advent of stereophonic sound and will likely provide it where distribution is technologically feasible. But, according to the NCTA, the enhanced MTS signal, with its untested consumer appeal, must not be made an additional mandatory carriage requirement for cable. Even assuming that must-carry status for MTS is desirable, the association continued, there is no evidence that the public interest demands the costs that would result. Imposing new technical burdens on cable systems can be justified only where the public interest decidedly favors additional regulation.

Noting that commission policy already mandates carriage of local broadcast programming, NCTA said that whatever the validity of the must-carry rules, the communications policy concerns that underlie those rules are not present in this case. While MTS may constitute attractive embellishments to local broadcast programming, such enhancements are not essential to assure the programming's viability.

First Data acquires KMP Computer Systems

OMAHA, Neb.—The cable services division of First Data Resources announced the acquisition of KMP Computer Systems Inc. KMP is a New Mexico corporation that provides micro-computer billing systems to cable television operators, and currently has over 100 active systems throughout the United States.

First Data Resources provides data processing and management information systems. The cable services division currently has over 2 million subscribers on-line, serving cable systems ranging in size from 1,500 to 180,000 subscribers.

Wegener 1600 chosen to deliver CMC

NORCROSS, Ga.—Turner Broadcasting System has chosen the Wegener 1600 system to deliver stereo audio for its Cable Music Channel.

The system provides true stereo audio to affiliates choosing to carry the new service. Placed in the FM band of the system, the stereo sound can be offered to subscribers to enhance the new video music service from Turner.

Cable systems already offering stereo to subscribers using Wegener equipment will only need to buy expansion cards for CMC in order to add it to their offerings.

Valley Cable build ahead of schedule

CHATSWORTH, Calif.—Valley Cable TV's last 70 miles of its 300-mile underground system in California's West San Fernando Valley is better than three months ahead of schedule, according to company officials. Valley Cable is using Integral Corp.'s cable-in-conduit, Cablecon™, for the 70-mile, new-build and, according to Hale Coughlin, construction manager for Valley Cable, it's proving to be both a time and money saver.

"We are able to eliminate a cable-pulling crew and we have at least a 20 percent savings in time. Installation is faster, there's less damage to the cable and we have been able to increase subscriber hookups by 25 percent," said Coughlin.

Instead of trenching down both sides of the street, the constructon crew is able to make just a saw-cut across the street for drops on the other side and then fill the saw-cut with an epoxy sealant. "It decreases the amount of cable required, speeds up construction and results in less disturbance for the neighborhood—which makes our subscribers very happy," said Coughlin. The saw-cut technique has reduced the build down to 70 miles from an original 100 miles and has resulted in a total estimated savings of more than $2.5 million.

Valley Cable TV was franchised in 1980. It has 58 active channels and over 50,000 subscribers. Over 300 miles of its 1,200-mile system are underground.

Canadian association's call for technical papers

OTTAWA—The Canadian Cable Television Association is now developing the technical program for its 28th annual convention, April 9-11, 1985. Original papers on topics of interest to the cable television community are invited. The convention papers will be published in a technical digest. The digest should be available for pre-registrants and during the convention.

Presentations will be limited to a maximum

of 15 to 30 minutes including discussion. Full length and short papers will be accepted in both French and English. Slide and transparency projectors will be available and other audio-visual aids can be arranged upon request. Persons interested in preparing a paper for the technical sessions are requested to submit a one-page, 150 to 200 word abstract no later than Nov. 30, 1984. If your paper is selected, you will be notified shortly thereafter and your complete paper will then be due Feb. 15, 1985. Submit abstract to: Roger Poirier, vice president of technology and planning, Canadian Cable Television Association, 85 Albert St., Suite 405, Ottawa, Ontario K1P 6A4.

New distributors and reps

DENVER—C-COR Electronics Inc. announced the selection of Comlink Systems Inc. as the distributor in Canada for C-COR's products. Products to be sold include conventional and feedforward amplifiers, main line passives, power supplies and other equipment for cable television distribution systems, the off-premises addressable converter, SCAT; and data products, including local area network and split-band amplifiers and RF modems. Comlink will sell the products from its offices in Canada.

ITW Linx Installer Products announced that Tele-Wire Supply Corp. has become a stocking distributor of its coax cable products line. Products to be carried by Tele-Wire are attachment devices: Tapin® clips, Snapin® baseboard clips, aluminum siding clips, and Stick-tight cable clips.

Panduit Corp. has appointed Bar Electric Agents Inc., Anchorage, as exclusive sales representative of Panduit's product line. Bar Electric Agents will represent Panduit in the state of Alaska.

AM Cable wins rebuild and turnkey contracts

QUAKERTOWN, Pa.—AM Cable TV Industries Inc., announced the initiation of new- and rebuild construction for Booth America's 230-mile system in Anderson, S.C.

According to Maqbool Qurashi, AM president, "The Anderson project involves 190 miles of total rebuild and 40 miles of new construction, and is valued at approximately $600,000. Our field services division has already begun the project, and anticipates completion early in 1985—including the transfer of 7,200 drops, and certain subscriber auditing and engineering services before removal of the old plant's strand and hardware."

AM Cable also announced that the company's field services division has been awarded and already initiated system rebuild projects for UA Cablesystems in Aspen, Colo., and the Beatrice, Neb./Marysville, Kan., system.

Valued at more than $1.6 million, the new contracts consist of rebuilding 47 miles of aerial and underground plant in Aspen, and 96

Federal rules and regs: Need an explanation?

WASHINGTON—Has your cable system ever had to comply with a Federal Communications Commission-mandated regulation and/or rule? Have you, as an engineer or technician, ever needed clarification of one of these federal criteria? If you answered yes to the above, and that's probably a safe assumption, the following list of FCC offices and cable TV specialists is printed here for your benefit.

State(s) covered	FCC office
Alaska	1011 E. Tudor Rd., Rm. 240 P.O. Box 102955 Anchorage, Alaska 99510 (907) 563-3899
Arizona California Nevada Utah	3711 Long Beach Blvd., Rm. 501 Long Beach, Calif. 90807 (213) 426-4451
	7840 El Cajon Blvd., Rm. 405 La Mesa, Calif. 92041 (619) 293-5478
	423 Customhouse, 555 Battery St. San Francisco, Calif. 94111 (415) 556-7701/2
Colorado New Mexico Wyoming North/South Dakota	12477 W. Cedar Dr. Denver, Colo. 80228 (303) 236-8026/7
Florida	Koger Bldg., Rm. 203 8675 NW. 53rd St. Miami, Fla. 33166 (305) 350-5542
	Interstate Bldg., Rm. 601 1211 N. Westshore Blvd. Tampa, Fla. 33607 (813) 228-2872
Alabama Georgia South Carolina Tennessee	Massell Bldg., Rm. 440 1365 Peachtree St. NE Atlanta, Ga. 30309 (404) 881-3084
Hawaii	P.O. Box 50023 Honolulu, Hawaii 96850 (808) 546-5640
Idaho Montana Washington	3256 Fed. Bldg., 915 2nd Ave. Seattle, Wash. 98174 (206) 442-7653/4
Illinois/Indiana Kentucky/Wisconsin	230 S. Dearborn St., Rm. 3940 Chicago, Ill. 60604 (312) 353-0195
Arkansas Louisiana Mississippi	1009 F. Edward Hebert Fed. Bldg. 600 South St. New Orleans, La. 70130 (504) 589-2095
Delaware/Maryland West Virginia Dist. of Columbia	1017 Federal Bldg. 31 Hopkins Plaza Baltimore, Md. 21201 (301) 962-2729

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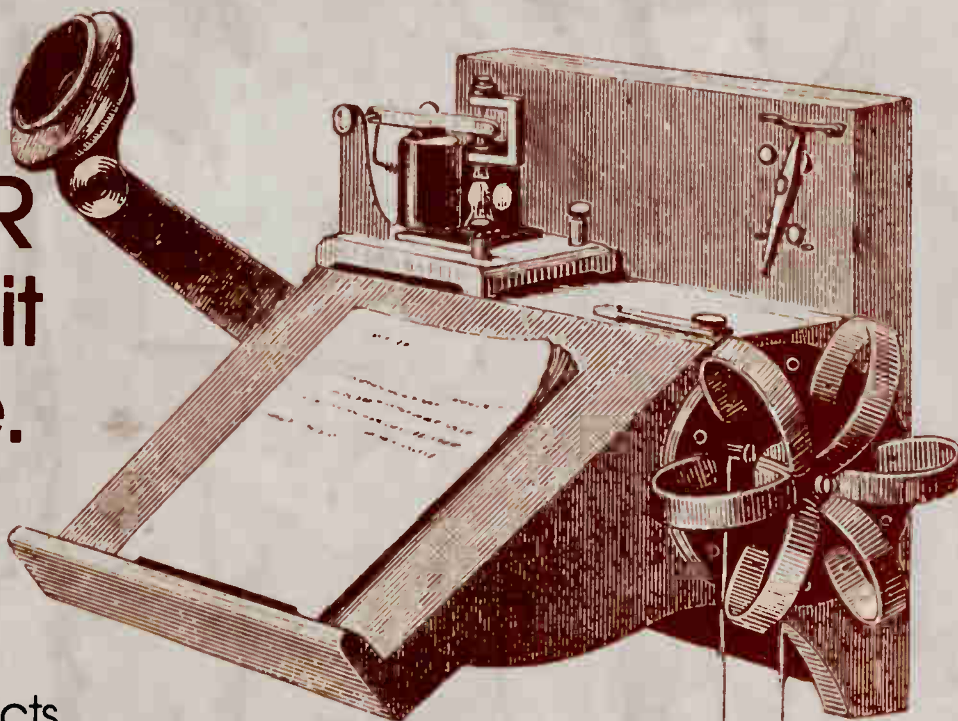
There was a time when communications were simple . . .



C-COR keeps it simple.

Power Products

C-COR Power Products keep you in control of your data communications or cable TV system despite utility power outages, brownouts, lightning strikes and transients. A PowerVision headend uninterruptible power supply (UPS) provides up to 900 watts of power at 115 Vac for up to 3.5 hours after the utility power fails. Standby power supplies of various output voltage ratings are available for pedestal, pole or strand mounting. Solid state transient suppressors achieve reliable, non-destructive surge arresting with automatic reset. A small surge protection module uses a voltage foldback phenomenon to most effectively protect amplifiers and similar equipment from overvoltages. All are cost-effective, sophisticated, yet simple.

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No matter how well you plot your course, installing miles of cable always throws you a few curves. And if you rely on standard low loss coax, it's easy to get stuck up a pole or bogged down in the trenches.

M/A-COM's new Quantum Reach™ can put you back on the fast track. Since it's the most flexible trunk cable on the market, it takes curves with ease. You'll need fewer splices and there's less chance of connector pull out or signal degradation than with the cable you're using now.

QR comes in trunk and distribution sizes in a variety of standard, flooded and armoured configurations. It goes up a lot faster and costs only a little more than standard GID so you can probably afford to reach a lot of rural extensions you've had to disregard before.

If you're in a big hurry to try it out, call us toll free at 1-800-438-3331. Ask for QR, the fastest cable on the road.

M/A-COM

M/A-COM Cable Home Group, PO Box 1729, Hickory, NC 28603, 800-438-3331, in NC 800-222-6808, telex: 802-166

State(s) covered	FCC office
Connecticut/Maine Massachusetts New Hampshire Rhode Island/Vermont	1600 Customhouse 165 State St. Boston, Mass. 02109 (617) 223-6609
Kentucky Michigan Ohio	24897 Hathaway St. Farmington Hills, Mich. 48010 (313) 226-6078
Michigan Minnesota Wisconsin	691 Federal Bldg. 316 N. Robert St. St. Paul, Minn. 55101 (612) 725-7810
Iowa/Kansas Missouri Nebraska	Brywood Office Tower, Rm. 320 8800 E. 63rd St. Kansas City, Mo. 64133 (816) 926-5111
New York New Jersey	201 Varick St. New York, N.Y. 10014 (212) 620-3437/8
New York	1307 Federal Bldg. 111 W. Huron St. Buffalo, N.Y. 14202 (716) 846-4511/2

(Continued)

miles of aerial plant in Beatrice/Marysville.

In addition to undertaking both projects on a turnkey basis, including system design, materials purchase and installation, AM will fully test the completed system before turning it over to UA Cablesystems.

Oak gets 1.3 million order

SAN DIEGO—Oak Communications Inc. received a $1.3 million order from Sun Cablevision of Hawaii for its addressable SIGMA System subscriber control cable television equipment. Up to 10,000 SIGMA home terminal units and associated headend equipment are to be delivered.

Sun Cablevision serves 7,700 subscribers on the island of Hawaii.

C-COR increases production workforce

STATE COLLEGE, Pa.—C-COR Electronics Inc. announced a plan to increase the production workforce in its State College and Altoona, Pa., manufacturing facilities. Production supervisors and manufacturing personnel are being hired in the area of assembly and testing. Since May, a total of 83 people have been hired to handle the increased production workload. In addition, C-COR has leased 16,000 more square feet, at its manufacturing plant in Altoona, to handle increased production. The recession in 1983 had forced C-COR to cut back on the production workforce, however, improved order input since January has necessitated the rehiring of some personnel and the hiring of new people to handle increased sales. Products in demand include feedforward and local area network amplifiers, status monitoring systems, main line passives and other electronics for data transmission and entertainment cable systems.

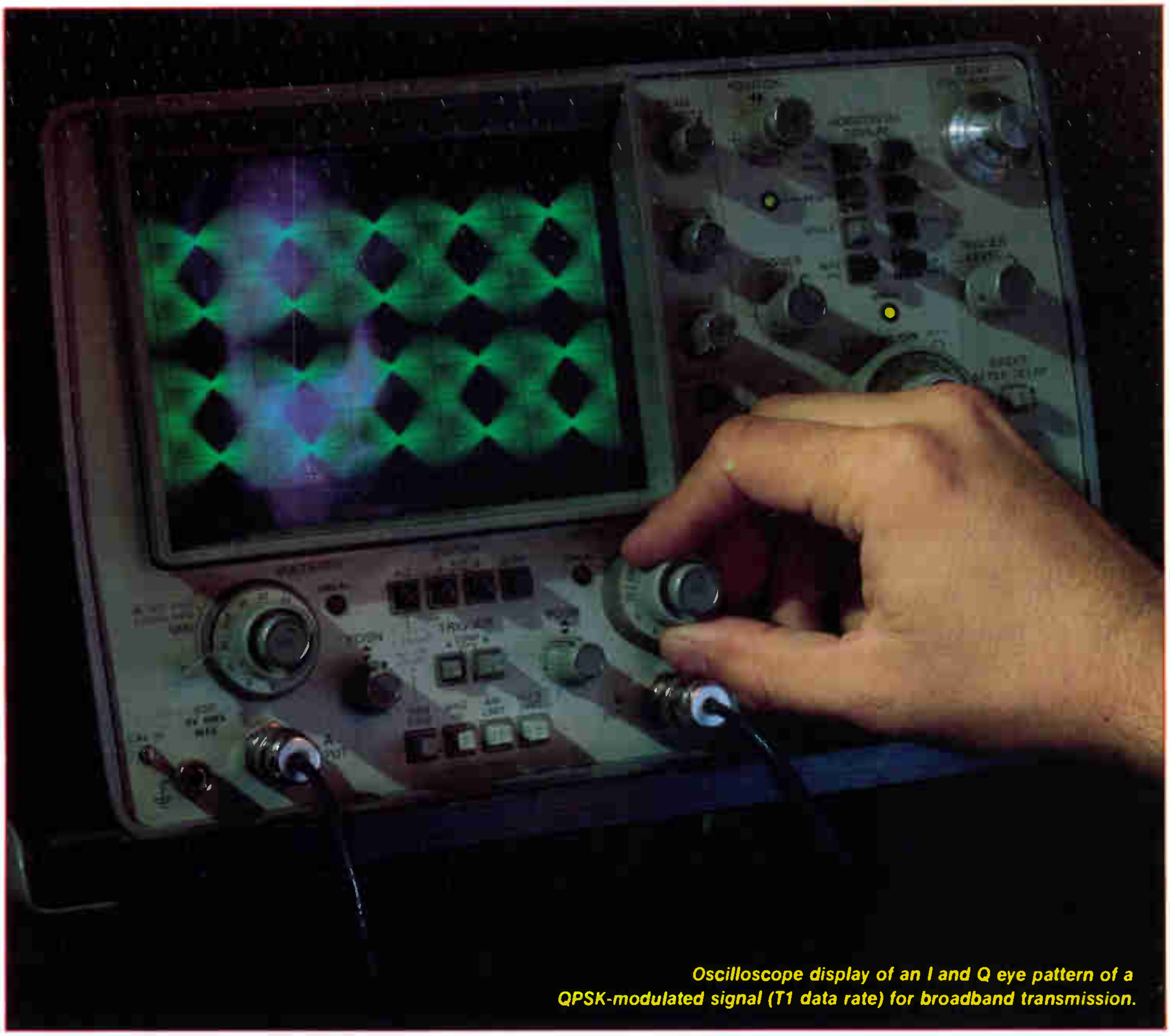
Jerrold moves N.Y. office

HATBORO, Pa.—The northeast region sales office of the Jerrold Division of General Instrument, under the direction of Charles Cooper, has been relocated to 31 W. 34th St. in New York. The telephone number is (212) 760-1700.

Sprucer technology boosts NYT Cable revenue

CHERRY HILL, N.J.—NYT Cable TV announced that its test of the Sprucer* two-way addressable converter system at McGuire Air Force Base and Fort Dix Army Post has produced a dramatic increase in revenue in its first eight months.

According to David MacDonald, cable group director for The New York Times Co., revenue per subscriber has increased by 69 percent to $25.76, while revenue per homes passed jumped by 80 percent to $13.55. "There is no question," said MacDonald, "that the Sprucer system has made a substantial



Oscilloscope display of an I and Q eye pattern of a QPSK-modulated signal (T1 data rate) for broadband transmission.

Future institutional nets

By P. Randall Bays
Marketing Specialist, Control Data Corp.

Six years ago, cable operators were busy negotiating with municipalities for sole rights to bring widely expanding CATV channels to home viewers within designated metropolitan areas. One requirement by many municipalities was that the franchise lay an additional cable for municipal and business use; thus was born the institutional network or I-Net.

The I-Net has been viewed for many years as having many benefits to both municipalities and businesses in metropolitan areas. Basically, an I-Net can link municipalities, schools and businesses together to form a local, or metropolitan loop for voice, data and video applications, as well as energy, security and traffic management.

I-Net advantages

The CATV company could do in days what has historically taken the local utility companies months to do. In addition, the communication quality and quantity is greater on the I-Net than on the Bell Operating Companies' (BOCs) outdated circuitry and architecture.

Transmission on a BOC's leased telephone line still must interface tandem switches on two- or four-wire circuits, which have less quality and performance standards than the coax or fiber system used by CATV companies. Tandem switching has been quoted as having a bit error rate (BER) of 10[illegible], which is not critical if the customer is operating below 19.2 Kbps. The maximum bit speed is 14.4 Kbps on a conditioned four-wire circuit with bandwidth of 3 MHz per channel. Transmission security is low in terms of data processing standards. Finally, I-Nets are extremely competitive when compared to the cost of installing and maintaining leased lines where hundreds of dollars are required for each move or addition the customer wants to make.

I-Nets, on the other hand, have at least a BER of 10[illegible], which is essential for high-speed transmission (56 Kbps and above). The maximum bit rate is virtually unlimited, certainly in excess of 100 Mbps over a bandwidth of 440 MHz. In addition, a customer wishing to move from one point to another on the I-Net need only pay for a tap installation, which should cost less than $50. Even more important, as a customer's communication needs expand, they do not have to purchase more circuitry and installation. They just request more bandwidth from the I-Net operator for an extra usage fee (see *Communications Technology*, April 1984, page 26). No additional installation equipment or charges would be required. I-Nets could allow a customer to have continuous full duplex transmission and reception of voice, data and full motion video teleconferencing. This would be advantageous to a customer wanting to link two buildings miles apart but within the I-Net. Ideal customers would be schools, hospitals, banks, building developers, communication resale services, other common carriers (OCCs) and municipalities, to name but a few.

The I-Net would enable customers to capitalize or make more efficient use of their communications and electronic monitoring equipment by hubbing all digital transmissions in one location. By hubbing communications traffic, equipment needs could be added or subtracted via a simple RJ11C wall plug. Also, communication services could be purchased at a less expensive rate than if each building were to purchase these services individually. Hubbing communications on an I-Net could be as much as 60 percent less expensive, and has shown to be more efficient than if the same services were to be purchased from a BOC.

In addition, customers such as banks and municipalities could manage the energy and security requirements of their branch offices along the I-Net from a central location. This means less equipment and personnel would be needed for these requirements and direct variable costs would obviously decrease through economical management of these facilities.

Specialized applications

There is definitely more application available on this specialized network for the I-Net operator. Long distance telephone resale is becoming a major topic in the telecommunications arena. Least-cost-routing has been a profit generator for years in hotels and now is taking root in the so called "smart building." Basically, a reseller buys long distance services at wholesale from many long distance companies. A computer is programmed to route each call in the most economical manner depending on destination and time of day. The reseller pools together all the telephone calls and electronic mail from independent parties into a focal point to increase volume and then resells the telephone service above wholesale but below what it would cost if the customer was calling directly to the long distance common carrier.

The same concept applies in an I-Net environment. All the buildings' telephone calls on the I-Net can be pooled together at the CATV company's headend and routed to their destination. In addition, all electronic mail, facsimile, telex, video and videotex traffic also can be routed at the same time over the same medium; something the BOC architecture cannot yet do.

In view of an increased demand for smart buildings, hospital annexes and municipal efficiency requirements, an I-Net operator can create or employ a management company for I-Net customers having energy and security management requirements. Electronic energy and security management equipment operates in conjunction with a central processor at speeds no greater than 9,600 bps. A central processor, located at the I-Net headend, could monitor the entire network with minimal bandwidth usage. The remaining bandwidth could be used to transmit high-speed data, voice and video.

'The communication quality and quantity is greater on the I-Net than on the BOCs' outdated circuitry and architecture'

For example, consider a hypothetical metroloop in Phoenix, Ariz. If this I-Net were operable, it would pass over 25 million square feet of office, municipal, hospital, hotel and school buildings in its 20-mile circuit. Interestingly enough there is projected another 5 million to 10 million square feet in the next seven years. This is but one metropolitan area in the United States ripe for an I-Net offering enhanced services. These services would save municipal and business organizations thousands of dollars in telephone, energy and security management equipment, as well as save time, increase efficiency and productivity, and reduce personnel demands. These services also would benefit the CATV company's return on investment at a time when video entertainment services are falling prey to competition in other industries such as VCR and home satellite.

According to officials at the 1984 Satellite Communications Users Conference in New Orleans, by 1986, 2.5-foot Ku-band earth stations will be in mass production for home use with costs estimated to be less than $500 per system. With this in mind, why is the I-Net taking so long to develop?

Why the hold up?

This is a complex question that cannot be answered in simple terms. In most cases multiple system operators (MSOs) are shaping the market for institutional networks. But there is some hesitation about the future of the regulations involving these services. It seems as though there are two bodies that control the fate of the I-Net, the Federal Communications Commission and each state's public utilities commission (PUC). The FCC basically has given the okay to operate competitively against AT&T but has left the question of competition with BOCs in the hands of the PUCs. There seems to be some skepticism as to the degree an I-Net operator can compete without having to be regulated. By installing an up-link in each metropolitan area that an MSO has franchise rights to, it is quite possible a CATV company could become a telephone company. Multiple system operators fear that they would be regulated; which is not what the MSOs nor the regulatory agencies want.

Little continuity exists between PUCs regarding the subject of institutional networking. Some PUCs favor limited competition, others totally disallow such ventures from developing into anything profitable.

In Portland, Ore., Rogers Cable has been in and out of the courts trying to implement an I-Net. The last ruling was in favor of Rogers Cable, but only on a limited scale. Among other things, Rogers is having trouble getting rights-of-way on telephone poles. They have decided to take a back seat for a while but still maintain what is currently operable.

Rogers in San Antonio, Texas, is actively working with other telecommuniction companies in establishing a multimillion dollar teleport—one of many being developed nationwide. Thus far, the Texas Public Utilities Commission has not had any response from the local Bell Operating Company regarding this project. Rogers is supplying the terrestrial link to San Antonio's metroplex. The I-Net is expected to be activated in the late fall.

Rogers in Minneapolis is still building its I-Net and is receiving a lot of corporate attention but no response from the BOC, yet. It plans to activate the cable the first part of 1985.

Manhattan Cable in New York seems to be the most active I-Net in operation. The New York PUC has given Manhattan Cable limited rights to operate data for 17 companies in a *private* environment.

Probably the most talked about I-Net in operation is Commline in Omaha, Neb., a subsidiary of Cox Cable Communications Inc. After activating some of its I-Net for data, the Nebraska PUC issued a cease and desist order against the offering of non-video services. But the ruling was overturned in a federal court, further suggesting that a common carrier regulation was inappropriate.

New Mexico's PUC, on the other hand, has held that New Mexico cable operators must obtain a certificate of convenience and necessity from the PUC before offering data or message transmission services. Even if properly applied for, it is unlikely that the certificate will be granted.

In Arizona, the PUC is seemingly leaning toward active competition with the BOC. As of Aug. 1, the Arizona Corporation Commission has agreed to resale services within joint tenant building environments—a step that should help pave the competition status of an I-Net operator.

The National Cable Television Association is further aware of on-going regulatory proceedings instigated by BOCs in Colorado, Kansas, Missouri, New Jersey, Oklahoma, Oregon and Texas. Decisions in these states will inevitably shape the future of the institutional network. Despite the regulatory battles, a market is actively developing that could make the I-Net profitable in the near future (2-6 years) and minimize the CATV company's regulatory risks.

Market development

Joint tenant networking is a concept that has been talked about for years but has taken root only recently. Basically, joint tenant networking involves a building that hubs tenant telecommunication traffic as well as the energy and security requirements into one focal point for processing. As described in the I-Net management system, a building manager buys public utility services at wholesale and resells the services to the tenant for less than if the tenant were to purchase the service individually. Conceptually, the tenant saves time and money, among other things, and the developer makes money.

Developers share the same skepticism as I-Net operators. They install the resale facilities and hire a management company right about the time the pendulum takes a back-swing in favor, this time, of the BOC. Developers know that their new buildings could take years to fill. Even then, they are not sure the tenants will want to use their facilities. Therefore, they would welcome the opportunity to recruit customers from other buildings without having to wait for the local BOC to supply a tie line that could be inadequate in months to come.

Networking, therefore, would take place all along the I-Net. The developer or building management company would, in essence, develop a market for the I-Net operator plus share the interest of local telephone competition.

Most of the larger MSOs are planning, if not already implementing, an I-Net. Practically all have said they have been approached by developers wishing to link buildings together. These developers also have shown interest in the concept of institutional networking, but would like to keep a low profile at this time.

The following lists some MSOs that are actively developing I-Nets. This list is not inclusive of all I-Nets.

1) Storer Communications has mentioned that it has 10 to 13 I-Nets including one that is 90 miles long in Arkansas. Most are transmitting data for schools or local governments; others have not been activated.
2) Times Mirror Cable is operating video teleconferencing at a West Hartford, Conn., school.
3) General Electric Cable is operating an I-Net in Peoria, Ill., for security, traffic and energy management applications; although not on a large scale.
4) United Cable is working with MCI on some limited tests.
5) American Television and Communications Corp. actively is pursuing I-Nets in its franchised areas with an emphasis not on competing with the BOCs but enhancing their capabilities.
6) Heritage Communications is developing I-Nets on a limited basis and is watching the smart building area unfold as a viable market.
7) Viacom in California is working on a limited test with GTE Sprint.
8) CommuniCom in California has over 30 miles of I-Net cable laid within a major portion of Los Angeles' business area, but is pending litigation. It also is pursuing actively the microwave and fiber networks to enhance service offerings. If successful in its fight for PUC approval, CommuniCom's I-Net could be the turning point for I-Net approval across the nation.

United we stand...

These and other MSOs could be called the pioneers of a great metropolitan need. But, like all pioneers, they must have support in order to survive. If this concept is to take root and succeed as a viable enhancement to the digital needs and requirements of metropolitan areas, focused attention should be given to the major institutional networks that are ready to deal. But, as one cable company spokesman said, "We are too small to fight the BOC's 20 lawyers; we can only afford one."

To sit back and watch as some of the more aggressive I-Nets fight will be as detrimental as the battle at Little Big Horn. CommuniCom, Rogers and Commline are keys to paving a favorable path to institutional networking. If they lose, where does the I-Net stand? Faced with Ku-band and video rental competition, how much longer can the MSO last with its sole dependency on the mature video market? It will be a set back in human progress if the I-Net must cease and desist.

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'SCPC is opening a new era, not only in data communications, but also in the low-frequency analog world'

Satellite data: A new era?

By James B. Grabenstein
Senior Applications Engineer, Satellite Communications, Microdyne Corp

When Marconi made his first radio transmission in 1895, he used a spark gap to generate the RF power and a simple coherer to detect the recovered RF energy. To identify these signals, he sent Morse code, a series of dashes and dots. This RF carrier relayed the information in digital form. If you think about it, Marconi sent the first data transmissions. Webster defines data as, "information; facts or figures from which conclusions can be inferred." So RF data transmissions are not new; they are as old as radio transmissions themselves. As for satellite communications, 1984 marked the 25th anniversary of the first television and telephone transmission by satellite. And data was part of the early telephone traffic.

Low-cost data transmissions

So what is new? The *cost* of sending information via satellite is new. In the beginning of the satellite communications era, the only way to send satellite signals was to own or lease a full transponder. This was a multi-million dollar investment that required high capitalization risk and extensive engineering planning to protect that investment. One of the most successful uses of satellite transponders has been supplying services to the cable television industry, with which you are already familiar.

Partial transponders

A technology you may not be familiar with is the use of partial transponders. Partial transponder is the name given to a system that allows you to lease only the amount of bandwidth and power you need to send information through a satellite. This partial transponder space is available from Western Union, GTE Space Net and National Public Radio. All of these carriers have their own rates, but as a rule of thumb, a 10 dBw effective isotropic radiation pattern (EIRP) signal with a 50 kHz bandwidth will cost approximately $2,000 per month on a one-year contract. As much as 40 percent savings on space segment can be realized by obtaining a contract for the life of the satellite from the partial transponder suppliers.

Figure 1: Estimated C-band partial transponder cost

EIRP dBw	Watts	Per month based on one-year contract
7	5.01	$ 1,060
8	6.31	
9	7.94	1,570
10	10.00	1,910
11	12.58	
12	15.85	
13	19.75	3,610
14	25.11	
15	31.62	
16	39.81	
17	50.11	8,710
18	63.09	
19	79.43	
20	100.00	17,210

Typically, the EIRP of a C-band satellite transponder for television is about 32 dBw. It requires about 1,000 watts of power into a 10-meter antenna to uplink the television signal. The single channel per carrier (SCPC) signal requires about 7 watts of power into a 5-meter uplink antenna to develop a 10 dBw EIRP out of the satellite. This use of lower power reduces the cost of the equipment to build the system.

As in all physical properties of RF transmissions, there is a trade-off to consider. The frequency response, bandwidth and power are all proportional to one another. The higher the frequency response, the wider the bandwidth that is required to pass the signal. Every time the bandwidth is doubled, the power to override the noise in that bandpass must be doubled. The advantage of using narrowband SCPC is that you only have to buy the space segment you need to transport the information you require.

Almost every radio network has gone to satellite distribution over the past two years. The reasons: cost-effectiveness, high quality and reliability. Some radio networks were paying as much as $30,000 a month to distribute signals over state and regional landlines whose quality and reliability were inadequate. The savings in monthly landline operations costs will not only pay for the SCPC space segment, but also will pay for the equipment within a few years. Thus, services that have been traditionally sent over twisted pairs can now be sent via satellite in a more cost-effective manner.

National Public Radio was one of the first to use SCPC satellite signals to distribute radio programming. It used two 17 dBw EIRP carriers with 200 kHz of bandwidth to distribute its stereo services. The results are excellent and far exceed the quality of twisted pairs.

Low-speed data transmission

Just as SCPC systems have proven to be cost-effective for radio networks, so too can they be cost-effective for data transmission, particularly at the lower bit rates. As the frequency, or data bit rate, goes up, the cost of transmitting that data goes up dramatically (Figure 1). Unquestionably, there is a need for transmission of mid- and high-speed data via satellite. But there is also a need for inexpensive, reliable dish-to-dish communications of lower-speed (300 bits to 19.2 kilobits per

How to make money

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Sigma's addressability does more than just let you offer subscribers an advanced remote control unit. In addition to 56 regular authorization tiers, Sigma offers 28 special or group authorization levels. Special levels are specifically designed to authorize subscribers for pay-per-view and also facilitate emergency alerts and other group-oriented functions defined by you.

Ten Different Kinds of Self-Diagnostics.

Should a problem occur with the home terminal unit or elsewhere in the system, a code number will appear on Sigma's L.E.D. display. When your subscriber calls, you can immediately identify the problem and in most cases correct it from the headend. This saves you the expense—and your customer the inconvenience—of an unnecessary truck roll.

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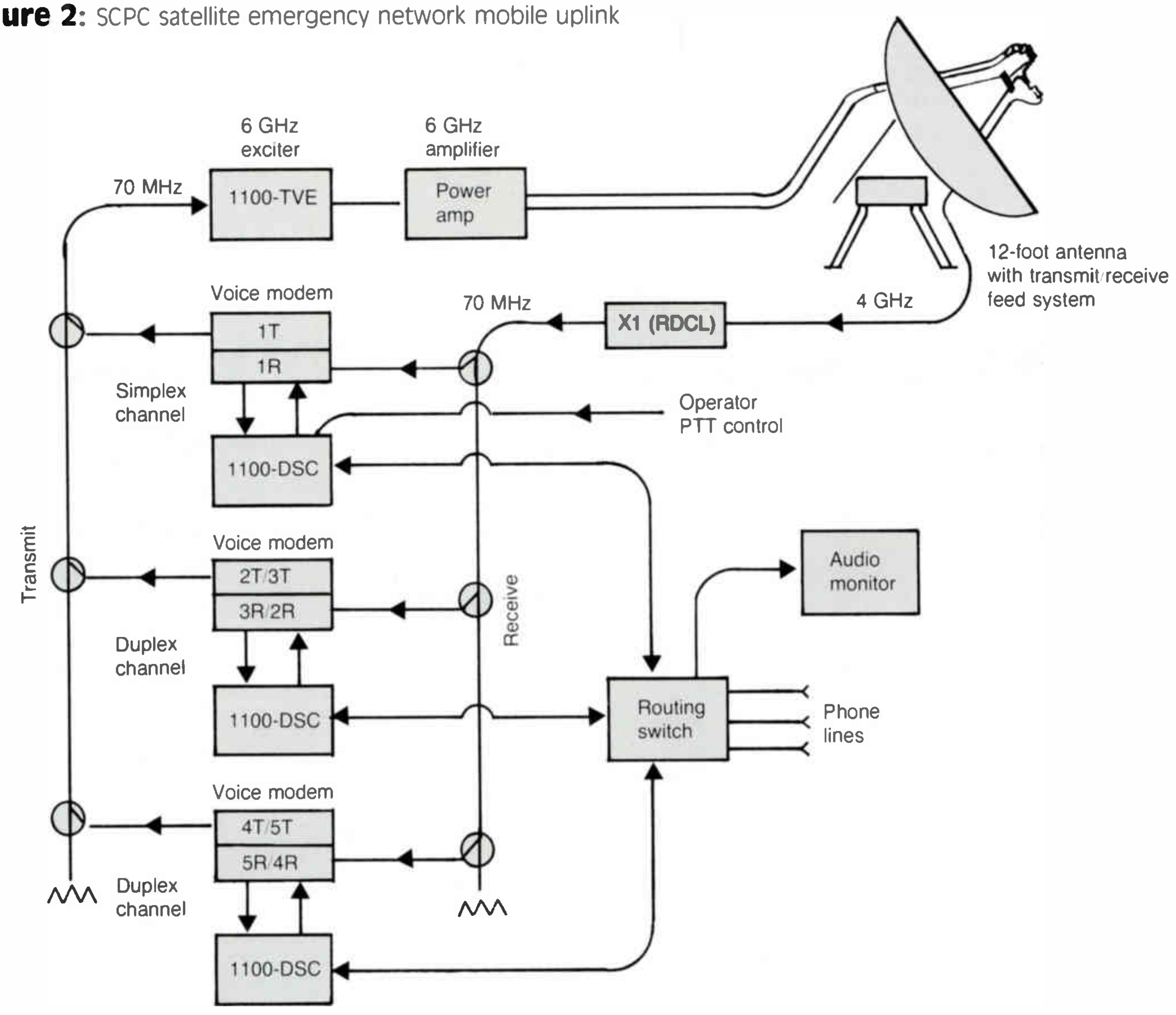
Fully Redundant Keypad—All keys on the remote handset also appear on the Sigma set-top unit.

Figure 2: SCPC satellite emergency network mobile uplink



second, perhaps as high as 56 kbps) data. Such data can now be sent over acoustical modems linked to an analog SCPC system at a significant savings in cost and improvement in reliability when compared to landlines.

In addition, these systems can provide service where no phone lines are available. Remote construction sites, offshore oil rigs and public service and safety communications circuits that must be independent of phone lines during natural disasters or a national emergency are all examples of such applications.

The technology for meeting these applications is here now. For example, the Florida State Radio Network has a system using a converted van that is capable of transmitting and receiving up to four separate SCPC broadcast-grade circuits. A transportable 12-foot antenna makes the van operable anywhere in the continental United States and allows the station to establish communications with other state and regional networks at the flick of a switch. Through the use of modems, data has been sent through systems of this type at baud rates of 4,800 bits per second, with zero bit error.

Narrowband telephone-grade services

Another service that can save space segment costs by as much as 40 percent is the use of even narrower band telephone-grade services. This type of system will work on a 7 dBw EIRP carrier with an occupied bandwidth of 30 kHz. (See Figure 2) The decrease in power of about 2.2 dB from 50 kHz to 30 kHz bandwidth and use of a 12-foot antenna will give you about the same performance as a 10 dBw EIRP signal with a 10-foot antenna (50 kHz bandwidth system). This system can be interfaced to a standard four-wire telephone switch control. It will handle up to 4,800 baud data channels and will interface with standard telephone interconnect switch systems. This technology is used on offshore oil rigs and uses the same circuits as data and voice communications to the mainland. The system can place single channel per carrier signals at 50 kHz spacing on a transponder. The number of channels is limited only by the type of upconverter and amplifier used on the system. The telephone 3.2 kHz response modulator and demodulator are housed in the same rack-mount chassis, which allows the units to be racked and stacked to a custom communications interface. The same chassis can house two modulators or two demodulators.

A word of caution in closing: All satellite circuits require a certain fade margin designed into the system, including data satellite systems. The higher the data rate, the more power is required to override noise in the bandwidths which that data will occupy. So you should carefully consider the maximum data rate that will do your job and the amount of head room, or extra bandwidth, that you need for system reliability. Single channel per carrier is opening a new era, not only in data communications, but also in the low-frequency analog world. We have an opportunity to expand this industry. The tools and the equipment are here; it's a matter of applying them to today's requirements.

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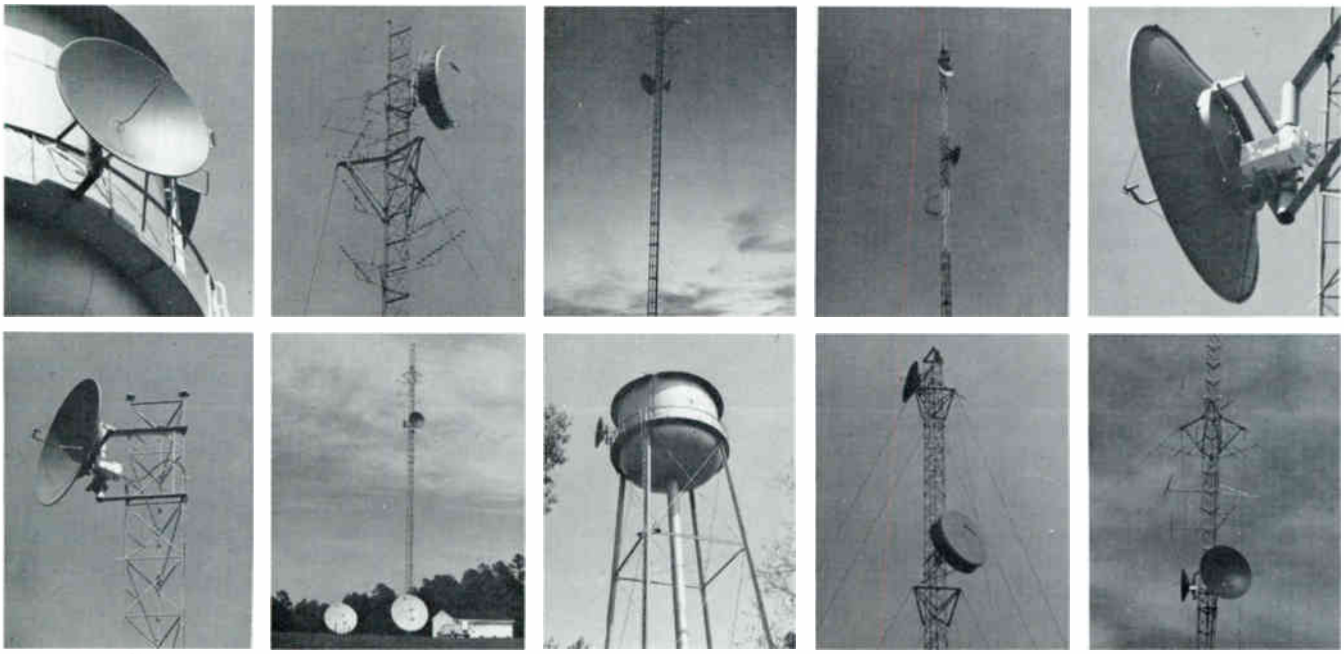

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A realistic approach to data communications

'Paramount among the many technical considerations. . .(is) a workable return path for two-way communications'

By Franc Stratton
Manager New Business Development Viacom Cablevision

A realistic approach to the implementation of data communications service over a broadband cable TV system impacts five crucial planning areas: 1) technical, 2) operational, 3) marketing, 4) regulatory and 5) financial. Each of these issues is important and interdependent on the others. A thorough understanding of each viewpoint should enable a CATV system to logically implement a profitable data communication service; *or* reject implementation based on a reasonable financial and operational mode.

Technical planning

Paramount among the many technical considerations that pre-qualify a cable system is the immediate potential for the system to implement a workable return path for two-way communications. In order to pre-qualify, system plant minimally should:

1) Have mid-split or sub-split return trunk and feeder amplifiers with two-way capability.
2) Have a total designed or measured carrier-to-noise (C/N), for the system and the longest amplifier cascade to the headend(s) and back, of approximately 40 dB or greater. This C/N figure should be weighted by data operating levels and bandwidth requirements (including headend translation, processing equipment and microwave links).
3) Have available the appropriate upstream and downstream channel pairs for two-way communications with the hardware type chosen. For example, T-8 and Channel L might be used by one manufacturer, or T-7 and Channel A-1 could be offered by another.

The preceding minimums pre-qualify a system for two-way potential. Without these minimum requirements, implementation involves very expensive redesign and rebuild.

Other technical issues concern the system's current design and operational parameters that may make the transition to two-way expensive, but not impossible. Secondary areas of concern are:

1) System two-way channel pair capacity should be enough to allow multiplexed services. Sub-split residential systems, of course, will have less channel capacity than a mid-split institutional network. However, the dedicated institutional network may have to be bridged to the residential system to maximize potential commercial user passings.

   Two-way channel capacity also determines the type and extent of the data service implementation. Bandwidth limited sub-split systems should consider a packet-switched, contention or token-passing network, primarily targeted toward the point-to-point, asynchronous or bisynchronous, character-oriented protocols. These modems turn on their carriers or capture tokens only when they have data to transmit. Mid-split systems, however, may choose to support point-to-point or multidrop, bit- and character-oriented protocols, and medium to high-speed communications in several different channels with dedicated-frequency or packet-switched modems from various manufacturers. Portions of this capacity must be mirrored in any microwave links between sub-headends or franchise interconnects.
2) The end-to-end propagation delay for worst case system cascade length and longest microwave hop must be less than the modem manufacturer's window of delay tolerance. For example, one packet-switched modem manufacturer specifies a maximum delay equivalent to about 35 miles of cable.
3) System passives must be compatible with data operating levels. Since most data carriers will be 14 to 15 dB below system video carrier levels, maximum tap values may have to be lowered to accommodate them. For example, a tap at the pole may deliver 0 dBmV to the converter outlet at video levels, but only a −14 dBmV to a modem outlet at data levels. If the modem manufacturer recommends a −6 dBmV input, then the tap must be replaced at the pole to allow the proper data carrier input. A padded diplex filter at the modem outlet will permit separate adjustment of the modem receive and transmit carrier levels.
4) Return system ingress and distortion parameters are highly dependent upon the physical and electrical condition of the system plant and drop parts. The overall carrier-to-ingress (C/I) ratio for the maximum system end-to-end loop should be at least as good as the C/N requirements. A good system maintenance plan with forward sweep, return alignment and radiation monitoring should help maximize this C/I figure.

   Problems to be reckoned with upon activation and maintenance of the return system are common mode distortion; impulse, transient and Gaussian noise; RF ingress from shortwave and business band radio; and active and passive non-linearities. Normally, corroded or loose connectors, poorly made fittings, poorly shielded drop cable, cracked trunk and feeder sheaths, and faulty or misaligned return amps are the major causes of these problems.
5) System operating dynamics are another factor affecting technical performance. The system end-to-end carrier levels theoretically should not vary more than 10 dB throughout the network. Practically, however, a 15 dB level dynamic range is very good using standard single to triple channel headend translators. Viacom is currently testing a narrowband translator (300 kHz) with a limiting option to tighten end-to-end dynamic level range. These ranges should be tightened before insertion into microwave links to avoid CSMA/CD channel dominance by stronger data levels.

   System frequency stability becomes more important for narrow bandwidth data carrier modulation, and a ±5 kHz tolerance is typical. For this reason, highly stable translators and microwave XOs are recommended over standard CATV equipment meeting only FCC specifications.
6) If intra-channel data carriers are multiplexed on the system with adjacent upper and lower TV channels, the appropriate guardbands will be necessary to prevent TV receiver interference. This lowers the number of intra-channel slots available for data use and necessitates careful management of the usable ones remaining.
7) Each system must determine for itself the uptime and response time that it will guarantee its potential data communications users. Standby power supplies should be considered for those areas of a system that experience the most electrical outages affecting uptime. Bridger-switching borders on necessity for shortened response time to service problems since fault isolation is automated. Planned redundancy also will improve uptime and service response times. If a system has the luxury of all the above, a greater than 99 percent uptime should be realizable.
8) System technical and operating capacity to implement a data communications service should be evaluated thoroughly. A mature system with addressability, on-line billing, an active return for a revenue-generating service like security and a potential for commercial user passings would least likely have difficulty implementing a

for broadband network interface...

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SUBCHANNEL SPACING	50 KHz	150 KHz	1 MHz

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For more information call: Neal Orr or Dick Brescia (212) 245-8893 data communications service. However, a system barely meeting the above necessary pre-qualifying requirements will have a difficult and expensive transition to data communications and two-way services.

Local telco packet-switching services will involve rebuild and expensive processing computers at each central switching office. Prices will be expensive for this slow 4,800-baud service, especially if the current digital offerings are any precedence.

Using existing cable-compatible hardware, the advantages that CATV can offer the present and future market for data and other coaxially multiplexed communication services are many:

1) If launching a packet-switched service, the CATV operator can deliver a cost-effective value-added service. Inherent within the packet network is CRC-16 data error-checking, speed selection and buffered conversion, format and flow control selection, and sophisticated network management and diagnostics. At a single RS 232 port, five-year lease of $30 per month for the basic tier and 8 a.m.-5 p.m. service, this modem could be a very attractive offering. Add network service surcharges, then the 2,000 to 4,000 port potential for each 6 MHz channel pair appears promising.
2) Coaxial cable is by nature a relatively noise and interference free medium. Despite the spectrum equivalency to 150,000 voice grade lines, it also is easily installed, maintained and repaired. Because of this bandwidth advantage, many services such as security, energy management, teleconferencing, telemetry, entertainment and information video, and much more can be multiplexed on a single coax.
3) With RS 232 port-to-port responsibility, finger-pointing is minimized and customer satisfaction is maximized. Add gateways to other commercial networks, and the packet-switched connection can be extended to any computer service or data base in the United States. Furthermore, close customer contact and education can be maintained by hardware and software vendors using multiplexed video information commercials.
4) Local third party server nodes connected to the network can provide protocol and text conversion services, transactional services, specialty printing, back-up and archiving, business services and local electronic mail delivery. Low monthly charges and good CATV service should help stimulate server node growth.
5) Certain services such as security, fire, burglary, medical alert and energy management could allow network users very advantageous insurance discounts, tax credits or operating savings. Furthermore, the data communications user will not have to design complex and expensive hardware configurations to overcome the inherent limitations of the costly, low-speed voice bottleneck. Certainly this low-cost modem would even be a cost-effective alternative to a local area network.

Operational planning

Closely related to technical planning areas are considerations for determining the impact of data communication services upon system operation. As previously mentioned, the more advanced, mature systems will have less trouble implementing data communications and other two-way services. Unique areas of major importance to system operation warrant discusson and planning.

Some systems or MSOs may want to operate the service initially as a separate business with dedicated personnel for installation, maintenance and sales. Gradually, the service can be phased into normal system operations as revenue growth, training and experience will allow. If an institutional and residential system must be interconnected for profitable operation, then integration into normal operations is mandatory.

If the system does not have return experience, then perhaps a service such as security should be implemented prior to the introduction of data services. Security has the stand-alone potential to financially justify the capital and operating expenses necessary for two-way communications. The service is failsafed with telephone dialer backup, and it will provide an excellent training ground for two-way operation.

Viacom's experience also revealed the value of security for status monitoring and subsequent system problem pin-pointing and repair. This side benefit shortened outage response time for the system by one hour on the average. Furthermore, the system did not rely on subscriber complaints via telephone to anticipate or locate system problems. Incidentally, this same system has return video carriers multiplexed with the security return carrier.

From security, Viacom also has learned of the importance of third party responsibility for certain enhanced services operation. Security and other opportunities like energy management require specific expertise. Operating and maintaining the coaxial delivery medium is cable TV's forte and should be the demarcation point of responsibility.

Some operational concerns have a familiar ring to them, especially if the system has implemented on-line addressability. Service and installation scheduling, QC and inventory management, and tiered monthly billing are similarly related to current CATV practices. The system or MSO has the choice, however, to address this problem with directory changes in existing CATV billing software or implement a stand-alone, internally written billing system. Current microcomputer data base management software makes the latter choice easily implemented from a manual system initially used for a few data service subs.

Other related problems of tier changes, disconnects and illegal modem ingress into your network are resolved by current packet-switching modems. These modems are addressable and network privileges may be added or deleted by the CATV operator. By taking away all the modem privileges a disconnect results. Off-hour, sequential poling of unused addresses at the CATV headend can effectively search for illegal CSMA/CD modems, move them to an unused channel, lock their carriers on, and permit discovery of their location. A CSMA/CD network controller would alternatively automate packet validation. Token-passing modem ingress should be more controllable.

If the packet-switched modems allow local statistics, then a basic tier would set a maximum per month kilo-packet limit, and any amount over this limit would involve surcharges. Peak traffic from batch services also may have to be scheduled and surcharged. Access to remote data bases via gateways to public data networks would likewise involve surcharges over basic. Token networks could further surcharge their priority users for guaranteed throughput even during peak load hours.

Additional tiering would be based on service hours. An 8 a.m. to 5 p.m., five-day service response would be cheaper than a 24-hour, seven-day service. Inexpensive RF, AC and RS 232 input surge protection is advised for the latter service guarantee.

System installation and maintenance procedures must be upgraded to accommodate the more sophisticated data communications market. Neatly installed coaxial termination boxes and professional RS 232 or modular patch panels will definitely impress the data communications user never enamored to the twisted-pair spaghetti mess. Installed drops can be easily color-coded with snap-on tap identifiers for maintenance and service tier identification purposes, especially if interconnected to the subscriber plant.

Data service technicians must be trained in basic RF digital and analog communications, protocols, RS 232 (and RS 422), specialized data test equipment and return system troubleshooting. Fortunately, experience has shown that advanced CATV technicians learn data communications far easier than data technicians learn broadband communications over cable. Furthermore, very good seminars, books and videocassettes exist for data communications training of qualified CATV technical personnel.

Additional test equipment must be budgeted for two-way communication services. Notch filters should be used for high level sweep transmitters to prevent interference to data channels. Return set-up and alignment equipment also must be included in the return capital budget. Fortunately, highly automated and intelligent data test sets allow properly trained technicians to diagnose, isolate and troubleshoot even complex service problems. These test sets resolve fingerpointing disputes between bewildered technicians and user M.I.S. departments.

Automated and remote testing is available for bit error rate testing, baud rate/format evaluation, data monitoring/trapping, bias distortion, event timing, poll and device emulation, and break-out box testing. Modem remotability of these interface test sets permits manufacturer and other expertise to be on line for problem identity and resolution.

Planning for growth in operations should involve a transition from a modest packet-switched circuit provider, with other third party services multiplexed as a commercial package, toward a CATV and data communications network with third party transactional, informational and business server nodes. Such a network ultimately should plan for circuits, bridgers and gateways to multi-tenant networks, satellite teleport centers, X.25 PDNs, long-haul networks and local area networks.

With the help of experienced third party or limited partner participation, the passage from the simplex CATV operation to a duplex metro area network could be accomplished over a shorter period of time with less risk.

Marketing considerations

Crucial to strategic planning for data services implementation is marketing. Briefly, the cable operator must define the current data communication area market, target that portion of the market best suited to cable-delivered services, and adapt the organization to delivery of these services more effectively and efficiently than its competitors. Classic marketing strategy meaning "find your niche and serve it."

Specific information on the local data communications market must be painfully gleaned from the "private line" (P/L) dollar volumes in tariff records at state regulatory commission offices. However, this figure may be misleading, since the number does not reflect data users on dialup lines. Local telephone user or political action groups may be another source for this data. At any rate, this total market must be redefined in terms of the cable franchise area.

In most areas, the majority of P/L circuits will be 1,200 baud, point-to-point leased lines from $50 to $200 per month, excluding modems. P/L circuits showing the greatest growth are the 9,600 baud, conditioned lines from $100 to $450 per month, excluding modems. The end to cross-subsidization of these circuits by the voice network could cause a very dramatic rise in all these prices.

The typical users of the P/L circuits tend to be urban "Big Blue" customers who must use a combination of modems, conditioned lines, concentrators and multiplexers to overcome the limitations and price of this twisted-pair voice system. Lead times for installation are currently very long, and service tends to be marginal. Finger-pointing among computer vendor, modem supplier and circuit provider is common and bewildering. Upgrades to this voice network either are not yet in place or prohibitively expensive.

Co-marketing and co-packaging of network services over coax is an advantage of third party participation. A synergistic effect may result where the effect of the whole network is greater than the sum of the parts. Interconnects and co-marketing with private microwave, DTS, cellular and uplinks may be advantageous and necessary. Sales efforts also can be coordinated with local mainframe and microcomputer outlets.

Potential users to be targeted for initial marketing efforts include:

- Federal, state and especially city governments (CATV's 5 percent limited partners);
- Time-sharing and business data service providers (called service bureaus);
- Institutions such as banks, brokerage houses, hospitals, schools and universities;
- Long-haul and public data networks seeking low-cost, but higher speed local loop alternatives; and
- Microcomputer users and user groups (especially if telcos add a $50 per month surcharge to modem usage on voice grade lines, and the mainframe-to-microcomputer connection becomes extant).

The serious marketing and sales effort involves establishing a local market information network. Business and institutional M.I.S. departments do not really understand data communications, especially broadband alternatives. Fortunately, Big Blue has legitimized the broadband concept for them with its new packet-switched local area network (LAN) and inexpensive, but powerful microcomputer file-server. Since the same broadband original equipment manufacturer also supplies CATV-compatible hardware, then LAN-to-LAN bridges may be potential revenue. A standard

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data and telecommunications maxim is "80 percent communications internal, 20 percent external."

The CATV image as an entertainment medium is another marketing problem for commercial services over cable. Perhaps limited business-oriented programming, infomercials and commercial services will transform this image over time.

Regulatory questions

Now that pre-qualifying technical and operational issues have been broached, and marketing concepts have been touched upon in an upside light, the downside questions of regulatory risk must be analyzed. Basically, the FCC and the courts tend to favor deregulation of competing communications services. Elected state utility regulators, however, tend to view deregulation as a threat to low universal phone service rates, especially since the breakup and end to local loop, intra-LATA service cross-subsidization from inner-LATA long distance and Yellow Page revenues. Congress stands somewhere between these two extremes with active input coming from cities and other cable franchising authorities.

Participation in state regulatory hearings and meetings has shown that these agencies do not understand cable nor cable's bypass potential. About 1.2 percent of telcos total revenues come from data communications, but only cross-subsidization from the voice network has kept them in this business. The cable industry so far has only two-tenths of 1 percent of the total telco data communications revenues. A little over two dozen cable systems now are offering various forms of these services over dedicated institutional or hybrid plant. Obviously, a primarily residential entertainment medium like cable will have a slower start at serving the data communications market than a common carrier whose plant is in virtually every commercial and residential building in America.

Not only are the telcos ubiquitous networks, but they also totally dominate the telecommunications market place. As an industry, total cable revenues are only about two-thirds that of the typical regional telco. Political, legal and R&D war chests, also funded from phone rates, are several times bigger than the yearly revenues from the largest CATV systems.

As an industry, CATV already provides subsidies to the telcos (and power companies) in the form of pole space rentals. These yearly rates are currently very high, and they provide some relief to upward pressures on monthly phone charges, thus lowering the potential threat to universal phone services.

When microcomputers become the tools for increased office worker productivity, then a real blocking burden may be placed on a voice network not designed for extensive 300 to 1,200 baud modem use. Large mainframe users, however, already are experiencing these bottlenecks. In fact, bypass by large business and government users of telco plant is a far bigger potential drain on phone revenues than cable TV. If poles and rights-of-way are bypass potential, then certainly local power companies can (and do!) overlash fiberoptics to neutrals and bypass telcos very cost effectively.

The telco operating companies currently have little or no intra-LATA voice competition. CATV systems, however, face stiff competition within their franchises from SMATV, videocassettes, movie theaters, MDS, DBS, broadcast TV, low-power TV, and whatever other medium can offer entertainment delivery. Since the coax is useful for purposes other than entertainment, the CATV industry must be allowed to compete for needed incremental revenues in those other market areas for which it is best suited—high-speed delivery of multiplexed entertainment and commercial services.

The very architecture and nature of the CATV system also poses no threat to universal phone service. The telco system is a switched network with dedicated phone pairs feeding from customers to central switching offices (CSOs) that actively route calls to other CSOs and phone users. The CATV plant, on the other hand, is a tree-and-branch bus with passive headends. Unlike inexpensive telco phones, cable "telephones" currently cost around $600 since routing intelligence must be included to overcome non-switching headends. Switched RF headends would require expensive architectural rebuild for cable. Extensive twisted-pair plant, cheap telephones and intelligent CSOs give the telcos voice network complete dominance in the transfer of voice and very low-speed information.

Packet-switched data communication over coax, however, is potentially a cost-effective alternative to cross-subsidized data communications over a voice network. Furthermore, packetizing is a value-added, rather than a common carrier service, and puts the cable industry in much the same position that allowed the public data networks to be developed in the late '60s and early '70s. An excess capacity argument also could be made for cable much in the same way that long-haul networks were allowed to sell their excess capacity.

Disregard the smoke screen threat to universal phone service, however, and the true nature of the struggle in the data market place is clear. Cable TV is a coaxial medium best suited to multiplexed high-speed communications; a telco twisted-pair network is designed for and best delivers voice. The market place should determine the niche for each. There are no divine rights in a democratic free-enterprise system save one—the right to compete fairly.

From the preceding brief description, local, state and federal regulatory and legislative bodies are a downside risk to the future of data communication over cable. This risk must be reflected as legalese within a circuit and equipment leasing contract and in return-on-investment requirements in determining monthly charges for data services.

Financial projections

Having pre-qualified by system type, having considered operational and marketing strategies and plans, and having weighed the regulatory risk, potential cost and revenue projections are ready to be made. Fortunately, interactive microcomputer spreadsheets can be helpful in creating an understandable financial model of the complex array of numbers and formulas necessary for such a projection.

Before beginning work on a projection, a yard stick of channel-value must be made to compare against the revenues of the new services. Some MSOs may use a fourth or fifth pay service potential per month, and others may say that the channel may be worth at least $1 or $2 per sub per month. Systems with less excess channel capacity will put a higher premium on channel value than one with 10 to 12 billboards filling up empty spectrum.

The yard stick of channel value must then be compared with the potential market value of the service. Total current market value weighted by the percentage applicable to the system franchise area should measure favorably against the channel value figure.

Next the capital cost of launching the service(s) must be totaled. This figure includes the actual cost of upgrading the system from whatever status it may be in now to a working two-way communications medium. Hardware unique to the launch and on-going maintenance of the service(s) must be included.

Assumptions now must be made for the leasing period for installation charges, income tax bracket percentages, investment and R&D tax credits, depreciation expenses, cost of capital expenses and operating expense levels necessary to maintain the service. Adjust this figure with after tax return on investment requirements commensurate with the risks and monthly gross results. This figure should meet or exceed channel value. Finally, divide by user capacity targets per channel and the minimum monthly leasing charges per port result.

Since CATV is currently an entertainment medium, systems have designed and built plant in primarily residential areas, with the 50 homes per mile minimum used as the limiting criteria. As a result, the cable industry has not penetrated the commercial areas to any great extent.

Plant extensions into commercial areas must be justifiable from fewer users providing greater monthly revenues. A multiplexed service mix with third party informational, transactional and service providers could be the source for these increased revenues.

Conclusion

As mentioned earlier, and for review, the implementation of a data communication service impacts five important planning areas: technical, operational, marketing, regulatory and financial. It is imperative that the upside and downside effects from each viewpoint be considered before implementation.

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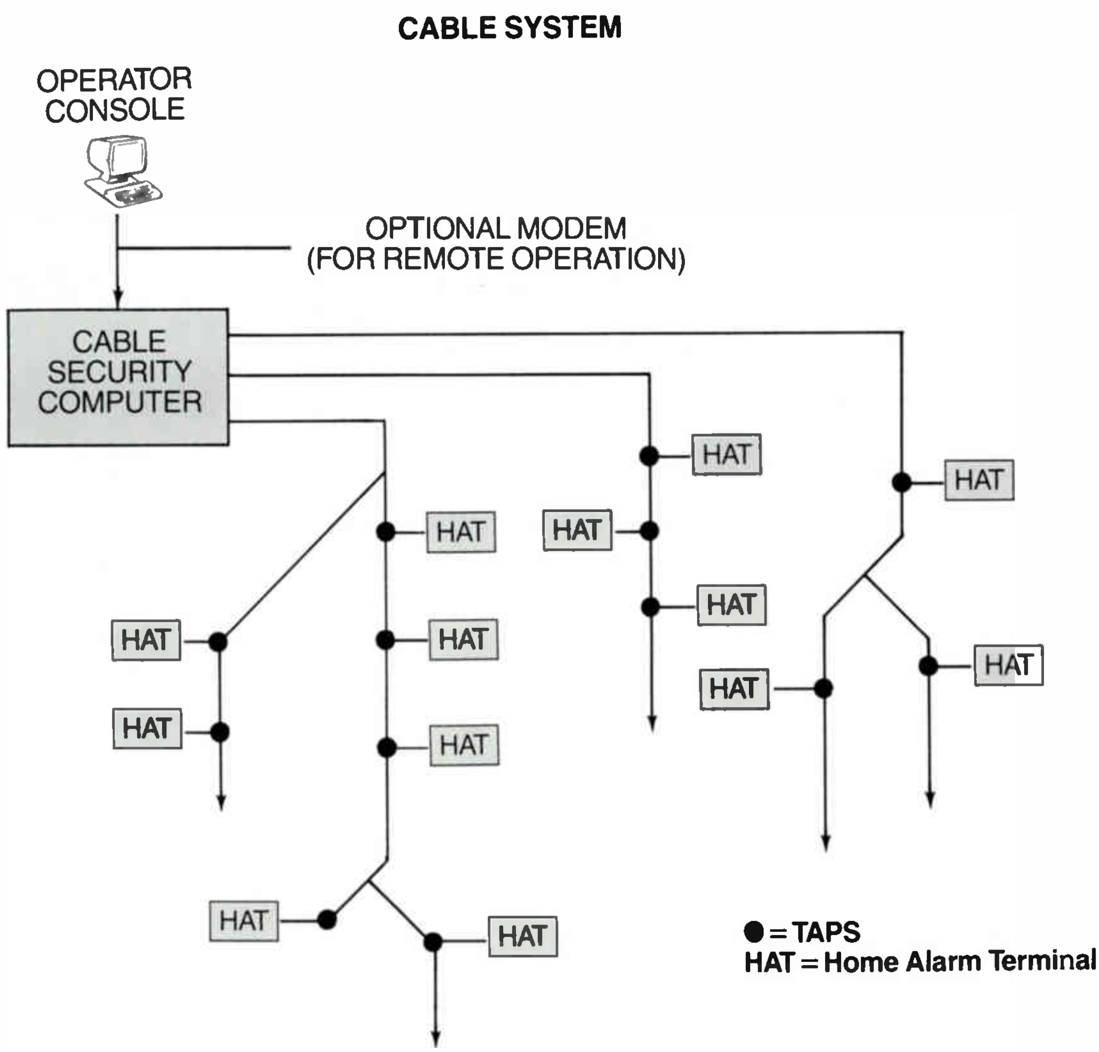
Diagram of alarm system with modular communication devices



'The installation revenue generated (by security services) will exceed $8 billion and the revenue for monitoring charges will be more than $1.4 billion per year'

Cable security update

Once viewed only as a future ancillary service, cable security today is a viable, growing industry in which operators are profiting from third party joint ventures.

By John Cummings
Product Manager, Cable Security TOCOM Division, General Instrument Corp

Cable security has been a designated term for providing traditional alarm services—intrusion protection, fire detection and panic alerts—to subscribers, with the capability for monitoring those events over coaxial cable. Since coaxial cable has the bandwidth, a signal can be transmitted both to the home or business and returned, thus providing a two-way interactive path between the central station and the protected property. This "polling" capability is the inherent advantage over other delivery services (telephone dialers and radio transmitters); the two-way cable security system becomes a supervised, polled system in constant communication with the monitoring center.

Security services monitoring via cable TV lines have been in existence for more than a decade. They began as a packaged service to the then emerging private unit development (PUD) market. (In fact, TOCOM installed the world's first operational cable security system

(Continued on page 52.)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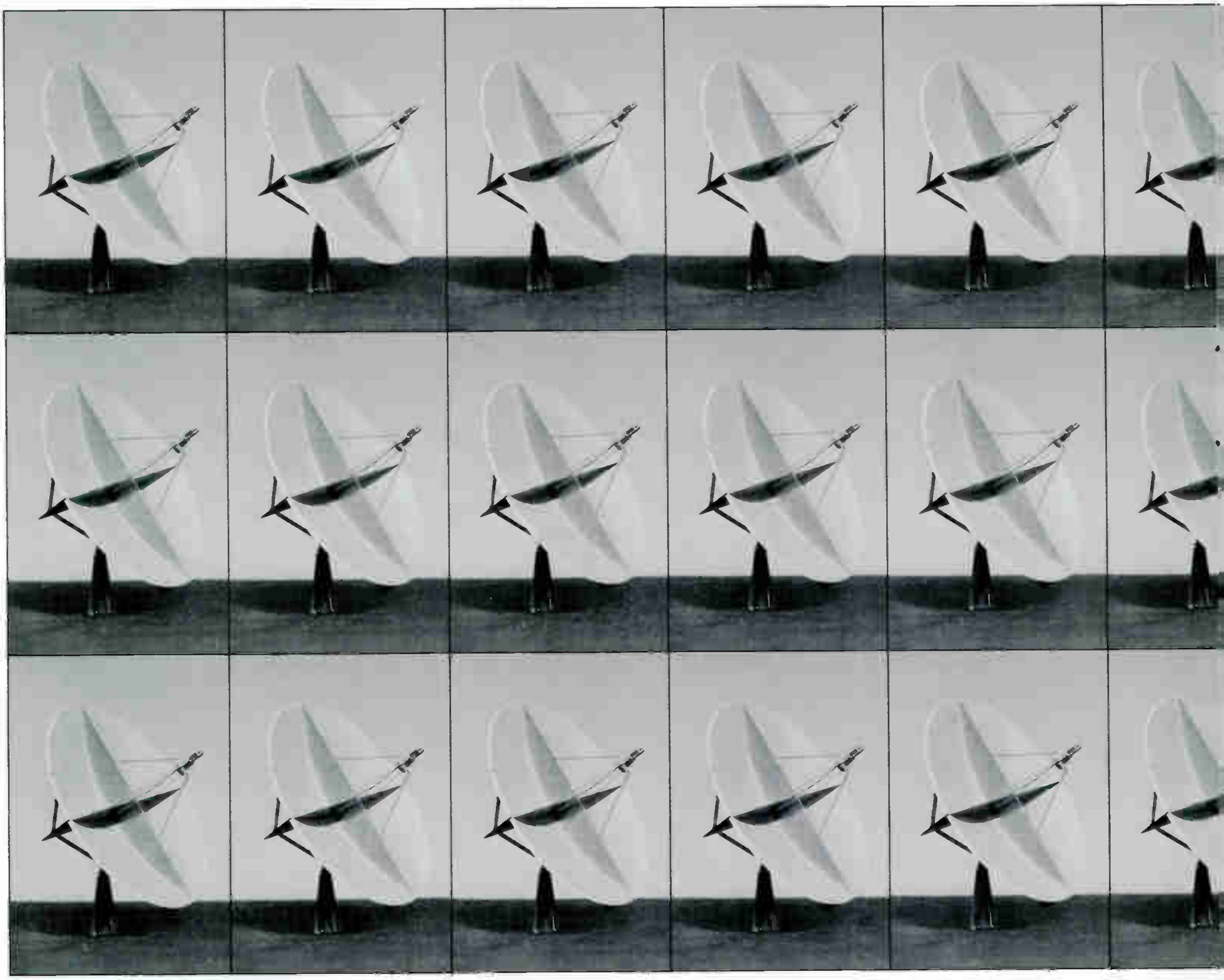

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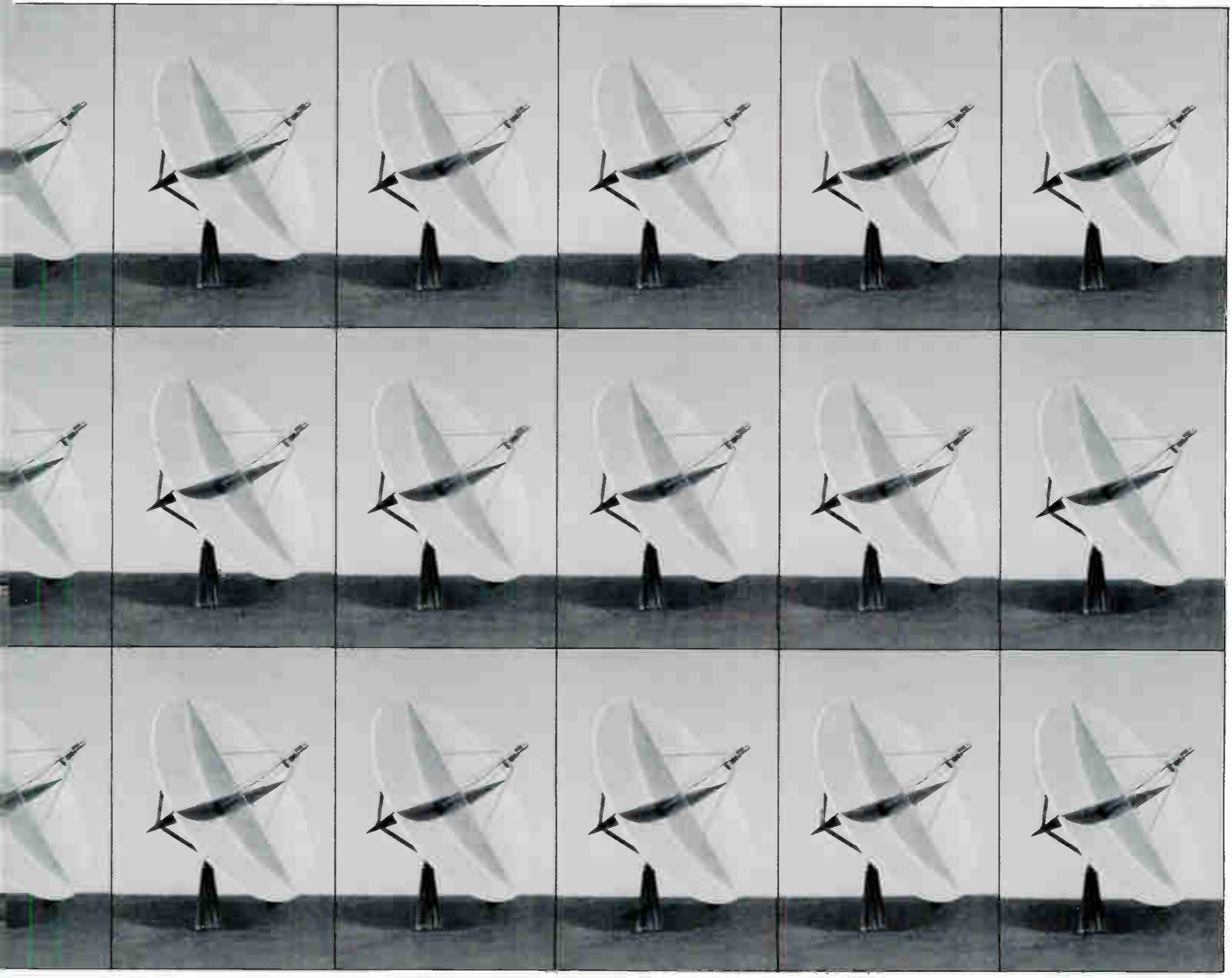

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(Continued from page 40.)

in The Woodlands, a planned unit development outside of Houston, Texas, in 1974.) Today, with the phenomenal growth in these types of communities, it is not uncommon for thousands of subscribers to be monitored over the private cable system.

Opening up the marketplace

With the success in private developments, it was apparent that cable security services could be provided to the traditional urban marketplace. Under the auspices of a joint venture agreement with Viacom Inc., TOCOM launched the first cable security operation in Dayton, Ohio, in 1978. The intention was to prove conclusively that cable security could be successfully delivered to the urban marketplace by cable operators and others.

Not only was the Dayton operation a business success in its own right, the timing for its opening could not have been better. As the franchising wars began in the late '70s, Dayton was the showcase for the eventual bidding of cable security by practically every MSO in the business. The plan was for cable security to be the first ancillary service to be provided, with a plethora of additional services to follow, such as banking and shopping from home, environmental control, video and teletext services, etc.

Numerous market forecasts then and now predicted cable security would achieve a realistic 10 percent penetration of all TV homes. Today, with 80 million TV homes in the United States, it can be easily calculated that a potential market of approximately 8 million homes exists for the next five years. This translates into sizeable revenue. With an average subscriber installation charge of $1,000 and an average monthly monitoring fee of $18, the installation revenue generated will exceed $8 billion and the revenue for monitoring charges will be more than $1.4 billion per year. With figures of this magnitude, it's interesting to note how cable security actually rolled out into the 1980s.

A joint venture proposition

The cable security industry of today can be best described as a joint venture proposition between a cable operator and a security dealer/installer. It may be that, with the eventual development of additional ancillary services, cable security will become an integral part of the cable industry. For now and the immediate future, however, franchise-promised cable security has been integrated into the traditional security industry or provided by companies such as Cableguard Inc., which caters primarily to the markets promised cable security.

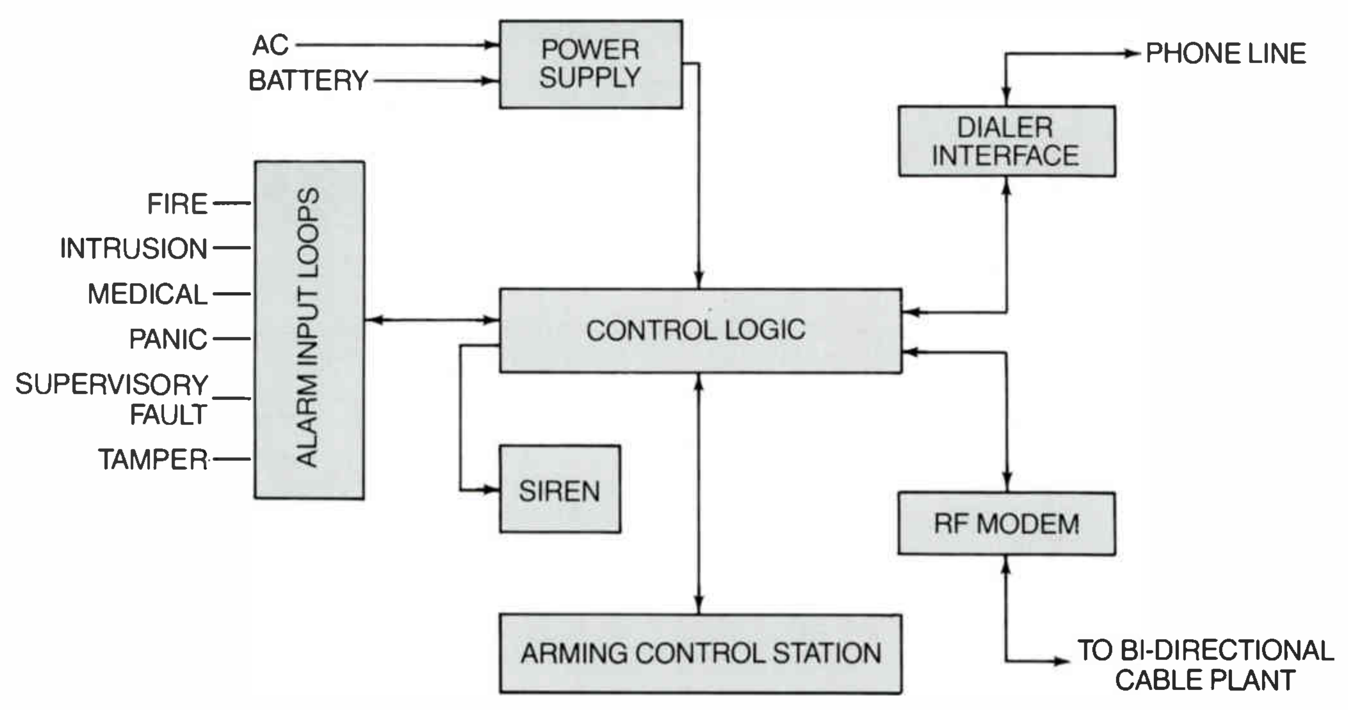
The joint venture agreement provides the best of both worlds. For the cable operator who frankly hasn't the time to learn a new industry, it provides the means of fulfilling his franchise commitment. Further, the cable operator shares in a percentage of the monthly monitoring revenue generated. In addition, the operator, having become a partner in providing life-safety services to residents, establishes credibility and achieves recognition within the community.

For the security dealer, the benefits are enormous. By affiliation with the cable operator, he also gains credibility and community recognition. His services are perceived as long term; in effect, he is viewed as "being around for the long haul." The ability to advertise and promote the security service on the cable system 24 hours a day is incalculable. Further, in most joint venture arrangements, the security provider has access to the operator's address lists in addition to bill stuffing in the cable operator's mailings.

Generally, the alarm dealer has primary responsibility for the implementation of the life-safety services under the joint venture agreement. Those responsibilities include sales, installation, and maintenance of the security services. The dealer is responsible for securing or enhancing current insurance coverage, a standard requirement in the security industry. Where state or local law requires, the dealer also may be required to have licensed personnel on his staff. However, as indicated before, most joint ventures currently are between the cable operator and an existing dealer, resulting in a simple integration into an existing business.

Partners in these joint ventures also are benefiting from current technology and equipment offerings. Since the first installation in 1974, a highly sophisticated cable security

Diagram of communication and monitoring system



technology has evolved. Today, it is possible for home alarm terminals to monitor multiple zones for intrusion, smoke and heat or panic alarms (fire, medical or assault). Distinct condition-type alarms also can be transmitted to indicate signal loss, low battery and tamper.

In any joint venture, a decision must be made regarding who will purchase the headend computers. In most cases, the alarm dealer ultimately owns the system and typically makes the purchasing decision. The emergence of new headend computer technology and the recent reductions in cost have made the decision easier. For instance, TOCOM's fourth generation system, the IV-A, is priced at approximately 80 percent lower than previous TOCOM monitoring systems.

What happens

In effect, the headend computer polls each home alarm terminal every few seconds and the home terminal replies. If an event is detected, the appropriate alarm type is indicated. A receiver at the headend picks up the data and routes it to the monitoring computer. The alarm is then displayed on a CRT terminal, along with the name and address of the subscriber and other stored demographic information. A hard copy report also is printed out. Frequently, the CRT and printer are located in the security company's monitoring center and are connected to the headend computer with data modems at each end. The telephone digital receiver also will be located at the "central station," acting as redundant backup or servicing those accounts without two-way cable.

Technological advances and full-featured, modular homeowner equipment also are benefiting the partners in today's joint venture. Many cable systems are "turned on" one section at a time, which limits the use of the return path for monitoring. Therefore, homeowner-level alarm panel systems have been designed to operate both in a cabled or non-cabled environment. The panel may communicate information over the cable system via a modem or by dialing out over the telephone line. This flexibility makes it possible to install digital communicators in subscribers' homes initially and add cable modems for monitoring capability at a later date when the system is upgraded to full two-way use. When and where two-way cable is in place, the telephone dialer option provides redundant capability.

Modularity also provides the security dealer with marketing flexibility, thus resolving the problems of a limited customer base and unqualified referrals that are inherent when marketing only within a franchise area. With modular home alarm panels, the security dealer can broaden marketing efforts to include locations and markets outside the franchise area. Only one set of equipment is required, which can be adapted for use in either cabled or non-cabled areas. This significantly reduces inventory requirements and costs, adding further to the profit potential of cable security.

A bright future

The future continues to look bright for residential security, and coaxial cable will play an ever increasing role as a communications provider. The consensus within the cable industry is that the once promised interactive services will become viable for use within the next 3-5 years. Accordingly, security monitoring over cable, coupled with other revenue sources, will justify the activation of "return-path" capability. For that matter, interactive cable communication paths may be an important alternative to telephone lines relative to what future rate structures are developed by AT&T and the divested local operating companies.

The future for cable security, albeit in a joint venture arrangement, looks very strong. The cable operator surely benefits, as does the security dealer. Accordingly, the customer is provided with an effective, reliable and increasingly important life-safety service.

John Cummings holds the position of product manager, Cable Security products for the TOCOM Division of General Instrument Corp. Cummings joined TOCOM as regional sales manager in 1981 after three years with Cableguard Inc. in Dayton, Ohio. While there he served as sales manager and vice president of operations. He most recently served TOCOM as sales manager, Cable Security products at the company's Dallas headquarters. Cummings holds a bachelor of science degree in marketing from the University of Dayton and is a member of the National Burglar and Fire Alarm Association.

Interactive cable-based security

By Pat Robison
CableBus Systems Corp

Whenever a cable system is installed, additional revenue is readily available by including in the programming package the option of offering cable-based security monitoring services, via an interactive system. Being interactive provides the opportunity for expansion of services even beyond the addition of security monitoring. Various forms of energy management can be made available and, especially in hospital and hotel/motel installations, promotion of cable enhancements such as television control and monitoring.

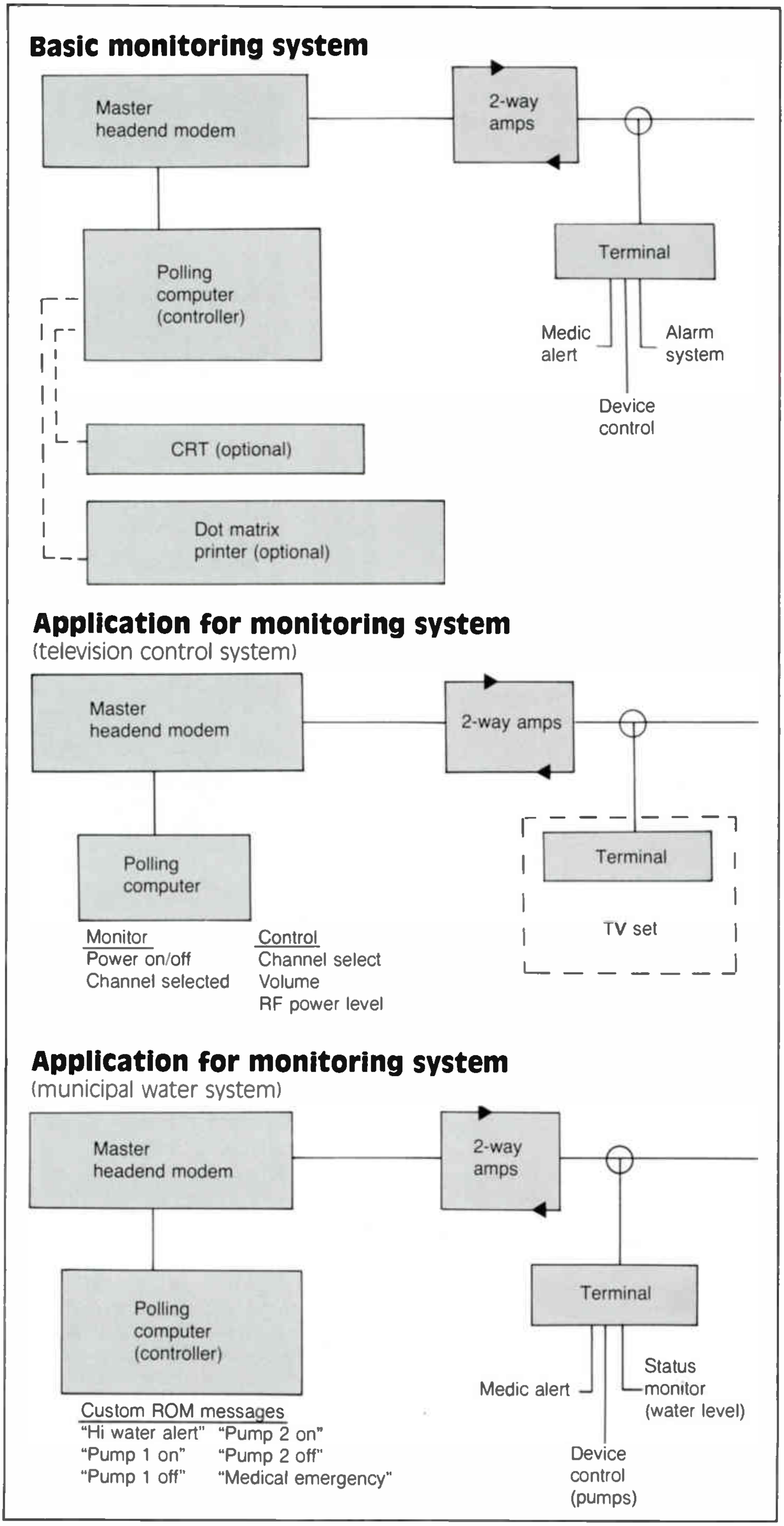
Cable-based security and status monitoring services are an additional marketing tool for system operators and can be put on an existing cable plant to enhance services already offered, utilizing the present subscriber base. In a new-build system, security and status monitoring services can be marketed in the initial sales effort and will increase overall revenue and rate of return on capital investment. As well, studies have shown once the subscriber becomes accustomed to the added services, churn is reduced.

The equipment required to make a system interactive is uncomplicated and inexpensive, assuming the cable plant has two-way capability. When the necessary amplifiers and filters are in place providing the two-way communication path, only three main components are necessary to offer interactive services. These components consist of a polling (or controller) computer, a master headend modem and a control terminal.

The polling computer

The polling computer is a sophisticated polling and display device that permits monitoring of each subscriber location on a continual basis for a status report. With CableBus equipment this polling, or interrogation, process takes approximately 90 seconds to poll the entire loop of subscribers. Approximately every 10 seconds the computer halts the sequential polling process and an "all call" procedure does a complete system check to pick up any alarm conditions further down the loop that may have occurred during the normal polling cycle. After this "all call" mode, the system reverts back to the sequential polling routine. The CableBus Micro-2 system offers a user programmable "software filter" that allows each system operator to customize the system's polling process. Users can adjust the number of times alarm or status conditions are verified, the time to wait before verifying and the time to restart the polling sequence.

Because the computer is programmed to



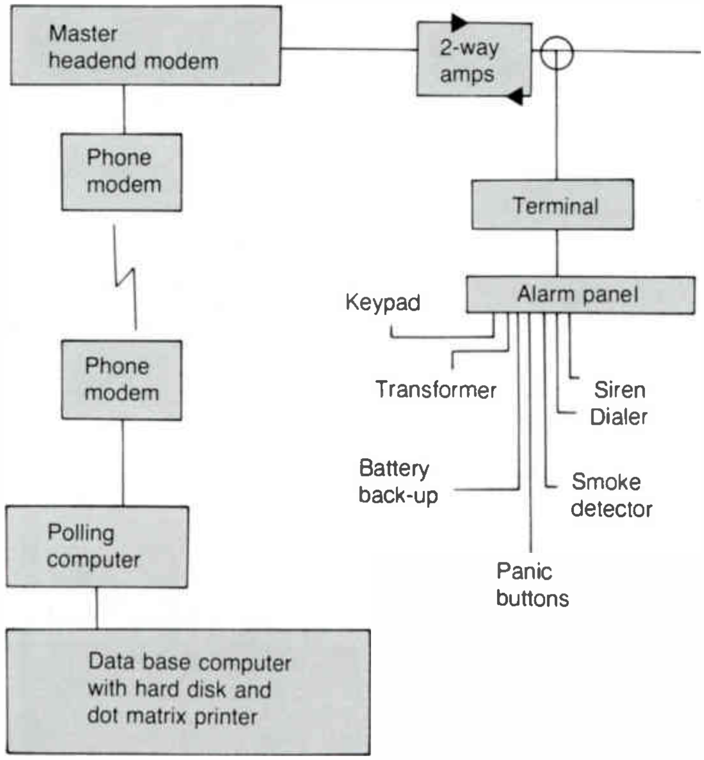
'The equipment required to make a system interactive is uncomplicated and inexpensive, assuming the cable plant has two-way capability'

expect a response from each terminal, it can report out of service units or cable system malfunctions within seconds. With this capability, the supervised alarm monitoring also becomes a form of cable system status monitoring.

The computer will provide a print log of all reported conditions. Most systems offer this print log in a basic form but options for enhancements such as CRT displays or color software packages with subscriber demographics are available.

The polling computer/controller would be located wherever 24-hour-a-day monitoring was available. Whether this be a division within the cable company, a facility on the premises of an installation such as in the case of an apartment or condominium complex where a guard station were manned continually, or using the facilities of a commercial monitoring

A cable security system
(monitored by central station)



company in a joint venture agreement would definitely depend on the amount of involvement and revenue return the cable system operator wished.

The master headend modem

The master headend modem is located at or near the cable headend, using standard "F" connectors and RG59 coax. The modem provides a serial data interface between the coaxial cable and the digital computer and terminals. The CableBus Mod-1 master headend modem is installed in the coaxial cable system via separate input and output connectors and attaches to the polling computer by way of an RS232 cable connection. Interfacing with the cable system at frequencies of 73.5 MHz and 31.4 MHz respectively, the master modem sends FSK (frequency shift keyed) modulated data and receives CW (continuous wave) modulated data. The narrowband modulation approach allows signal levels to run 10 dB below the picture carrier.

The control terminal

The control terminal contains a microprocessor that is given a unique address by setting switches within each unit. When a status report or alarm condition is reported it is this box address that signifies the exact location reporting. It has to receive RF signals, demodulate the message for computer processing and transmit a modulated message back to the polling computer, via the master headend modem.

Alarm sensing devices are wired into the control terminal and during the polling process the terminal has the intelligence to distinguish and report which alarm condition may be occurring or to report a system malfunction or outage.

CableBus offers two types of control terminals. The ACT-1 alarm control terminal has five supervised inputs, one custom input that can be used at the subscriber's discretion to check or monitor devices such as a water heater or air conditioner, and four controllable outputs. The ACT-1 reports 18 alarm-related messages.

The CDT-6/4 cable data terminal offers six independently sensed inputs and four controlled outputs. It provides additional readouts and the ability to set transmit output level remotely. The unique "watchdog" feature of the terminal automatically resets the microprocessor and all outputs in the event of power fluctuations caused by static electricity.

The cost of the control terminal is usually passed on to the subscriber in the form of an installation fee and is not a start-up cost for the system owner/operator.

Conclusion

The addition of cable-based security monitoring or various other interactive services available is a marketing benefit that can help sell an operator's cable package, offer additional income revenue and even monitor the cable system. Equipment for the services is installed easily and readily available on the market without a major investment.

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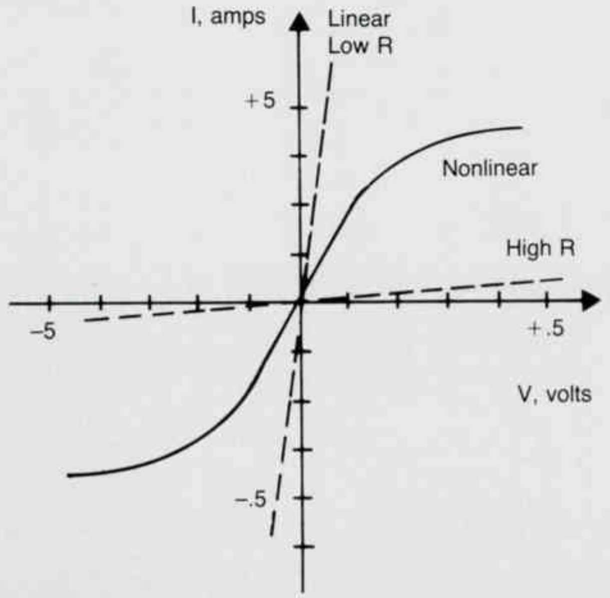
Figure 1: V-I characteristics



'The highest third order intermodulation products were generated by aluminum-aluminum and steel-steel contacts'

Solving intermod problems

Measurement of intermodulation products generated by corroded or loose connections

Metal-to-metal junctions can exhibit nonlinear characteristics as a result of corrosion or low contact pressure. The nonlinearity can be seen on a V-I (voltage-electrical current) curve tracer and has been implicated in causing intermodulation interference, especially in the 5-30 MHz band. Although the junction behavior at RF under actual operating conditions cannot be accurately predicted from the low frequency V-I curve, measurements have been made of the actual level of third order intermodulation products generated at RF by a variety of connections.

By Bradford S. Kellar
Development Engineer, Raychem Corp.

Junction nonlinearity is receiving increased attention as a possible cause of excess noise in the troublesome 5-30 MHz upstream band. Lovern and Butler[1] have presented an extensive theoretical analysis of the effect in CATV systems, while reporting only one measurement at 60 Hz, 0.5 volts AC and 0.15 amps. Other researchers[2,3] have measured the generation of third order intermodulation products at microwave frequencies with incident RF power of approximately 3 watts. This article focuses on the results of measurements made at typical cable television frequencies and power levels, with and without 60 Hz power on the junction.

A junction is linear if it obeys Ohm's Law over the range of interest ($R = V/I = \text{constant}$). A curve tracer will display this V-I characteristic as a straight line with slope $m = 1/R$ (dashed traces in Figure 1). Some junctions exhibit V-I characteristics more like the solid trace, however. The curvature is caused by electron tunnelling through thin oxide or other corrosion films separating the metal contacts[4]. This is easily seen on aluminum contacts under low contact pressure, for aluminum is known to grow a uniform insulating layer of Al_2O_3 ranging from 30 to 100 angstroms thick upon exposure to air.

Generally speaking, a junction with nonlinear V-I characteristics will cause intermodulation products (IPs) to be generated when two or more different frequencies are incident upon it. The most commonly encountered IP is the third order ($2f_1$–f_2), followed by the fifth order ($3f_1$–$2f_2$). In systems transmitting a range of frequencies, many IPs could fall in the 5-30 MHz band[1]

Measurement configuration

The actual generation of IPs was measured with the equipment set-up shown in Figure 2. Fifty Ohm RF hardware was used throughout, due to availability. The fundamental signal frequencies $f_1 = 130$ MHz and $f_2 = 280$ MHz were chosen to produce a third order IP at 20 MHz. The signal levels were controlled by step attenuators, then boosted by a pair of Amplifier Research 5 watt power amplifiers so that the level of f_1 reaching the sample could be varied from –20 dBm to +20 dBm and f_2 from –20 dBm to 0 dBm. The amplifiers were followed by multiple-section passive bandpass filters (BPFs) to remove any harmonic distortion from the signals and to prevent power from flowing between sources. The signals were then combined via a resistive "delta," resulting in a 6 dB drop, and fed to the test bed.

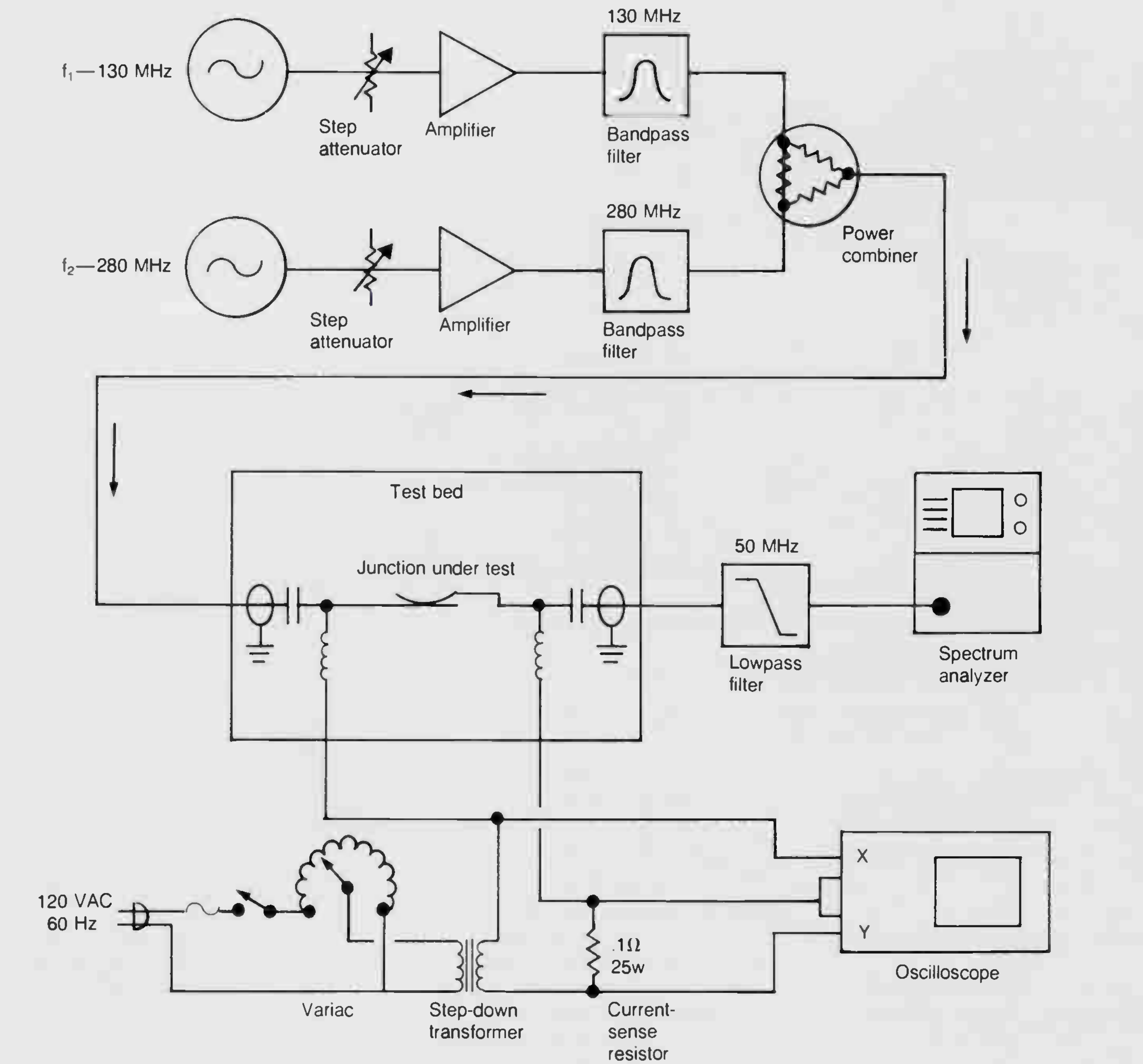
The test bed was constructed by mounting two type-N connectors and a decoupling network on a copper-clad ground plane. The samples under test were secured at the ends to plexiglass support blocks, and when possible, soldered into place.

The output signal from the test bed was then fed through a 50 MHz four-section low-pass filter (LPF) to block the high amplitude fundamental signals. If these are not blocked, the overloaded front end of the spectrum analyzer can generate its own third order IPs, indistinguishable from the ones generated by the junction under test.

The curve-tracer section of the set-up consisted of a variac (variable transformer), step-down transformer, current-sense resistor and an oscilloscope in x-y mode. The x-deflection displayed the voltage drop across the sample, while the y-deflection in volts times 10 equalled the current in amps.

Verification of the set-up was accomplished by soldering a wire across the test bed in place of the sample under test and measuring the fundamental signal levels transmitted to the spectrum analyzer with the LPF removed ($f_1 = -20$ to $+20$ dBm, $f_2 = -20$ to 0 dBm). Replacing the LPF, residual third order IPs

Figure 2: Test equipment configuration



were searched for. None were found down to the noise floor of −80 dBm. This performance is adequate for the testing described in this article.

Measurements

Experimental Al-Al junction: The first junction that was tested was comprised of two pieces of aluminum outer conductor that were cut from cable that had been in the field for several years. The surface appearance was gray-white with almost no metallic luster. The samples were simply rested against each other, under no external mechanical load. With no RF signal applied it was observed that the junction's V-I characteristic varied significantly as a function of the applied voltage. For V = 0.1 volt peak-to-peak (p-p), the V-I characteristic looked very linear with a resistance of approximately 1 ohm. As V was increased to 0.3 volts p-p, the V-I characteristic assumed the "S" shape of Figure 1. When V approached 1 volt p-p, the junction produced an audible crackling noise, and the V-I characteristic became linear with a resistance of 50 milli-ohms. As the voltage was reduced, the junction remained linear with the same moderately low resistance. Because the junction was under no mechanical load, it was very sensitive to vibration and tapping, which showed up as broken, noisy traces on the oscilloscope. Tapping disturbed the low-resistance connection, essentially returning the junction to its original state. The observations are summarized in Table 1.

With the curve tracer turned off, RF signals were applied to the junction and the third order IP level was recorded. The results are presented in Table 2. Again, vibration and tapping were very evident on this loose connection, with levels jumping 10 to 30 dB and broadband noise appearing during vibration.

One very important result is noticeable. Even for this very poor junction, it takes relatively high signal levels (from a CATV standpoint) to generate appreciable third order IPs. This supports the curve tracer observation that for low voltages, the junction is linear.

The next experiment with the Al-Al junction was to observe simultaneously the low frequency V-I curve and the third order IPs. For low curve tracer voltage (0.1 volt), the RF performance of the junction was identical to the results in Table 2. As the voltage was increased to 0.3 volts, the spectrum analyzer displayed high though intermittent levels of broadband noise and the third order IP signal fluctuated wildly. With 1 volt applied, the IP signal disappeared completely, though some broadband noise from the poor connection was still visible.

The explanation for the observed change in junction characteristics with applied voltage lies in a phenomena called "fritting"[4]. This is basically a breakdown of the thin Al_2O_3 film due to extremely high local electric field intensities. If a 100 angstrom Al_2O_3 film has 1 volt potential applied to it, the electric field intensity is 10^8 volts/meter, enough to cause break down. Continued current flow tends to widen the conduction path, reducing the junction's overall resistance. (Reference 4 contains extensive details of fritting.)

The final experiment with the Al-Al junction was to intentionally frit the junction. The curve tracer voltage was set to 5 volts, but disconnected from the circuit. High levels of RF were applied to the junction, and the third order IP observed. Immediately upon applying the 5 volt power, the third order IP disappeared entirely. No amount of vibration made it reappear, as the junction had been fritted. Removing the 5 volt power, no third order IP was visible until tapping once again disturbed the junction.

Tap box set screw-center conductor connection: Most tap boxes contain an aluminum contact block with a plated steel set screw to establish contact with the center conductor. One of these assemblies was removed from a tap box and mounted in the test bed to evaluate the effect of low contact pressure. The center conductor used in this experiment was new copper-clad aluminum from a polyethylene foam (PE) type cable. It had been scraped with a knife, though a very thin layer of PE still adhered to it. This is the way craftsmen often prepare the cable.

It was much more difficult to obtain the "S" shaped curve with this sample. With the set screw completely loose, the curve tracer indicated an open circuit for V = 0 to 15 volts AC. It appears that tunneling does not occur through the residual PE. Tightening the screw very gently by hand, just until contact was established, produced an immediate jump of the V-I curve to a linear low resistance state, regardless of applied voltage. The "S" shaped curve could only be produced by gently tapping the assembly with approximately 0.3 volts applied until the assembly loosened. Then the curve was unstable, tending to jump to either the short- or open-circuit condition.

The RF characteristics with no AC power applied also were better than with the Al-Al sample (see Table 3). The maximum $2f_1$-f_2 levels observed during tapping were more short-lived and noisy than those reported in Table 2, and it was generally more difficult to produce a stable third order IP.

The behavior of this junction under simultaneous RF and 60 Hz power was similar to that reported for the Al-Al junction. Again, fritting occurred with approximately 1 volt applied to the junction, completely preventing third order IP generation. Interestingly, when the curve tracer indicated an open-circuit condition, the level of fundamental signals f_1 and f_2 had only dropped by about 10 dB. Apparently there was a substantial parasitic RF coupling across the otherwise open junction.

The copper-clad center conductor used for this series of tests was replaced by a tin-plated brass pin cut from a pin-type connector. The curve tracer generally indicated either an open-circuit or a short-circuit condition with the set screw loose—no stable "S" shaped curve was observed. An intermittent "S" shaped curve could be seen during tapping on a very loose connection. It is reasonable to assume very low third order IP generation from this configuration. Regardless of the center conductor material, tightening the set screw with a screwdriver prevented any third order IP generation.

Pin-type connector center conductor seizure: Pin-type connectors rely on some internal arrangement to press the fingers of a "pin-basket" down on the cable's center conductor to grip it and establish contact. A tin-plated brass pin basket was removed from a connector and mounted on the test bed to simulate the worst-case condition of no externally applied contact pressure. A new copper-clad Al center conductor (with some residual PE) completed the circuit.

The curve tracer indicated either an open-circuit or short-circuit condition, with no stable "S" shaped curve. This is not surprising, since clean tin and copper are excellent contact materials, and PE, when present, is a good insulator. Under RF power, this junction generated no third order IPs.

A severely tarnished section of copper-clad Al center conductor was recovered from a styrene-foam cable that had been in the field for many years. The foam was not bonded to the center conductor so consequently water had tracked down the cable. The tarnish was black and shiny, and was determined to be copper oxide.

A junction consisting of this tarnished copper conductor and the loose tin-plated brass pin basket was mounted on the test bed. The curve tracer showed the junction to be initially non-conductive, but after some wiggling, a stable "S" shaped V-I characteristic was observed (V = 0.3 volts). The nonlinear characteristic was very similar to that seen with the Al-Al junction, pictured as the solid trace in Figure 1. Again, increasing the voltage across the junction to 1 volt broke down the oxide layer, resulting in a linear, low resistance connection. The third order IP levels from this junction before fritting are listed in Table 4. No IPs were found after fritting.

Aluminum outer conductor-to-connector junction: Raychem, Gilbert, and LRC ½-inch pin-type connectors were installed to connect aluminum coaxial cable to taps in accordance with manufacturer's instructions. No connection demonstrated visible nonlinearity on the curve tracer when new. The samples were then corroded by two month's submersion in a salt bath with daily airing. The samples built up a thick layer of salt, and the aluminum cable developed lines of small holes shot through to the PE. When reconnected to the curve tracer, again no sample showed nonlinearity, and the junction resistances were low. It appears that the original connections remained intact, perhaps protected by a surrounding Al_2O_3 film.

Discussion of results

The results reported here agree with the conclusions by Bayrak and Benson[2], who reported that the highest third order IPs were generated by Al-Al and steel-steel contacts, the lowest by copper and brass contacts, with intermediate levels produced by aluminum-copper contacts. They also reported that the

Table 1: V-I characteristics of Al-Al junction under no mechanical load

Step	Applied voltage (p-p, 60 Hz)	V-I curve shape	Resistance
1	0.1 V	Linear	1 ohm
2	Increased to 0.3 V	"S" shaped	Nonlinear
3	Increased to 1 V	Linear	.05 ohm
4	Decreased to 0.3 V	Linear	.05 ohm
5	Decreased to 0.1 V	Linear	.05 ohm
6	0.1 V, junction tapped	Linear	1 ohm

Table 2: Third order intermodulation product generation (Al-Al junction under no mechanical load)

f_2 level, dBm	f_1 level, dBm (3): −20	−10	0	+10	+20
0	<−80 (1) <−80 (2)	−50 <−80	−25 −55	−20 −40	−25 −50
−10	−60 <−80	−60 <−80	−50 <−80	−40 −60	−30 −60
−20	<−80 <−80	−60 <−80	−40 <−80	−30 −70	−30 −60

Notes: 1) Maximum level of $2f_1-f_2$ in dBm observed during tapping. Always intermittent and accompanied by broadband static.
2) Maximum level of $2f_1-f_2$ in dBm observed with junction at rest. The actual level from junction at rest varied from this level to <−80 dBm in depending on tapping.
3) To convert the level in dBm in a 50 ohm system to dBmV, add 47.

Table 3: Third order intermodulation product generation (loose tap box set screw/C.C. connection)

f_2 level, dBm	f_1 level, dBm (3): −20	−10	0	+10	+20
0	<−80 (1) <−80 (2)	−65 −80	−40 −60	−30 −40	−40 −40
−10	<−80 <−80	<−80 <−80	−60 <−80	−50 −60	−60 −60
−20	<−80 <−80	<−80 <−80	−60 −80	−50 −60	−80 <−80

Notes: See Table 2

Table 4: Third order intermodulation product generation (tarnished copper-tinned brass junction)

f_2 level, dBm	f_1 level, dBm (3): −20	−10	0	+10	+20
0	<−80 (1) <−80 (2)	−80 <−80	−60 −70	−50 −60	−45 −60
−10	<−80 <−80	<−80 <−80	−65 <−80	−55 −70	−65 −70
−20	<−80 <−80	<−80 <−80	−75 <−80	−60 −70	<−80 <−80

Notes: See Table 2

highest level IPs were produced by junctions under minimum mechanical load, with the IP level falling rapidly as load is applied. Finally, they confirmed that a thin insulating film of plastic (in their work, Teflon) prevented IP generation.

The observation of film breakdown by fritting is strongly supported in reference 4. Anyone interested in further study of electrical contacts should locate this book. Especially relevant is the description of "applied fritting" from the telephone world, where an EMF of 48 to 60 volts with equivalent source resistance of 100,000 ohms is maintained on relay circuits to frit the contacts for reliable connections.

The level of the third order IP generation reported here is low in all but worst cases. A connection really has to be pretty poor to generate third order IPs, and poor connections generate a host of other problems: static, varying signal levels, voltage drops, intermittence, RFI, etc. No connection studied here generated solid third order IPs without showing some of the other symptoms of poor connections.

Summary

1) Intermodulation products can be generated by corroded, tarnished, or loose connections under low contact pressure.

2) Signal levels must be high to generate significant IPs. For signals at −20 dBm (50 ohm system), third order IPs were below −80 dBm for all connections. Signals at −10 dBm produced third order IPs below −80 dBm in all but the worst case of Al-Al under zero load; here they reached −60 dBm intermittently. Signals at 0 dBm (+47 dBmV) produced third order IPs of −55 dBm to −70 dBm in loose connections.

3) Junctions with more than 1 volt of 60 Hz power applied generated no IPs due to contact fritting.

4) When observed, the IPs were always jumpy and accompanied by broadband static from the loose connection.

5) Any reasonable amount of contact pressure prevented IP generation.

6) Based on these observations, it is unlikely that problems in the 5-30 MHz upstream band are due to IP generation at loose connections. A more likely explanation is RF ingress, as described in reference 5.

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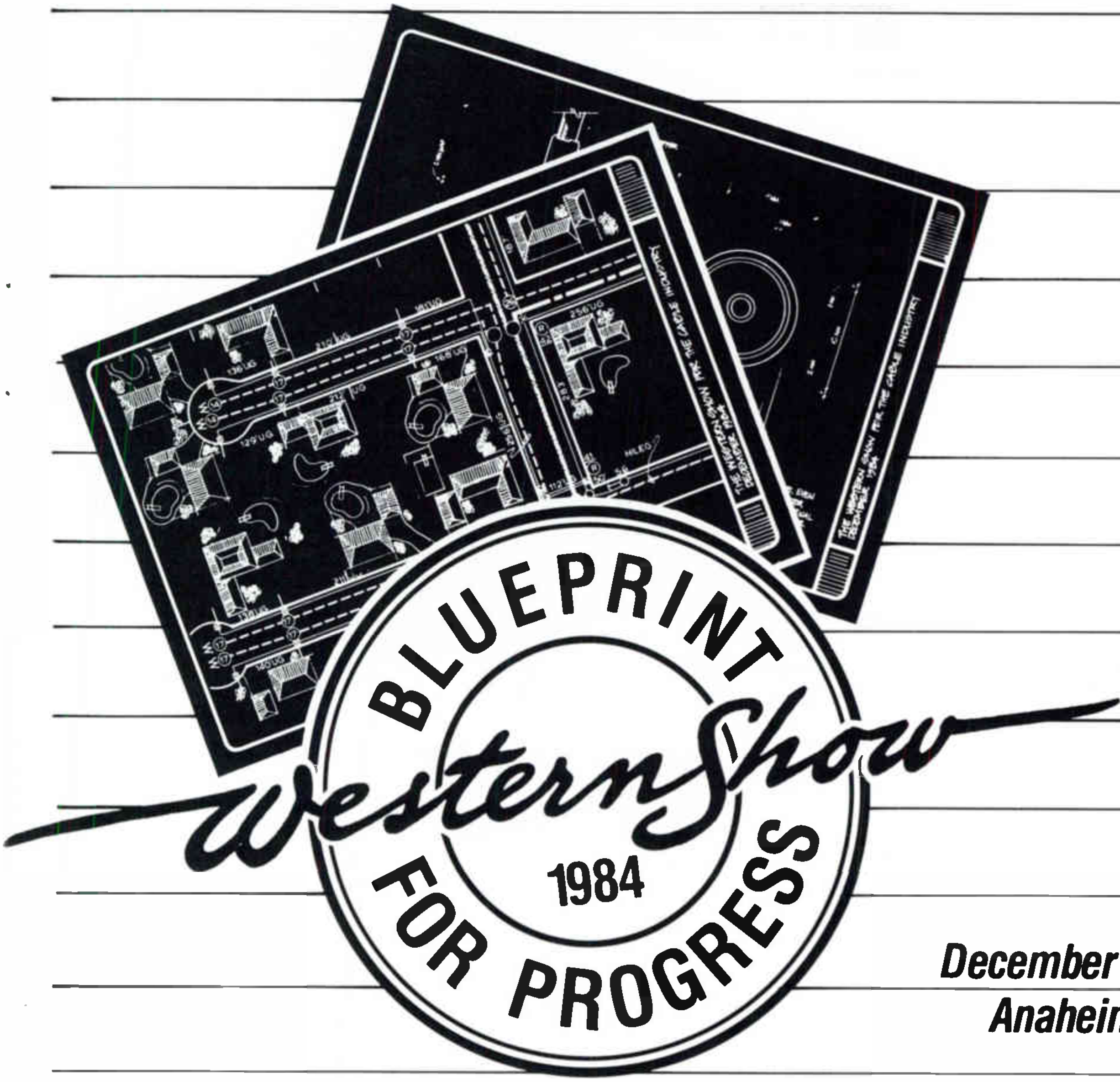

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Reducing the effects of reflection in CATV feeders

This is Chapter IX of the "Technical Handbook for CATV Systems." Each month another installment of this excellent technical tool will be presented.

By Ken Simons
Consultant to Wavetek CATV Division

The pressure type tap is a convenient and economical way of connecting the customer house drop cable to the feeder cable in a CATV system. Because of this convenience the large majority of taps in use today are of this type. Hundreds of thousands of them are providing satisfactory service in systems all over the country. Unfortunately there is a penalty attached to the pressure tap's convenience. Because it must tap into the feeder cable with no opportunity for series compensation, the pressure tap inevitably introduces reflections into that cable. This chapter shows how these reflections can be minimized by careful tap design, and how their adverse effect on the transmission of picture signals can be greatly reduced by grouping taps in optimum arrangements.

Improvements in pressure tap design

Until recently, Jerrold has manufactured four basic types of pressure taps. The earliest designs, Models PTR and PTC, employed a series resistor or a series capacitor connecting the pressure point to the center conductor of the drop line, as illustrated in Figure 75. The resistor tap (PTR) was used for line-to-tap losses of 30 dB and over, the capacitive tap for lower loss magnitudes. This design had the advantages of simplicity and low cost. While the capacitive tap had high efficiency (i.e., the loss on the feeder line, for a given line-to-tap loss, was low compared to that of other designs) it introduced reflections on the feeder that were much worse than those introduced by transformer taps having the same line-to-tap loss.

Figure 76 shows the schematic diagram of a transformer tap. A tightly coupled auto-transformer steps up the impedance of the load to a high, and essentially resistive, impedance bridging the feeder line. A coupling capacitor isolates the primary at low frequencies and a series resistor raises the output impedance so the tap acts as a well-matched source for the drop line. Jerrold manufactures two kinds of transformer

Table M: Reflection introduced into a feeder by one tap at the worst frequency (216 MHz)

Loss from line to tap at 216 MHz	Resistive and capacitive taps		Transformer taps			
35 dB	PTR (6)	26.0 dB	CMT (35)	22.0 dB	BMT (25)	26.0 dB
30 dB	PTR (3)	25.5 dB	CMT (30)	21.0 dB	BMT (20)	28.0 dB
25 dB	—		CMT (25)	22.0 dB	BMT (16)	29.0 dB
20 dB	PTC (W)	19.5 dB	CMT (20)	21.6 dB	BMT (12)	26.7 dB
16 dB	PTC (R)	16.4 dB	CMT (16)	21.4 dB	BMT (35)	25.4 dB
12 dB	PTC (Y)	14.2 dB	CMT (12)	19.5 dB	BMT (36)	21.1 dB

Note: Reflection figures on this table were obtained by measurement of production units selected at random. Published specifications show somewhat greater reflection in each case.


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taps which are similar electrically but differ mechanically. The CMT tap is convenient as a replacement for the older taps. It is mechanically interchangeable with the PTR and PTC. However, the ⅜-inch hole into which this unit threads is too small for optimum electrical performance. The BMT transformer tap uses a ½-inch hole; this increased clearance allows a reduction in stray capacitance with a considerable improvement in high-frequency performance.

Table M compares the reflections introduced into an otherwise reflectionless 75-ohm line by single taps of each type. Notice the substantial reduction in reflection accomplished by the use of transformer taps at low tap losses. At a 16 dB tap loss, for example, the reflection from the CMT is nearly 6 dB less than that from the PTC, and that from the BMT is nearly 10 dB less. For tap losses above 30 dB, where resistive taps were used, the transformer taps do not show the same improvement, but still have the important advantage of providing a back-matched source.

Periodicity

To understand reflections on CATV feeders it is essential to understand "periodicity," the accumulation of reflections from equally spaced discontinuities. A number of simple examples may help to explain the effect. Figure 77 illustrates conditions existing on a lossless 75-ohm transmission line perfectly terminated with a 75-ohm resistor. There is no reflection at any frequency (b), so the input impedance is constant at 75 ohms (c), and the application of a pulse to the input creates no echo (d).

Now consider what happens when a 3,700-ohm resistor is bridged across the line at a distance from the input equal to one-half wavelength at 25 MHz (Figure 78a). This discontinuity across a 75-ohm line produces a constant 1 percent reflection of all frequencies (b); this results in a VSWR of 1.02 and as a result the input impedance varies from a minimum of 73.5 ohms (75 ÷ 1.02) when the reflected voltage wave arrives at the input 180 degrees out of phase with the input, to a maximum of 76.5 ohms (75 x 1.02) when the two waves arrive in phase (c). The application of a pulse to the input results in a single echo following the input pulse by a time corresponding to the round trip delay from the input to the discontinuity and back (d). Next, two equal discontinuities spaced at equal distances are bridged across the line (Figure 79a). At zero frequency, and at even multiples of the frequency at which the spacing is one-half wavelength, the two reflected waves arrive at the input in phase, so they add to produce a net reflection twice that of either wave (b). At frequencies where the spacing is an odd multiple of one-quarter wavelength the two reflected waves arrive at the input 180 degrees out of phase and cancel, so there is no net reflection at those frequencies. The input impedance varies as shown in (c), reaching a minimum of 72 ohms at the frequencies of peak reflection, and touching 75 ohms at the odd quarter-wavelength frequencies where there is no reflection. Following the input pulse there are two echoes (d).

Four discontinuities, Figure 80(a), produce complicated variations in reflection (b) and impedance (c). Certain general tendencies become clear. With many equally spaced discontinuities the reflections add to produce relatively narrow peaks of reflection centered at frequencies that are multiples of the one where the spacing is one-half wavelength. Between peaks there are relatively broad ranges where the total reflection is low. This becomes even more pronounced with eight discontinuities (Figure 81). This pattern with widely spaced narrow peaks of reflection is characteristic of "periodicity," showing up whenever there are many equally spaced sources of reflection. Figure 82 summarizes the dependence of the reflection pattern on the number of taps.

Periodicity in cable

This effect shows up as a problem in the manufacture of cable for CATV. When the manufacturing process results in small variations in cable dimension which are repeated at equal intervals, the resulting small reflections can add to produce severe effects at certain frequencies. Great care is required in the production of such cable to avoid the problem. Figure 83 illustrates the reflection characteristics of three reels of cable selected to point out the problem. Figure 83 (a) shows a very carefully selected reel exhibiting a minimum of the problem by having a return loss greater than 40 dB (less than 1 percent reflection) across both TV bands. Figure 83 (b) is typical of a majority of the cables being used, with a few peaks reaching 30 dB (3 percent). Figure 83 (c) shows a most unusual case. This reel showed less than 26 dB (5 percent) reflection at all frequencies except at 195 MHz, where there was an 8 dB (45 percent) peak! Note the similarity between the shape of these reflection peaks and those shown in the preceding "synthesized" samples.

Figure 75

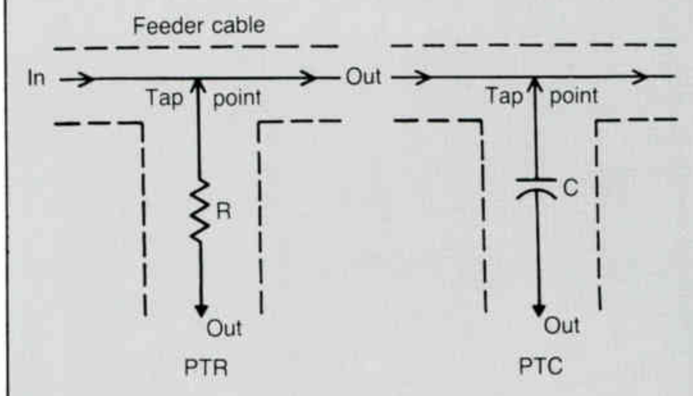


Figure 76

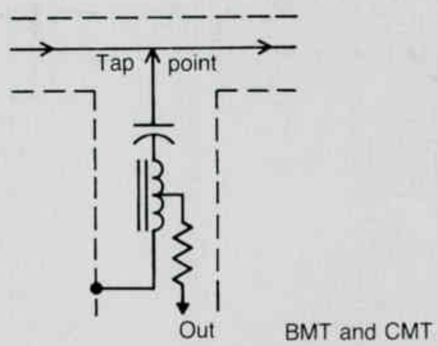
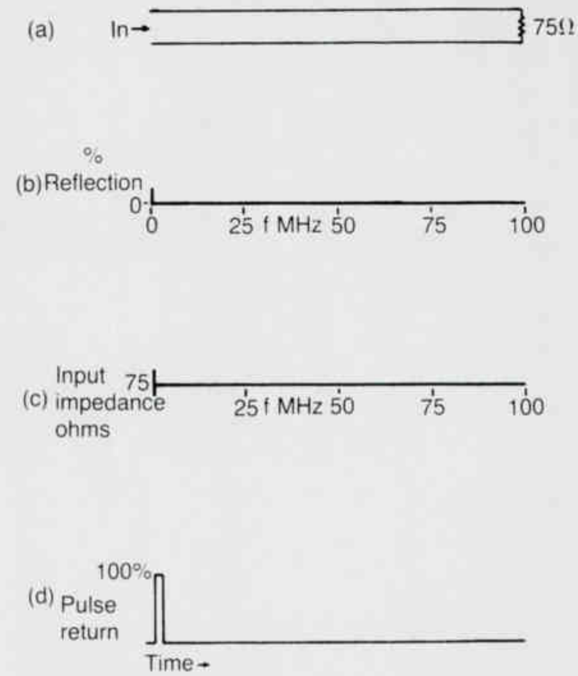


Figure 77: Uniform lossless line, terminated in its characteristic impedance, no discontinuity



Periodicity problems with pressure taps

If care is not exercised, periodicity can cause problems when pressure taps are installed on a feeder. With telephone poles spaced at regular intervals along the street there is a tendency to space taps at regular intervals along the feeder cable. This can cause severe trouble. Figure 84 shows the measured build-up of reflections with various numbers of BMT taps spaced exactly 50 feet apart on a feeder of one-half inch foam-insulated cable.

The effects of cable attenuation can be seen by comparing Figure 84 with Figures 77 to 81, inclusive. This cable had an average attenuation of about 1.3 dB between 174 and 216 MHz. As a result the reflections from the more distant taps are reduced in amplitude, so the shape of the patterns and their peak amplitude is reduced as compared with what would happen if there were no attenuation. Table N compares the measured peak reflections with those that would occur with no cable attenuation.

Table N

	With no attenuation		Measured	
Number of taps	Return loss	Percent reflection	Return loss	Percent reflection
1	28 dB	4%	28 dB	4%
2	22.4 dB	7.7%	23 dB	7%
4	17.5 dB	13.3%	18 dB	13%
16	8.3 dB	38.1%	13 dB	22%

With these severe reflection spikes spaced every 8 MHz across the high-band, transmission of the TV signal through the tap to the customer's receiver is distorted. Figure 85 shows the frequency response through the first and eighth taps, with response variations of more than 2 dB across a single channel. This condition may well lead to ringing and smearing in the reproduced picture.

The problem is reduced somewhat when taps are installed at irregular intervals so that there is no repetitive pattern. Figure 86 shows the reflections and responses that resulted when the same 16 taps were installed on the same feeder but spaced completely at random. The reflection pattern is no longer regular and shows reduced amplitude. Transmission variations are improved to a little more than 1 dB in the worst case. This still represents a situation somewhat short of one that would guarantee excellent picture transmission.

The importance of optimizing the design of the individual tap for minimum reflection is illustrated by Figure 87. This shows a situation identical with Figure 86, except that the poorer transformer taps (CMT) were substituted for the better ones (BMT). This increases the peak reflection from 16 dB (16 percent) to 11 dB (28 percent), and increases the variation from a little over 1 dB to more than 3 dB.

Figure 78: Uniform lossless line, terminated, one discontinuity

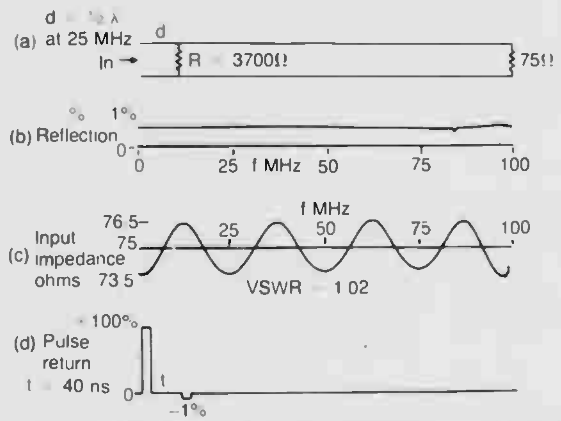


Figure 79: Uniform lossless line, terminated, two discontinuities

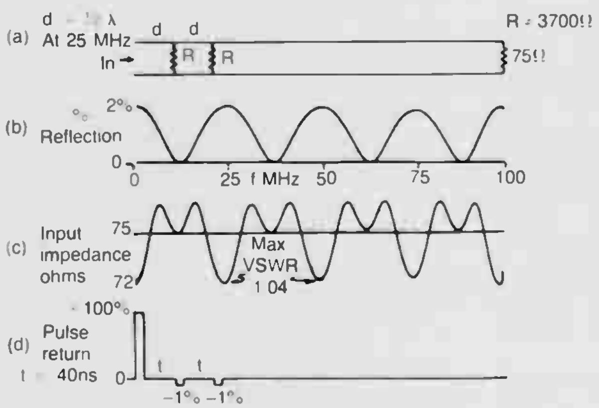


Figure 80: Uniform line, terminated, two equally spaced discontinuities; 4 equally spaced discontinuities

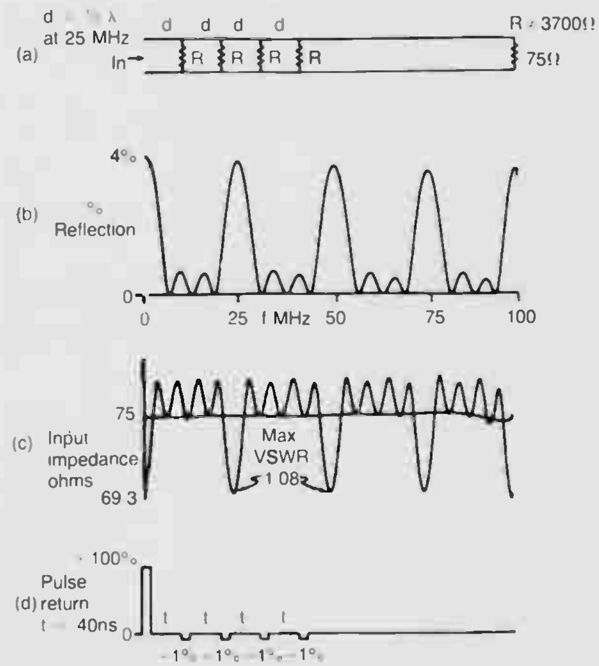
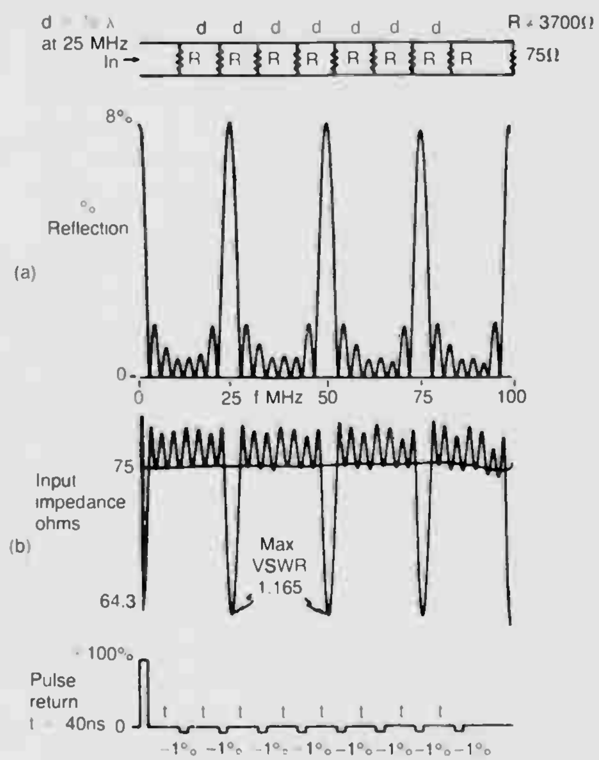


Figure 81: Uniform terminated line, eight equally spaced discontinuities



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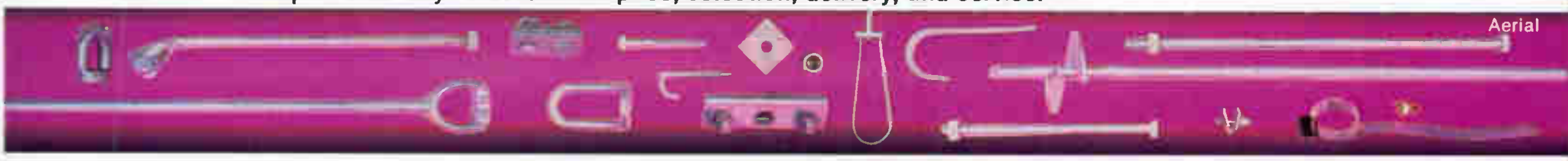

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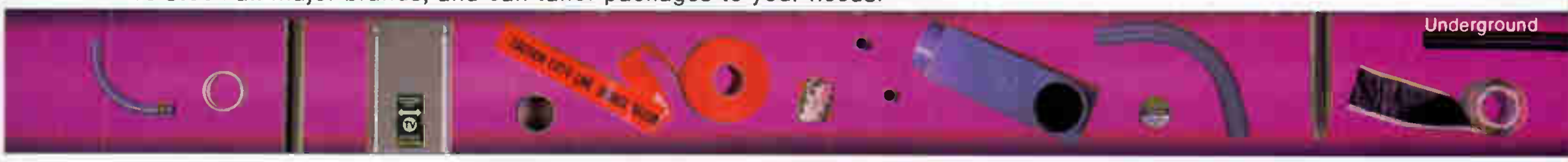

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Figure 82: Increase in reflection with one to eight equally spaced discontinuities

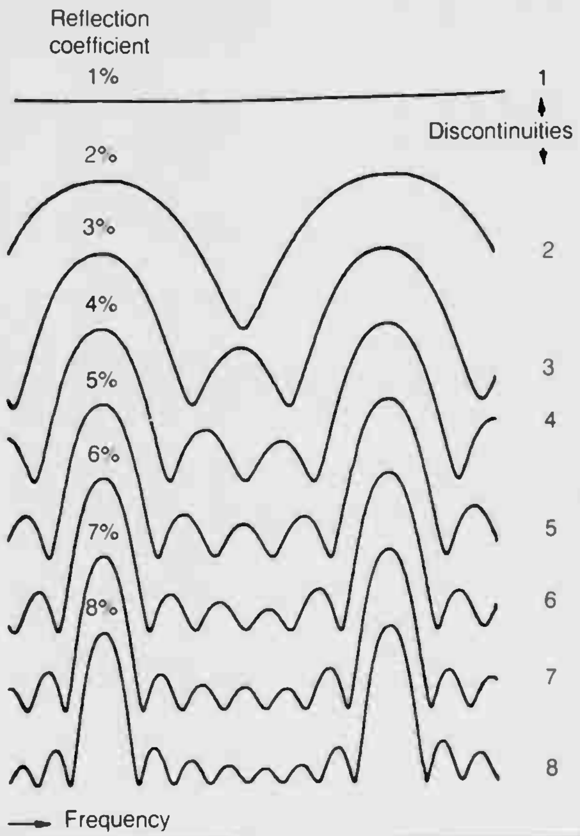


Figure 83: Reflection vs. frequency—three reels of CATV cable showing effects of periodicity

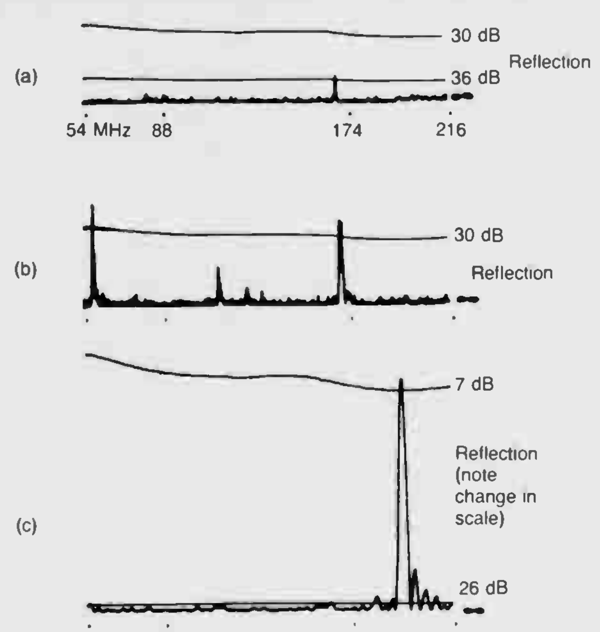
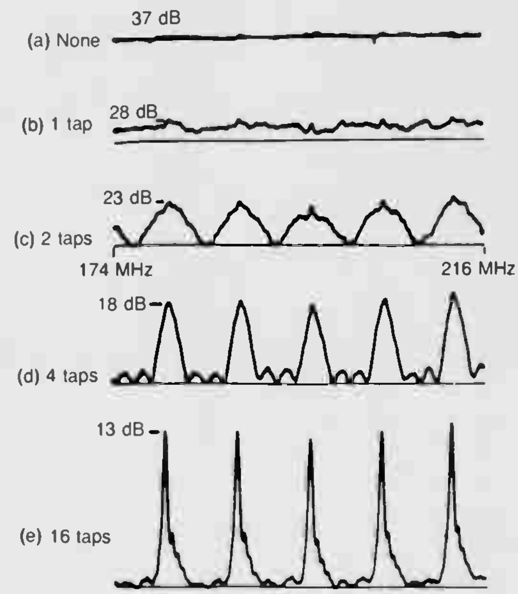


Figure 84: Addition of reflections, pressure taps spaced at 50-foot intervals along ½-inch foam cable



Using periodicity to minimize reflections

The patterns obtained with simplified reflection conditions (Figure 81, for example) show narrow peaks with relatively broad areas between where the reflections were low. This effect can be used to reduce reflections in the TV bands by installing taps in periodic arrays with peaks outside of these bands. If the spacing between taps is made 36 inches (for foam-insulated cable) the reflection spike will be at 135 MHz, where this spacing is one-half wavelength and where the reflection does no harm. At 67 and at 201 MHz, where the spacing is one-quarter and three-quarters of a wavelength respectively, the reflections from successive taps will cancel, causing a minimum effect for the TV channels between 54 and 88 and between 174 and 216 MHz.

Figure 88 illustrates this. Figure 88 (a) shows a plot of reflection vs. frequency for a single transformer tap (BMT25). It reaches a maximum of close to 28 dB (over 4 percent) at 216 MHz. When two of these taps are attached to the line 36 inches apart, their reflections cancel at the center of the low band and the center of the high band, as illustrated in Figure 88 (b). The net effect is that the two taps cause somewhat less reflection than one! An even more dramatic effect is obtained when three taps, Figure 88 (c), and four taps, Figure 88 (d), are connected. Whereas four of these taps could cause as low as 16 dB return loss (16 percent reflection) if they were installed so that their reflections would add in phase, by scientific grouping they can be made to give less reflection within the TV bands than one tap alone.

When four taps are to be installed at a given location, a fairly common situation in a CATV system, several arrangements are possible. Figure 89 shows the reflection plots for some of them. The arrangement shown in Figure 89 (a) probably is the most physically convenient, in that the installer has to reach out only 18 inches to either side of the pole. The electrical performance, however, is poor, showing excessive reflection on channels 6, 7 and 13. Either of the other arrangements shown is good; the one shown in Figure 89 (c) with taps close together at the center, and the other two spaced 36 inches on either side, seems to be

Figure 85: 16 BMT taps on ½-inch feeder, 800 feet long, 50-foot spacing, high-band performance

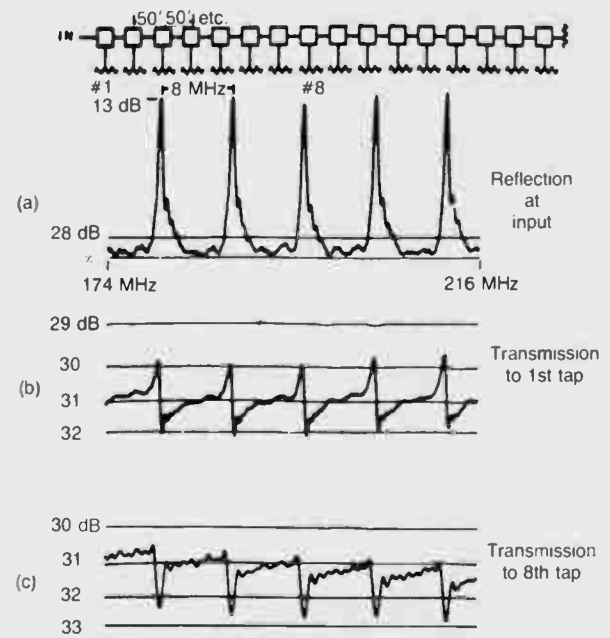
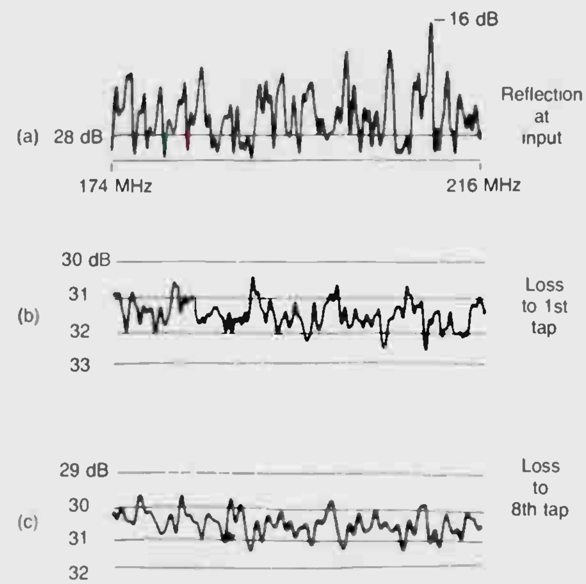


Figure 86: 16 BMT taps on ½-inch feeder 800 feet long, hi-band performance (there was one tap in each 50-foot cable section but spacing was random)



the best from both the electrical and the mechanical point of view

To show the improvement that can be obtained by this simple technique an 800-foot feeder was equipped with the same 16 BMT taps used in the earlier examples They were installed in four groups of four, each group arranged in the pattern illustrated in Figure 88 (d) Figure 90 shows the result (Note that the vertical scale of Figure 90 (a) is doubled to exaggerate the reflections) Grouping of the taps in this way increased the feeder return loss as compared with the conditions of Figure 86 from as low as 16 dB to a minimum of 24 dB Transmission variations across any one TV channel were reduced from about 2 dB down to about 0 5 dB With no increase in equipment cost, tap grouping substantially reduces the possibility of picture degradation due to reflections and response variations in the feeder

This technique is quite evidently useless where signals are distributed covering the entire spectrum between the low frequencies and the upper end of the band Since the reflection patterns achieved by grouping of taps improve conditions within the two bands at the expense of the region between the bands, the grouping method is useless where this region too has signals

Directional coupler multi-taps

It is interesting to compare the performance of pressure taps under these optimum conditions with the results obtained when using a tapping device having, electrically, the best possible characteristics. This device is the directional coupler multi-tap. Where low-reflection performance is desired throughout the entire spectrum, the directional coupler multi-tap is the best device and has three other important advantages over the pressure tap:

1 *Directivity:* It is more sensitive to waves coming down the feeder than to waves traveling back up the feeder, and thus discriminates

Figure 87: 16 CMT taps on ½-inch feeder 800 feet long, high-band performance (there was one tap in each 50-foot interval but spacing was random)

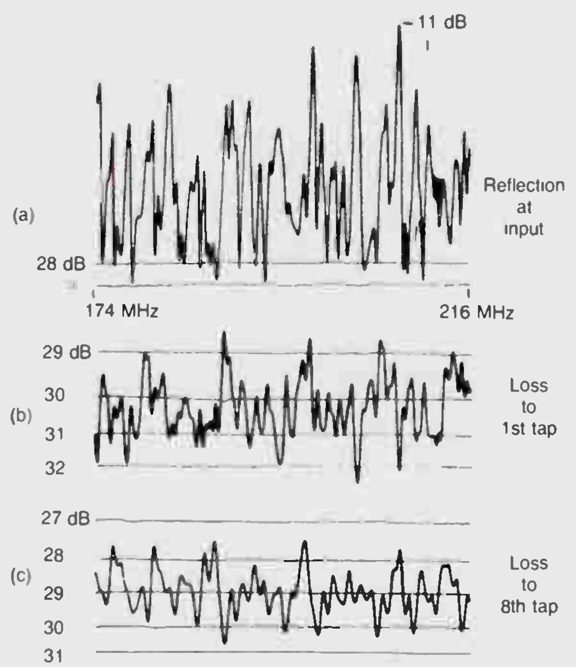


Figure 88: Reflection vs. frequency—BMT pressure taps on ½-inch cable

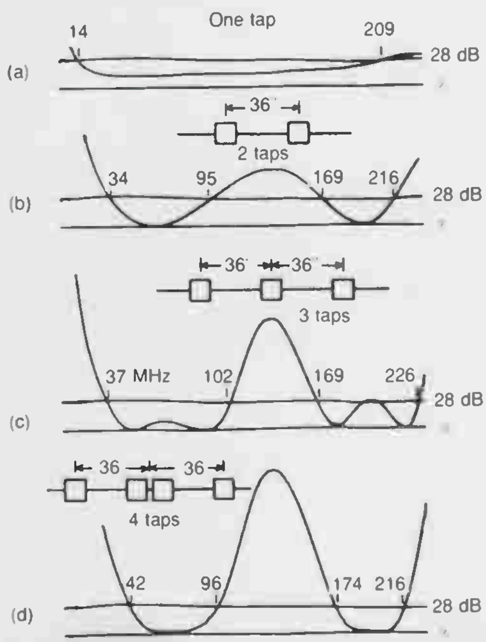


Figure 89: Reflection vs. frequency—four pressure taps in various possible arrangements

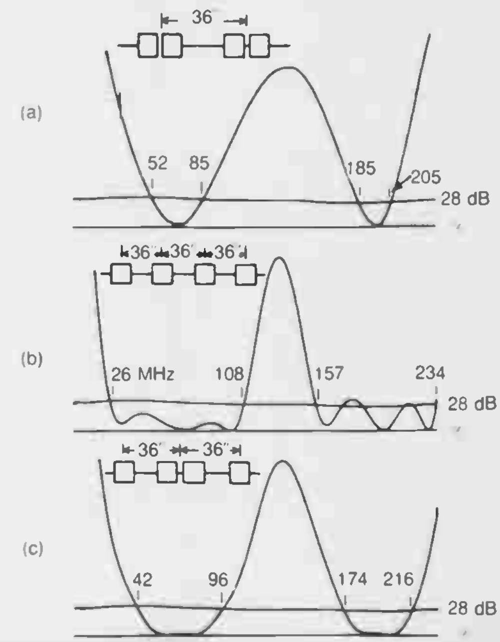
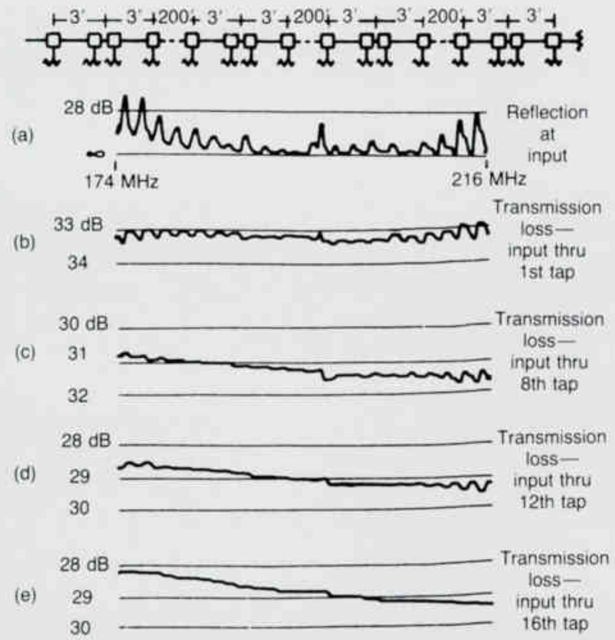


Figure 90: 16 BMT taps on ½-inch feeder 800 feet long, grouped for minimum reflection—high-band performance



against reflections or spurious signals coming from taps or receivers further down the line.

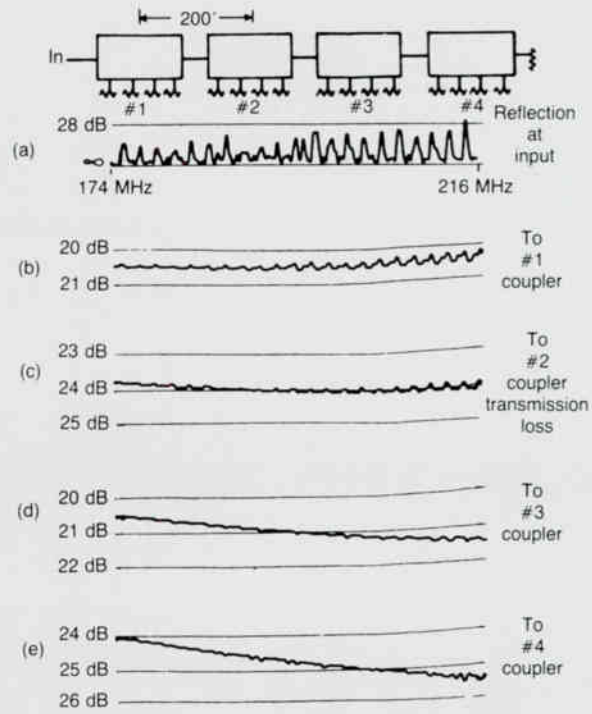
2. *Lossless backmatch:* With a transformer tap approximately half the energy tapped off the line is lost in the backmatch resistor. With a directional coupler none of this energy is lost, the reverse termination acts only to absorb energy reflected from the receiver. Thus the efficiency of a directional coupler (which determines the line loss for a given tap loss) can be very high.
3. Multiple outputs: This means that fewer units are needed with correspondingly fewer possibilities of reflection. The Jerrold Starline series of couplers (e.g. Models DCM) have four outputs, so only one-fourth the number of units is required as compared with pressure taps.

The multi-tap has three disadvantages as compared with pressure taps:

1. *Installation:* To install a multi-tap the feeder cable must be cut. This takes time and interrupts transmission in systems already in operation, so the pressure tap is more convenient.
2. *Pre-loading:* A complete multi-tap must be installed even if only one house drop cable is to be connected initially; thus the use of multi-taps requires more advance planning and investment.
3. *House drops:* Although the multi-tap is usually located at a point on the feeder cable where the average house drop can be kept as short as practical, some of the house drop cables will be longer than they would be if pressure taps were used.

To allow comparison of directional coupler multi-tap performance with that of the foregoing pressure tap arrangements, the 800-foot feeder was equipped with four DCM units at 200-foot intervals. The reflection and response characteristics are shown in Figure 91. It can be seen that the coupler has slightly higher return loss (28 dB vs. 24 dB) as compared with the best arrangement of pressure taps (Figure 90) and less response variation (about 0.3 dB vs. 0.5 dB) but their performance is quite comparable. The coupler requires no care in regard to spacing, works equally well across the entire spectrum, and has the other advantages listed above.

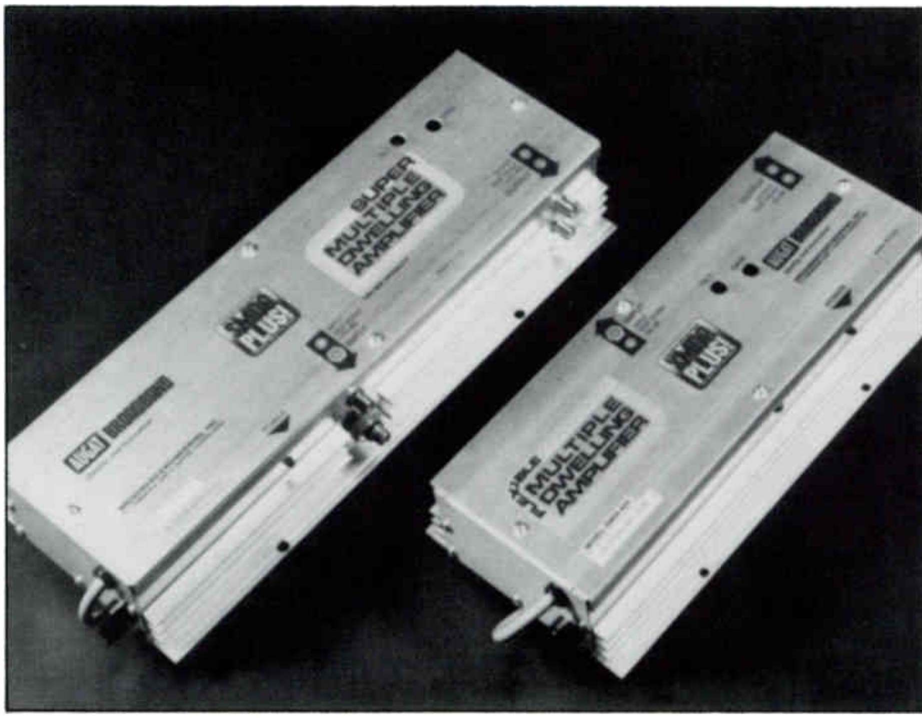
Figure 91: Four DCM multitaps on ½-inch feeder 800 feet long, hi-band performance



Summary

This chapter has presented a technique for minimizing the reflections from pressure taps by careful grouping. While the best results are obtained with the better transformer type of taps (BMT), the same improvement will be experienced with any pressure taps. The directional coupler multi-tap is shown to have slightly better performance than the best that can be obtained from pressure taps. With its other advantages this suggests the use of the coupler for situations where the very best performance is desired and where the necessity of cutting the cable is not too great a deterrent; in other situations the use of pressure taps may be quite adequate.

This chapter of the "Technical Handbook for CATV Systems" is being reprinted courtesy of the General Instrument Corp.'s Jerrold Division. To obtain a complete copy of the "Technical Handbook," send $10 plus $1.50 for postage and handling to: Technical Handbook Order, Customer Service Department, General Instrument/Jerrold Division, 2200 Byberry Rd., Hatboro, Pa. 19040. Jerrold customers may place orders with their customer service rep. (Make checks payable to General Instrument/Jerrold Division.)



Power doubling amps

Broadband Engineering Inc. announced the addition of power doubling technology to its line of indoor amplifiers. The XMDA and SMADA (one- and two-way multiple dwelling amplifiers) are now available as the XMDA-Plus and SMDA-Plus, both units using Amperex power doubling hybrids.

According to Broadband's president, Bill Ellis, the new hybrids help solve some of the design problems inherent in multiple dwelling units: "Operators now have a couple more options available. They can run their indoor amps at their present levels with 6 dB less distortion. Or they can run them at 3 dB higher output levels with no change in distortion."

The indoor amplifiers will now be manufactured with or without the power-doubler hybrids at customer request. Production models of both the XMDA-Plus units are available immediately.

For complete details, contact Broadband Engineering, P.O. Box 1247, Jupiter, Fla. 33458, (305) 747-5000.

Broadband catalog

Scientific-Atlanta Inc., has published its 1984/1985 Broadband Communications Products Catalog. The 308-page catalog describes S-A's complete line of broadband communications products including distribution equipment, broadband data products, coaxial cable, satellite receiving equipment, off-air antennas, headend equipment, subscriber products and mini-cable/SMATV systems. Also included in the catalog is a guide to product support services.

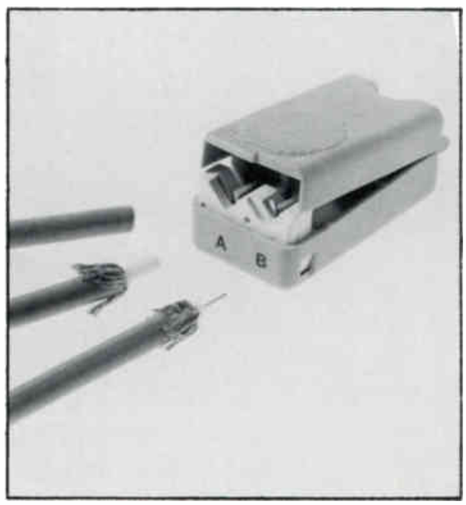
New products featured in the catalog include the feedforward sub-split trunk station, the Model 6810 feedforward distribution amplifier, the Model 6440-I data translator, the Model 6130 signal processor, the Model 9530/9530A video receiver and the System Manager II/LAMS.

To obtain a catalog, write to Scientific-Atlanta Inc., Box 105027, Department A/R, Atlanta, Ga. 30348.

Directional tap

A new indoor directional tap, the DTI, is available from Antronix Sales. The DTI is available in eight values, making it easy to select the right isolation. The unit is built and engineered to meet the toughest electrical specifications, according to the company. The totally weather shielded zinc diecast housing has an extra long tap port, which permits mounting to a wall plate while providing sufficient threading for an "F" connector.

For more details, contact Antronix Sales, Gedi Corporate Park, Englishtown, N.J. 07726, (201) 446-2626.



Coax connectors, stripping tool

All Tech Industries Inc. is now carrying a stripping tool and line of connectors made in West Germany.

The connectors are designed for coax cable smaller than RG8U and, according to the firm, the connection itself is guaranteed to be equal to or better than a soldered connection in quality. The types now available are BNC, PL(UHF) and push on F type. The BNC and PL connectors can be used for either in-line or panel-mounted applications.

Developed by Freitag Electronics, these connectors are made to attach without crimping or soldering and without the need of any tools. Hand tightening is sufficient for a quality connection, according to the company, however, a 1/3 additional turn with pliers will result in a connection guaranteed to be stronger than the cable itself. In addition, they can be disassembled in seconds and reused at least 25 times. Laboratory tests showed that no detectable signal degradation occurred between 40 and 1,000 MHz. The connector also withstood the application of 1,000 volts without dielectric breakdown.

The coaxial stripping tool, without the need to change, adjust or replace blades, will accommodate cable sizes smaller than RG8U (shield diameters [outer conductors] from 4.5 to 7.5 mm and inner conductors from 0.4 to 1.4 mm). The plastic hand-held tool is about the size of a business card and the surgical steel blades give it a useful life of at least 2,000 cuts.

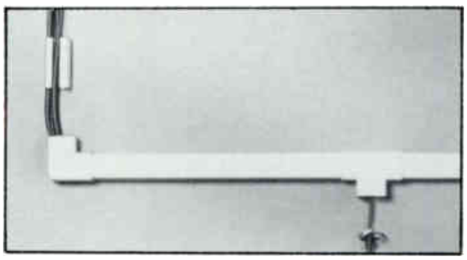
For complete details, contact All Tech Industries, 424 S. Seymour, Mundelein, Ill. 60060, (312) 949-1119.

'N' connector, hex crimp tool

Macom Industries OEM Enterprises announced the addition of a new low-cost satellite "N" connector, Model NMA-234, to its line. The NMA-234 is a one-piece, attached ring, crimp-on "N" connector to fit both RG213 and RG214 cables. The connector's center pin can be soldered or crimped.

Also new, the Model HX-11, is a low-cost hex crimp tool available for use with the NMA-234, which is made from brass with a weather resistant nickel plate.

For more specs, contact Macom/OEM Enterprises, 8230 Haskell Ave., Van Nuys, Calif. 91406, (800) 421-6511 or (818) 786-1335.



Clip duct system

A new two-piece clip duct system for interior routing of low voltage and communications wiring is available from Panduit Corp., Electrical Group. The system includes a cover that snaps onto either an adhesive base or a fastener-secured mounting clip. The snap-on cover is easily removed when circuit revisions are required. The durable PVC cover is supplied in 8-foot lengths and is available in three colors: beige, brown and white. The adhesive base is supplied with an adhesive foam tape along the entire length and will support a static load of .50 lb/in. It also is available in 2-inch pieces. Both cover and base can be cut to size.

Steel clips with user-supplied fasteners are an alternative mounting method. The clip has a self-spacing feature to speed installation. For both mounting devices, the wires are first inserted into the base or clip and then the cover is snapped on. Seven fittings are offered to speed installation by eliminating mitering and special cuts of duct.

For more details, contact Manager, Inside Sales, Panduit Corp., 17301 Ridgeland Ave., Tinley Park, Ill. 60477-0981, (312) 532-1800.

Platform supports

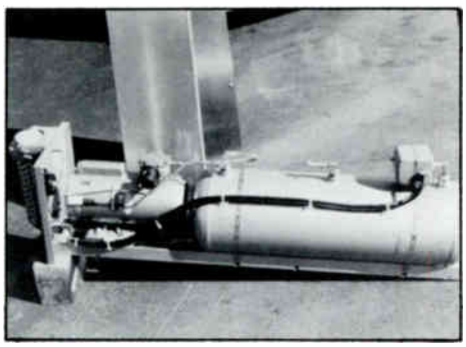
Microflect's lightweight aluminum manhole platform supports are now available in two sizes. Model 81A telescopes from 44 inches to 81 inches in length; Model 108A telescopes from 53 inches to 108 inches. Both are made from 6061-T6 tubular aluminum with zinc-plated steel hangers. The supports are designed to lock into existing equipment racks in manholes and cable vaults. Safety features include internal wire stops to prevent over-extension, work safety latches to prevent accidental disengagement from racks, and extension safety latches to prevent extension of tubular members during transportation and handling.

For more information, contact Microflect Co. Inc., P.O. Box 12985, Salem, Ore. 97309-0985, (503) 363-9267.

Support bracket

The new Model RSB rack-mounted equipment support bracket from CWY Electronics relieves stress and torque on rack-mounted equipment by adding rear support, according to the firm. The unit includes and is mounted to a single-space ($1\frac{3}{4}$ inch) plate that allows for air flow around and through mounted equipment. The new support bracket does not interfere with servicing of equipment.

For more information, contact CWY Electronics, P.O. Box 4519, Lafayette, Ind. 47903, (800) 428-7596, or in Indiana, (800) 382-7526.



Nitrogen bottle replacement module

Puregas introduced a nitrogen bottle replacement module designed to replace nitrogen bottles used for dry air and pneumatic tool applications. The module fits easily into a vehicle's nitrogen bottle compartment. It eliminates the cost of nitrogen bottles, refill charges, and the storage and handling of them. The basic module weighs only 135 pounds, is lighter than a full nitrogen bottle and is portable so it can be easily transferred from vehicle to vehicle or into a facility for emergency buffering.

For more information, contact General Cable Apparatus Division, P.O. Box 666, Westminster, Colo. 80030, (303) 427-3700.

Safety lock

The Sterling Rotary Shackle Lock manufactured by Engineering Unlimited Inc. is designed for industrial security by electric, gas and telephone utilities, the cable television and railroad industries, and the military.

The lock's shackle rotates to lock in place. Without cuts in the steel, external pressure is distributed equally over the shackle, rather than concentrated on the latching mechanism, for greater strength.

Three styles of locks are available: the "Standard," "One-Shot Seal," and "All-Brass." The Standard is steel-formed and zinc-coated for weather resistance. The One-Shot Seal lock permanently locks after closing. A plastic shackle cap prevents accidental closure. The All-Brass lock is designed for use in high moisture areas to prevent corrosion. All styles are made to order and available in two sizes: $2\frac{3}{8}$" and $1\frac{13}{16}$" in diameter across the shackles.

Extra-strength locks, with case-hardened, heat-treated steel shackles also are offered. Nine-inch chains are optional. To keep duplicate lock combinations to a minimum, over 1,000 key combinations are available. The Sterling Rotary Shackle Lock can be stamped with the customer's name, key number and date.

For more information, contact Engineering Unlimited Inc., 2841 Dupont Ave. So., Minneapolis, Minn. 55408, (612) 872-4144.

Safety: You can't live without it

By Anthony J. DeNigris
President, Nationwide CATV Services Inc

Have you ever considered yourself lucky that someone hasn't been killed or seriously injured on one of your construction projects? Does this statement sound foolish? Don't we all feel we are doing everything possible to instill and maintain safety practices to the utmost on the jobs we are part of? If that is the case, then why are we shocked when the unthinkable does in fact happen?

Accidents will happen

It cannot be denied that there always exists the possibility of an accident occuring anytime and anyplace! But, what is an accident? Is it an accident when climbers are running strand across an intersection and the strand is sagging so low that just as a kid on a bicycle approaches, naturally oblivious to the work going on, he rides right into it. Wouldn't you know, this happens just as the driver of the truck pulls out the next span. Up goes little Joey, bike and all!

How about the situation where the weight on the end of the throw rope, which the ground man is attempting to thread through the trees, hits the lineman (halfway up the next pole) squarely on the side of the head, and the shock of that happening results in him falling off the pole?

Then there is the all-too-often occurence where the lineman, in an attempt to clear some branches from an obstructed lasher, climbs up a tree and goes out on the limb. After the lasher is freed-up, he decides to take the easy way down—sliding down a lay-up stick being held by another lineman. Since this procedure has been working so well in the past, no one gave any thought to the possibility that the stick might break. This time however, it finally does break—and down comes Big Joey!

What about the very serious case, which I am sure has occurred numerous times in the industry, where a groundman haphazardly flings the lead rope up and over a primary line during a stranding operation. Not realizing what he has done, the idiot attaches the rope to the hitch of the vehicle. As the rope is pulled forward and the strand comes in contact with the electric primary, a lineman working on the preceding pole, with his feet on telephone strand, gets electrocuted.

Can you conceive of a situation where "Big Joey," after being released from the hospital, has learned his lesson well and vows never to climb up or down a lay-up stick again. This time, when the lasher gets hung up mid-span, he decides to use a ladder—the proper way of doing things. However, when he takes the ladder off the truck and places it against the strand, he notices that the strand hooks are turned inward, and rather than take it down to position the hooks properly, he calls to the groundman to come over and hold the base of the ladder steady. Up he goes in total confidence. But what he doesn't realize is that the crew that originally ran the strand had been allowing for slack between every four poles, resulting in strand that is not under tension between poles. As "Big Joey" climbs up and nears the upper portion of the ladder the shift in weight against the strand causes the unforeseen slack to be let out. The ladder now jolts forward and out from under the strand. Poor Joey.

Stupidity does happen

What has been described in the preceding five examples of so called "accidents" are not accidents at all. In each instance, someone has failed to use common sense. Take the case of little Joey who was left hanging by his handlebars. Strand should never be allowed to hang so low as to pose any type of danger to innocent bystanders. This is not to say that the line crew itself is free of danger when strand is allowed to hang so low. Should a truck or any other type of vehicle come by and snag that strand, the linemen can be snapped off the poles, even dismembered under certain circumstances. It *has* happened.

In the second example, had the groundman been aware of his responsibility for the safety of crew members, he would have made sure that no one was anywhere near the probable landing zone of the throw weight. This lack of concern especially was reflected in the example where the lineman was electrocuted. This is not only a reflection on the groundman, but on the other crew members as well. There are numerous situations that should be watched for and guarded against by the whole crew.

Finally, in the case of "Big Joey," it is plain to see that this fellow does not believe in using equipment in the manner in which it was designed or the purpose for which it was intended. Why?

The unpreventable

True, accidents cannot be prevented. However, there are very few of these. All of the situations used as prior examples are the result of human error, and in each instance,

'No matter what phase of cable TV work one might be doing, and however confident that person might feel, hazards do exist'

could have been avoided. Unpredictable and unavoidable situations are the criteria for the unpreventable.

You can't predict the drunk driver slamming into the pole that you are working on. One cannot foresee or prevent a tree from falling onto power lines, bringing them into contact with the cable run you might be working on. What about the innocent lineman working on a pole that suddenly fractures and topples due to internal damage from termite infestation not visible from the outside? Certainly the lineman could not have avoided such a situation, and hence, responsibility for the occurrence cannot fall on his shoulders. But would you consider this a true accident? Was it unpreventable?

Negligence

Lack of preventive maintenance is the true culprit in this case. It is obvious that the cause of the problem was the unseen damage within the pole. The authority responsible for inspecting the pole did not do its job, which translates into pure and simple negligence. What suffers in such a case? Human life! Negligence is probably the most significant and universal reason behind most so-called accidents.

One recent case involved the loss of human life because a routine inspection check was not made. A telsta operator was working in the bucket at a substantial height with the boom fairly well extended. When the elevation drive chain snapped, the bucket crashed to the ground. Upon investigation of the "accident" it was learned that the safety descending cylinder contained no hydraulic fluid. Had there been sufficient fluid to cause the cylinder to function properly, and act in the same manner

as a shock absorber reacts, the boom would have only fallen a few feet and the operator would have been uninjured. Is this an accident, or manslaughter?

The preceding case is one example among countless situations that could occur if disregard for equipment condition exists. There is a big difference between a piece of equipment that works well and is properly served vs. a piece of equipment that is kept in constant service and is allowed to fall into such a state of disrepair that failure is inevitable.

The human element

All too often one can observe disregard for safety procedures in the field. What might seem to be a relatively minor infraction can result in serious ramifications. For example, hardhats don't come with chin straps, and they do occasionally fall off while one is working up on a pole. Consider the groundman who is not wearing his own hard hat when the lineman's hits him on the head. What if it was a bell wrench?

Of a more critical nature is a case wherein a line crew was placing strand across a major intersection to a terminating junction pole (dead end). Traffic across the intersection was heavy. The lineman on the junction was in the process of jacking-in the strand with a chain hoist and grip when the chain hoist slipped, allowing the chain and, subsequently, the grip to swivel and fall off the strand. The strand let go and fell in the midst of traffic, causing a major accident. Another incident that could have been avoided. Two precautions were not taken: First, traffic should have been stopped until that strand was actually secured and locked in so that no danger whatsoever could possibly exist; second, as the strand was originally pulled across the intersection and raised to the junction pole, it should have been additionally secured with a preform dead-end and a pole sling (then, even if the grip or chain hoist let go, the strand would not have fallen). This situation is typical of an attitude that sometimes prevails among linemen who think "they know it all" and express a lackadaisical concern for that little bit extra that it takes to do the job right, as well as to eliminate or guard against hazards. As concerns the necessity for precautions: It's not what you know will happen; rather, it's what you don't know that could happen.

Let's shift the emphasis from aerial to a situation that involved an installer going to a customer's house to which he was assigned the task of providing a service drop. The installer had plenty of experience in this type of work, and even though it was company policy to drill from the outside into the house, the installer decided to save some time and popped the hole from the inside. The hole never got popped but the installer did. A few minutes later, the cable office got a phone call from the subscriber asking, "What do you want me to do? Your installer drilled right through my power main. All my electricity is out, and your installer passed out on the floor."

Why the mention of an installation experience? Well, it just goes to show that no matter what phase of cable TV work one might be doing, and however confident that person might feel, hazards do exist.

As an individual in a position of responsibility required to set standards and enforce safety policy, one cannot be totally confident that these procedures are being followed in the field. The human element exists and people will take short cuts, become careless and cut corners. And accidents will happen! What motivates this type of attitude and behavior?

The push is on

Let's give some serious consideration to the factors one must contemplate in order to understand some of the reasons for disregard of safety procedures and the "I don't give a damn" attitude that exists in the industry. Few of us will readily admit this applies to our own organizations. Where does the responsibility lie?

It starts at the top. And which way does it flow? Naturally, downhill. The state of the industry today is such that the emphasis on price has seemingly become paramount above all other considerations. It is no secret that fierce bidding pressure exists in procuring construction contracts for system builds. This forces a contractor to squeeze every ounce of productivity in all areas of his business. There is nothing wrong with this in itself—it's an admirable goal in any business. But when pricing considerations force a contractor to push productivity to the maximum limit in order to survive, and that attitude is transmitted down to field personnel, pressure to perform and achieve results overshadows all other considerations. This does not necessarily mean that quality will suffer—but the end result does not justify the means.

You may look with pride at a project that has just been completed, but perhaps the people who built the plant were indirectly forced to work in such a manner that safety was compromised. And since this does happen, should you really be surprised when accidents occur as a result of short cuts, haste or negligence? Can you place all the blame on lower echelon personnel when you yourself have looked in another direction when deadlines mean dollars?

It can happen to you

We are fortunate that the type of situations described do not occur every day. But they do occur! There are inherent dangers in cable television construction that we cannot change. We must seek to minimize these dangers wherever possible. We must, in many cases, have an even greater degree of concern for the welfare of our employees than they have for themselves. We must, above all else, never assume we are doing everything possible to assure that safety procedures are being followed, and that the concern for safety is shared equally by all members of our organizations. You must constantly guard against complacency and the attitude that "It can't happen to me." Nothing is more important than a human life—no one can afford to lose one!

Please see our card on page 25.

If it's not broke what do you do?

By Bob Vogel
Raychem CATV Group

The cable industry today needs a higher definition of preventive maintenance (PM) than, "If it's not broke—don't fix it."

No doubt you've heard that viewpoint, in one form or another, at sometime in the past. Maybe it's your guiding philosophy on electronic and plant repair; and it has some validity. Many pieces of electronics are better left alone while working *properly*. And therein lies the key to preventive maintenance: knowing the standard of what's working properly and being able to identify the need for a repair when the system is not broken or clearly nonfunctional but only partially degraded.

Every preventive maintenance plan for a cable system incorporates elements that allow for a passive, non-disruptive check to see if the system is working properly. Although at times it seems that the district or regional engineering staff has nothing better to do than draw up a "new" PM plan, the object is improved subscriber service. And never has a plan been put down on paper that improved subscriber service if the plan was not implemented—that is, followed by all technicians in the field.

What avenues are open to ensure that the PM checks really get done and the data received is useful and available to engineering management?

Ensuring PM success

First, we do need a plan. Since the basic outline has been drawn many times, you should be able to get a copy of a basic PM plan (from your corporate or regional engineering staff, from a nearby system, or me). It's much easier to adapt an existing outline to your specific system and needs than to start from scratch. Most outlines cover three basic functional areas: headend, distribution plant and customer premises. If any one is left out, it's usually customer premises. (It shouldn't be since our legal [FCC] and practical responsibility to our customers ends at the connection to the TV set. The signal out of that final piece of coax is the source of our revenue.)

Second, the plan has to be put into practice, which means gathering data on system performance. Because this is where many PM plans fall down, a closer examination will come later.

Third, the data must be put into a clear, concise, usable form that will tell what parts of the plant are OK and what parts need actual repair work because the performance is degraded.

Sources of data

"Do we get the data we need in standard trouble call reports?" Of course this varies somewhat from system to system, but certainly there is plenty of valuable information already available to us. Some weak points might be:

1) Generally headend data is gathered and integrated into overall system trouble reports in a very informal way if at all. What's needed is a formal weekly or monthly report that would cover:
   - Last check of off-air antenna signal strength and picture TASO including ability to compare with previous reading.
   - Last check of satellite signal strength, ideally from a monthly programmer test and a previous reading comparison.
   - Last check of outgoing signal levels and their picture quality compared with previous readings.

(Of considerable value to the report is a column or space where any changes made that affect the plant could be clearly recorded, especially pilot carrier level change, any repair that improves picture quality or sound on a given channel or times the sweep is on if it's visible. Of course, a date and time of change will be essential to tie this information to field reports.)

2) Plant data is probably the most readily available of all, but, a few additions here might help:
   - Always tie a customer problem to the specific plant problem that repairs the situation.
   - When recording plant problems, the specific amplifier fixed, replaced or adjusted should always be noted. In one way or another, a file should be kept on each amp of repairs and adjustments to pinpoint trouble spots in the system.
   - Pole knockdowns should be recorded, along with any cable spans replaced.

3) Customer calls generally record the problem fixed. Be sure to add the following items to your records:
   - Signal levels, at least a high and low frequency reading at the input to any TV set. If the techs can determine readily when they are at an end of line location, a full set of readings could be used as end of line checks.
   - A clear reference to a known (or found) headend or line problem should be made.
   - Picture quality checks, at end of line on all channels.
   - Converter change out information should be recorded. This can be an integral part of a converter tracking system.

'The key to preventive maintenance . . . (is) knowing the standard of what's working properly'

In addition, end of line checks should be made in some sensible order. As a minimum, a picture quality check should be done. A carrier-to-noise and distortion check should be included where the equipment is available. A program should be worked out to cover every end of line point monthly. A quarterly check may be more appropriate in a large system or if short on manpower. Here is where an end of line check done on a service call could save time.

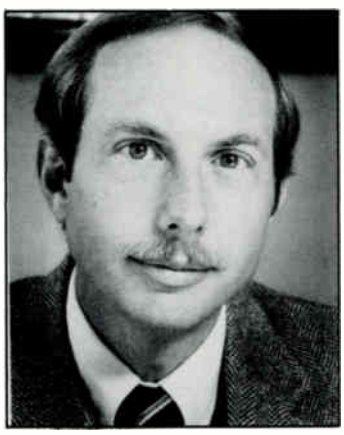
Collating the data

Now that the data has been collected, with perhaps only a few changes or additions to the existing forms, how can it be used more effectively? In a small system, a simple card file (say a card for each amp, a few headend cards and a card for each end of line location) may suffice, along with regular review by the system chief engineer. It seems likely, however, that many systems already have, at their disposal, an easier way to use field information faster and more effectively—a personal computer. The problem in implementing such a program will be data entry and a program to put it all together. Most programs currently in use cover only one or two of the broad areas (headend, plant or customer), which means, for optimum plant maintenance, you will want to integrate several of them.

Who should put together such a data collection and manipulation system? Probably, each cable system. Each one is very different and requires various data available to it. It might make sense to do a basic master program, however, that would only cover the system in a very generic outline form. Maybe this has already been done; if so, the industry could use some knowledge about its format and usefulness in the field.

Shaughnessy

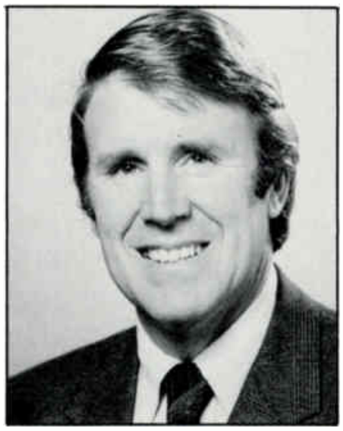
Smith



Wechselberger

Michael Shaughnessy has been promoted to vice president and general manager of **Oak Communications'** cable television division. Shaughnessy joined Oak as director of strategic planning in 1981 and was promoted to sales and marketing vice president in August 1982. Prior to that, he was with Booz, Allen and Hamilton, where he was involved in strategic planning and market projects for the research firm's clients.

In addition, **Rj Smith** has been promoted to vice president of sales and marketing, and **Anthony Wechselberger** has been promoted to vice president of systems engineering. Previously, Smith was director of sales, while Wechselberger was director of advanced engineering. Smith came to Oak in 1983 as its sales director from CableData in Sacramento, Calif., where he was division manager. Wechselberger has been with Oak Technical Operations since 1980. Before joining Oak, he was a project engineer for General Dynamics Corp., Electronics Division. Contact: 16935 W. Bernardo Dr., Rancho Bernardo, Calif. 92127, (619) 485-9880.

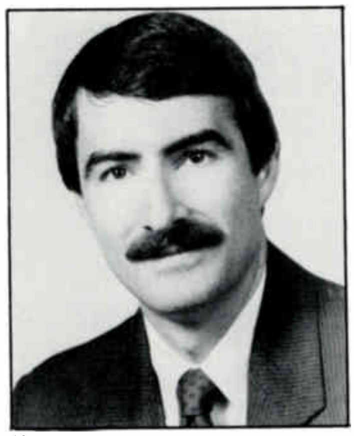


Hill

Cook-Vasques

William Hill has been appointed vice president of sales for **Anixter Communications Canada** (ACC). He will be based out of ACC's Pickering, Ontario, facility. Hill moves to ACC from Anixter Communications-U.K., where he was general manager. Previously he served as European sales manager for the company.

Also announced was the appointment of **Liz Cook-Vasquez** to CATV district manager-southwest for **Anixter Communications**. Cook-Vasquez will be based out of the company's new southwestern regional headquarters in Dallas, and will be responsible for directing CATV sales in Texas, Oklahoma and Louisiana. She was most recently inside sales manager in Anixter's Houston offices. Prior to joining the company in 1980, she was a purchasing agent for Rogers Cablesystems in Syracuse, N.Y. Contact: 4711 Golf Rd., 1 Concourse Plaza, Skokie, Ill. 60076, (312) 677-2600.



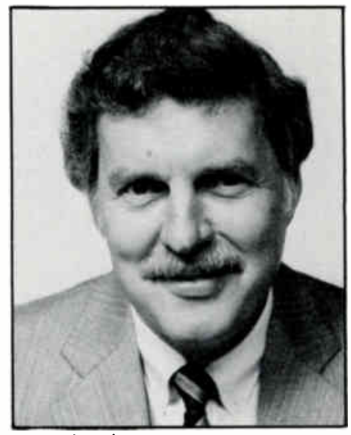
Kearns

Times Fiber Communications Inc. announced the recent appointment of **Richard Kearns** as vice president of marketing for the Communications Systems Division. Kearns was formerly employed by Dun & Bradstreet as director of network planning and customer consulting. Contact: 358 Hall Ave., P.O. Box 384, Wallingford, Conn. 06492, (203) 265-8500.

CaSat Technology Inc. recently appointed **William Gagnon** to the engineering staff. Gagnon will be involved in the R & D department.

CaSat also announced that **Richard Hagan** has joined the firm as accounting manager. Hagan comes to CaSat from M/A-COM MVS Inc., where he was most recently senior cost accountant and financial analyst. Contact: 6 North Blvd., Unit 5, Amherst, N.H. 03031, (603) 880-1833.

Pioneer Communications of America Inc. announced the addition of **Matt Lovegrove** as manager, software development. He is responsible for the development of software offered by Pioneer which supports both one-way and two-way addressable systems. Prior to joining Pioneer, Lovegrove was the system project leader for Warner Amex Qube operations in Columbus, Ohio. Contact: 2200 Dividend Dr., Columbus, Ohio 43228, (614) 876-0771.



Copeland

Scientific-Atlanta Inc., announced the appointment of **Jerry Copeland** as general manager of its Video Communications Division, which designs and manufactures a complete line of satellite earth station receiving equipment. Copeland has been with the company for 2½ years and most recently served as general sales manager for the Broadband Communications Group. He came to Scientific-Atlanta from Tactex Systems Inc., a division of RCA. Contact: 1 Technology Pkwy., Box 105600, Atlanta, Ga. 30348, (404) 441-4000.

The **Southern Cable Television Association** elected its 1985 slate of officers during the annual meeting held at the Eastern Show. **Bob Bevis**, director of operations of Southland Communications, was elected president. **T.W. (Skip) Meadows** will be serving as vice president of SCTA. For the past 16 years, Meadows has been general manager of Decatur Telecable. **Don Perry** was elected secretary/treasurer. He is president of Donald Perry & Associates. Contact: 5780 Peachtree Dunwoody Rd., Suite 460, Atlanta, Ga. 30342, (404) 320-1716.

CALENDAR

November

Nov. 9: Southern California Cable Association annual dinner, Los Angeles. Contact SCCA, (213) 684-7024.
Nov. 12-13: TeleStrategies seminar on satellite communications, Washington. Contact (703) 734-7051.
Nov. 13-15: Jerrold technical seminar, Spokane, Wash. Contact Kathy Stangl, (215) 674-4800.
Nov. 13-15: C-COR Electronics technical seminar, Sheraton-Tampa, Tampa, Fla. Contact Deb Cree, (814) 238-2461.
Nov. 14: SCTE North Jersey Meetings Group's first meeting and technical seminar, Holiday Inn, Wayne, N.J. Contact Don Daniels, (201) 997-6600.
Nov. 14: SCTE Golden Gate Meeting Group, seminar on distribution systems by C-COR, location to be announced. Contact Rich Adams, (707) 208-2340.
Nov. 14-16: National Translator/LPTV Association annual convention and exposition, Las Vegas, Nev. Contact David Stone, (714) 794-4704.
Nov. 14-16: Magnavox CATV training seminar, Memphis, Tenn. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
Nov. 19-21: Magnavox CATV training seminar, Memphis, Tenn. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
Nov. 19-22: TeleSat Canada's Canadian Satellite User Conference, Westin Hotel, Ottawa. Contact Mike Bryan, (613) 746-5920.
Nov. 20-22: Online Conferences' Videotex International conference and exhibition, RAI Centre, Amsterdam. Contact Online, (212) 279-8890.
Nov. 23-25: Burrull Communications Group SMATV/private cable hands-on workshop, Orlando, Fla. Contact (608) 873-4903.
Nov. 29: Microwave Filter Co. terrestrial interference seminar, East Syracuse, N.Y. Contact Bill Bostick or Carol Ryan, (315) 437-3953.

December

Dec. 4: QV Publishing seminar on "Addressing Addressability and Pay-Per-View," Disneyland Hotel, Anaheim, Calif. Contact Barbara Freundlich, (914) 472-7060.
Dec. 4-6: Jerrold technical seminar, Philadelphia. Contact Kathy Stangl, (215) 674-4800.
Dec. 5-7: California Cable Television Association annual convention, the Western Show, Anaheim (Calif.) Convention Center. Contact (415) 428-2225.
Dec. 5-7: Magnavox CATV training seminar, Anaheim, Calif. Contact Laurie Mancini, (800) 448-5171.
Dec. 12: SCTE Delaware Valley Chapter meeting on addressable terminal technology, George Washington Motor Lodge, Willow Grove, Pa. Contact Bruce Furman, (215) 657-4690; or John Kurpinski, (717) 323-8518.
Dec. 12: SCTE Golden Gate Meeting Group seminar on audio services, Concord, Calif. Contact Rich Adams, (707) 208-2340.
Dec. 14: Microwave Filter Co. Terrestrial Interference Seminar, East Syracuse, N.Y. Contact Bill Bostick or Carol Ryan, (315) 437-3953.

January

Jan. 22-24: C-COR Electronics technical seminar, Los Angeles. Contact Deb Cree, (814) 238-2461.
Jan. 30-Feb. 1: Texas Cable TV Association annual convention, the Texas Show, San Antonio Convention Center. Contact Bill Arnold, (512) 474-2082.

February

Feb. 4-6: American Federation of Information Processing Societies Inc. annual Office Automation Conference, OAC '85, Georgia World Congress Center, Atlanta. Contact Helen Mugnier, (703) 620-8926.
Feb. 5-6: Arizona Cable Television Association annual convention, Hilton Hotel, Phoenix. Contact ACTA, (602) 257-9338.
Feb. 14-March 2: American Federation of Information Processng Societies international shipboard computer exposition, Tokyo to Singapore. Contact Ann-Marie Bartels, (703) 620-8926.
Feb. 20: SCTE Delaware Valley Chapter meeting on system design, George Washington Motor Lodge, Willow Grove, Pa. Contact Bruce Furman, (215) 657-4690; or John Kurpinski, (717) 323-8518.

March

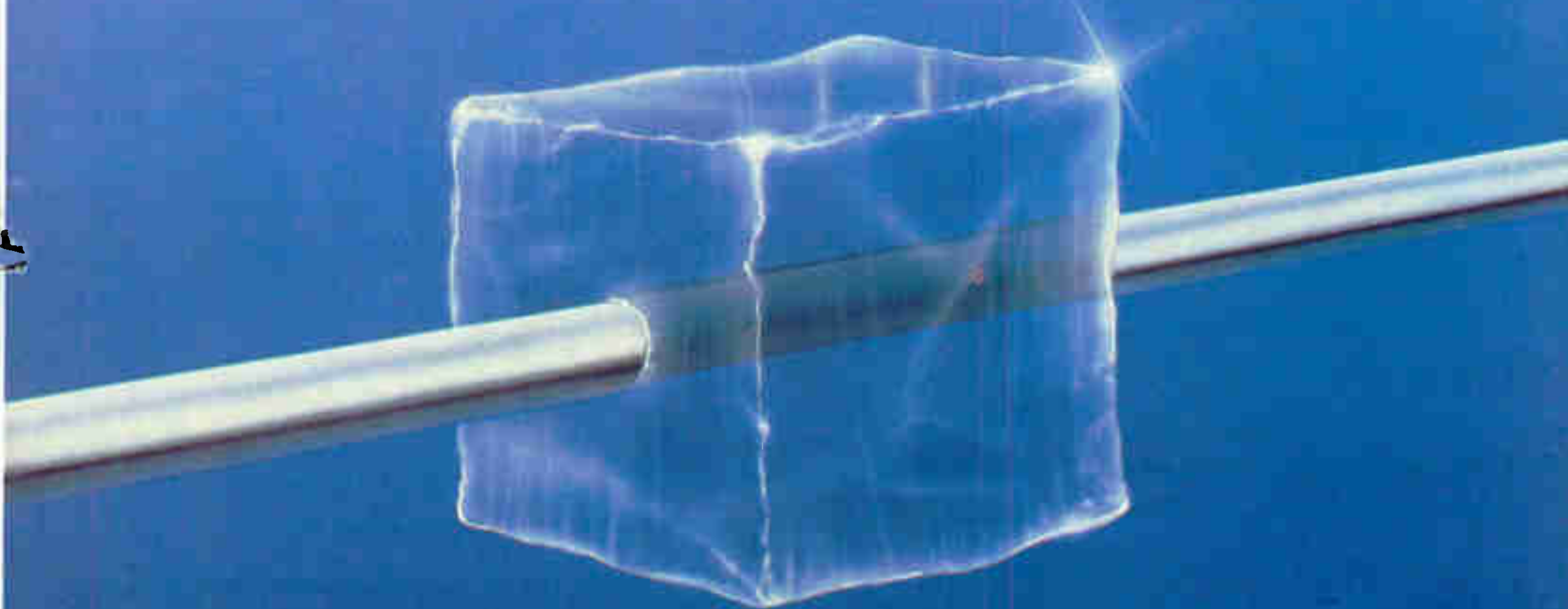
March 6-8: Arkansas Cable Television Association annual convention, the ArkanShow 1985, Statehouse Convention Center, Little Rock. Contact (501) 374-3892.
March 13: QV Publishing seminar on "Two-Way Tomorrow: Planning Today for Tomorrow's Services," The Yale Club, New York. Contact Barbara Freundlich, (914) 472-7060.
March 19-21: C-COR Electronics technical seminar, Columbus, Ohio. Contact Deb Cree, (814) 238-2461 or (800) 233-2267.

Planning ahead

Dec. 5-7: California Cable Television Association annual convention, Western Show, Anaheim (Calif.) Convention Center.
Jan. 30-Feb. 1: Texas Cable TV Association annual convention, the Texas Show, San Antonio Convention Center.
March 4-6: Society of Cable Television Engineers annual convention, Cable-Tec Expo '85, Sheraton Washington Hotel, Washington, D.C.
April 9-11: Canadian Cable Television Association annual convention, Toronto Metro Convention Center.
June 2-5: National Cable Television Association annual convention, Las Vegas (Nev.) Convention Center.
Aug. 25-27: Annual convention of the Southern Cable Television Association, the Eastern Show, Congress World Center, Atlanta.
Sept. 18-20: Atlantic Show, Atlantic City, N.J.

AD INDEX

THE NEW MC² COAXIAL CABLE IS MORE RESISTANT



Because each cell is an hermetically sealed compartment, MC² is more resistant to moisture ingress and migration. No other cable can stand up to its environment better than the new MC².

MORE SIGNAL STRENGTH

The new MC² Coaxial Cable's patented design of using air instead of foam means less attenuation and more signal strength. And that's with a signal load of 77 channels.

MORE SAVINGS

Because MC² components are bonded together for maximum flexibility and minimum signal loss, you save more money on installation, connections, labor and on the cable itself.

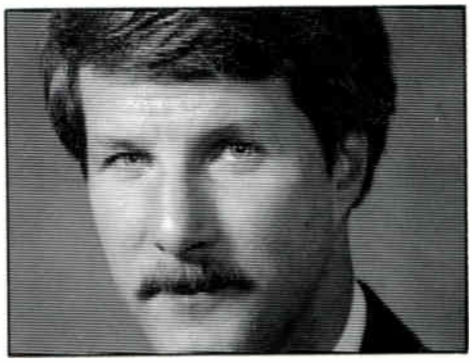
MORE economical. MORE reliable. MORE flexible. MC² outperformed the competition hands down and we'll be happy to show you the results anytime.

General Cable CATV

A Unit of The Penn Central Corporation

Visit us at booth 370 at the Western Show.

Part 1—Busy, busy, busy: Too busy for subscribers



By Bob Luff
Vice President, Engineering, United Artists Cablesystems Corp

Have you ever gotten so tired waiting in a store checkout line that you eventually just piled your would-be purchases on the floor and walked out in disgust? I remember thinking at the time, "If they cannot even buy enough cash registers and hire enough people to take my money, I'll go somewhere where they want my business enough to at least efficiently process my purchases." And do you know, I have never been back to that store. Are our cable subscribers leaving their would-be purchases on torn-out newspaper ads and hanging up in disgust because cable systems have not bought enough phone circuits or have not staffed the customer service department with enough representatives to efficiently answer and process calls?

Interestingly, the universal complaint heard about cable these days from subscribers and franchise authorities is not rates, programming or outages—it is getting a call through to our offices. It is clearly counter-productive for the industry to give so little attention to such an important and solvable situation.

A technical community opportunity

So what does the "too busy for subscribers" problem have to do with cable technology? I believe that the problem is largely a "technical" one, and one on which the cable technical community can and should focus their attention. When was the last time you tried to call your own cable system during the day, especially during lunch hour, 15 minutes before closing, or during one of the major pay programming promotions, or horror-of-all-horrors, during a major outage? I do not mean your private inside number. I mean the regular public number—the number the folks that pay our salary must use when the impulse to call and purchase more programming hits, or when they are having trouble. No fair you say—these are the worst times to expect to get through. You are right. But what makes them the worst times is so many other eager (or angry) subscribers also are trying to get through.

People call at these times not because they want to, but because they have to due to job restraints of their day, or because it is the most convenient time available for them to call. With money in hand or no service—busy, busy, busy—forever the line to customer service is busy! But they will call back later you say. They always have.

Competition is upon us

Maybe they will and maybe they won't. But our industry is based on providing service. Is it in our best interest, especially when multi-pay penetration is down and VCRs and 99¢ tape rentals are nipping at our heels, to not take every single call while the passion for purchasing more cable programming is hot? How many cable TV customers have hung-up in disgust? How many have decided instead to apply the additional $10 per month toward a VCR credit card purchase and never come back? And with pay-per-view just around the corner, the cable community certainly must get a better grasp on the science of turning "busy, busy, busy" into "thank-you for your orders."

Changing times

Generally, the primary responsibility for telephone equipment specification and customer service staffing has fallen solely on the manager or the customer service department. In the past, telephone equipment was pretty much all the same, and efficient 12-channel customer service staffing was pretty much trial and error. But, "the times they are a-changing." Today's 35 plus channel systems with higher churn multi-pays and addressability are changing management's and subscribers' success with the old trial and error approach. The trial and error method has two major weaknesses in today's cable environment. First, it is rare that the manager knows whether the staffing was over or under required levels until it is too late to do anything about it, and second, today's more complex operations keep daily telephone traffic in a constant state of flux.

Science of the 'Call Blocking Theory'

The technical community can act as a much needed catalyst to apply the time proven science of "Traffic" or "Call Blocking Theory" to cable TV customer service departments. The Call Blocking Theory is an amazingly interesting (and complex) set of probability formulas that take the mystery out of the relationship between number of customers trying to call, number of lines and representatives, average length of the call, and probability of busy, busy, busy. Blocking Theory is used successfully in "people engineering" all around us. Some examples are: number of toll booths and agents on a turnpike, number of cash registers and checkers at a supermarket, number of windows and tellers at a bank, and more parallel to the cable industry, the number of telephone lines and agents at major airline reservation facilities.

Space and the scope of this article do not permit a full discussion of the details of the Blocking Theory. Its success and routine application in so many other industries guarantees its availability in many references at any local library. But a brief review of the general Call Blocking relationships and how they might be applied to our customer service departments may encourage keener interest.

Science, not intuition

The most important point to first make in the science of Blocking Theory is that handling large groups of customers by relatively few phone lines and representatives is, unfortunately, deceptively simple. Intuition cannot accurately ensure the first and most important step in customer service—getting through! Of course, adding more lines and representatives always reduces customer busy signals. But how many is too many? And worse, how many is not enough? And when the costs of lines and representatives are considered, where is the best balance between operating costs and new orders?

Blocking Theory answers all these important questions. Examination of the dynamics involved is very revealing. Interestingly, the relationship between the number of busy vs. number of lines and representatives is very steep and nonlinear, both of which are to the industry's favor, but highly dependent on length of the average customer call. It means that not only will one more line and rep always increase calls handled per hour by its own independent contribution, but it also means that the now larger size of the pool of lines and reps as a whole will result in a significantly reduced probability of a customer trying to place an order and being blocked; i.e., receiving a busy signal. But perhaps the most important Blocking Theory concept is that the two most powerful and inexpensive solutions to customer busy signals is careful monitoring, training and design of promotions to ensure that the random subscriber initiation of calls are spread as evenly as possible over time, and the average customer call duration be as short and crisp as possible. Seconds make a big difference on overall performance.

Part 2 will appear next month with specific suggestions to apply Blocking Theory to customer service departments.

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