CED

Communications Engineering & Design/The Magazine of Broadband Technology

February 1984

TECH II
Drop, fiberoptic cable

Connecting with local area networks

IT'S EASY TO SEE WHY WE SELL SO MUCH PIII.

We're selling more PIII coaxial cable than ever because we're making it better than ever. And our new anti-corrosion, Double-Clad™ center conductor treatment is just the latest improvement.

Double-Clad is an innovative treatment involving both a pre-coat and a newly developed compound which combines with the copper surface of the center conductor to lower its corrosive potential. The result is a two-level conductor protection system. When the conductor is cleaned, the first level is easily removed. However, the second level of protection stays with the clean center conductor and remains bonded to the conductor surface for a long-lasting barrier against corrosion.

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Reader Service Number 1


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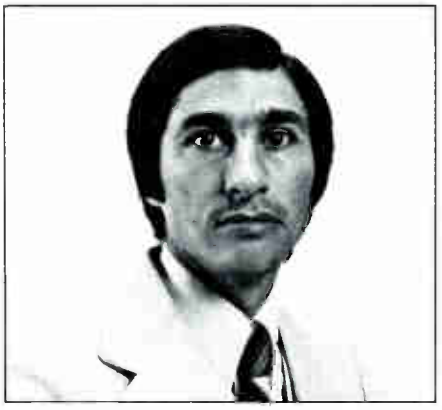
GENERAL INSTRUMENT

Reader Service Number 3

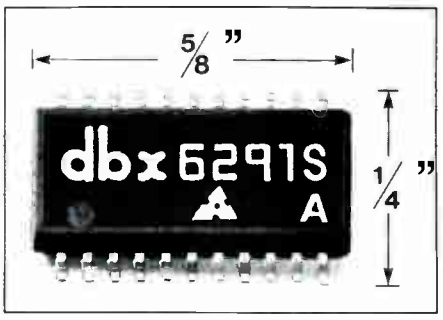
CED

February 1984

About the cover
Local area networks are linking various communications users within small geographic areas, as illustrated by Malcom Farley.



Sytek's Edward Cooper discusses differences between LANs and institutional loops, offers advice to cable engineers, and predicts growth for the LAN industry in an interview that is included as part of our feature section. See page 30.

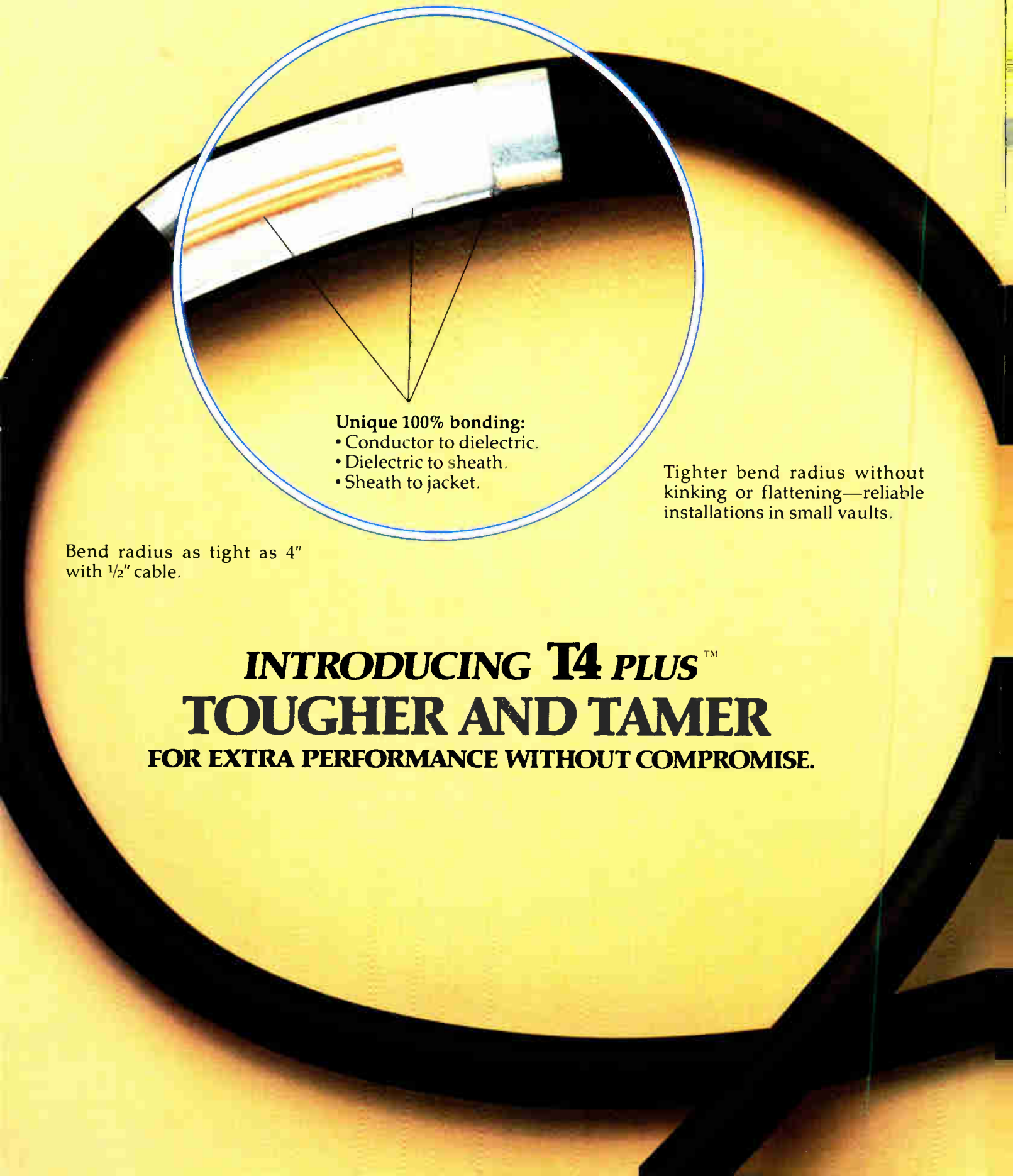


Noise reduction IC chip for dbx TV stereo sound system. Zenith and dbx systems were recommended as the industry standard for multichannel sound. See page 16.

 CED. (USPS 300-510) (ISSN 0191-5428) is published monthly plus extra editions in March, June, September, plus 2 in December by Titsch Communications Inc., 2500 Curtis, Suite 200, Denver, Colorado 80205. ©February 1984. Volume 10, Number 2. Subscription Price: 1 year, $26.00; 2 years, $43.00; 3 years, $63.00. OUTSIDE USA 1 yr. $64.00; 2 yrs. $89.00. MUST BE PREPAID IN US FUNDS ONLY! Second-class postage paid at Denver, CO. *CED* is published on behalf of all parties, including the Society of Cable Television Engineers (SCTE). POSTMASTER: Please send address changes to P.O. Box 5727-TA, Denver, Colorado 80217-5727. MEMBERS OF THE BPA.

BPA

THE ANATOMY OF A SUPER CABLE



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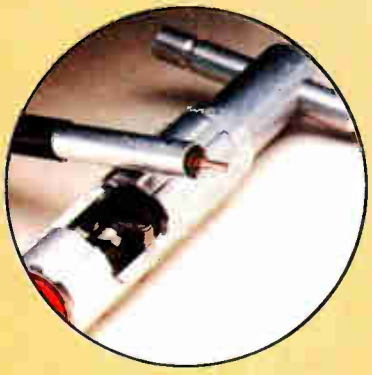

Easy coring with standard tools. Full-wall seamless aluminum tube, resistant to connectorization abuse. No objectionable non-conductive dielectric residue left on aluminum ID.

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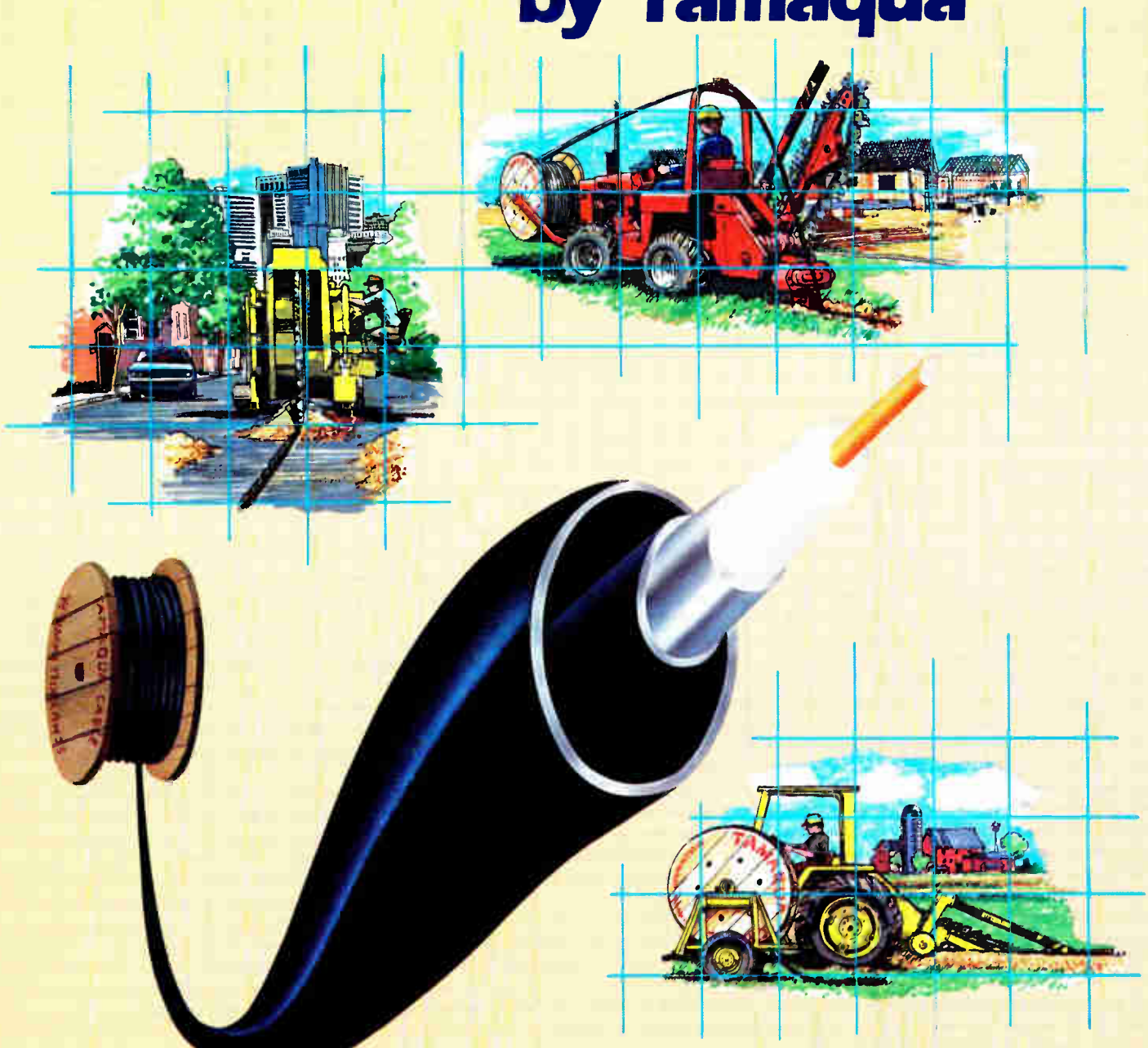
Reader Service Number 4

COMM-DUCT™
by Tamaqua



Comm-duct is an innovative installation concept. Virtually any configuration of coax, fiber-optic or telephone cable can be supplied by Tamaqua to the installation site in a flexible polyethelene duct system ranging in nominal pipe sizes from 0.5 to 4.0 inches. Tamaqua warrants the entire system, duct and component cable.

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Reader Service Number 5

Citizenship snag

Colin O'Brien's first major task as executive vice president and assistant to the president of Times Fiber may have more to do with the U.S. government than it does with the cable industry. Times Fiber CEO heir-apparent, O'Brien, who is an Australian, will have to become a United States citizen before he takes over those duties when present CEO Larry DeGeorge moves to chairman. Times Fiber is involved in what O'Brien called "a fair amount of defense work," requiring O'Brien to have security clearance before taking over the helm. O'Brien has not lived in Australia for 5 years; he facetiously said he never became a U.S. citizen to keep from being taxed or sent to war. The citizenship process usually takes about six months; DeGeorge's move from CEO to chairman is on hold until O'Brien is given clearance. About his new position, O'Brien said: "I'm excited about it. I'll be able to run my own operation." Originally, he was supposed to have taken over the Times Fiber post on Jan. 30.

Catel buys RCA Cablevision

Catel, a division of United Scientific Corp., announced recently it has acquired RCA Cablevision Systems' headend product line for an undisclosed price. Catel is moving the RCA operation to its Santa Clara headquarters, where it will manufacture modulators, demodulators, processors and related products using RCA specifications. The products will be marketed under the Catel name. In the meantime, Catel will sell what RCA headend products are left in the inventory. RCA Cablevision Systems, which announced it was going out of business last September, currently is talking to potential buyers about selling off its distribution equipment. At the time of the announcement, officials at RCA said they decided to close down the unit because of a small market share, depressed sales due to the construction slowdown and lack of an industry standard for converter technology.

New DBS moves

Satellite Television Corp. (STC) will use NASA's space shuttle to launch its first two DBS satellites, scheduled for launching in mid-1986. The DBS birds, which are being built by RCA Astro-Electronics, will be delivered to the Kennedy Space Center in the beginning of 1986. STC is currently developing a multichannel satellite-to-home Pay-TV service for the birds. Other DBS news concerns Hughes Communications' filing of an application with FCC to construct, launch and operate a DBS system.

Information please

ATC has debuted Cablevision Information Line, a 24-hour computerized telephone information service, in its Charlotte and Raleigh, N.C., systems. The service is programmed with a series of messages about topics such as programming, billing, installation, repair, etc. The service also provides subscribers with information for troubleshooting minor service problems and allows callers the opportunity to leave messages for the cable system. The service was developed by Data Acquisition Services, CED

Titsch Communications Inc.

Robert Titsch, President
Michael Borer, Chief Financial Officer
Joyce Hemmen, Director of Operations

CED

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By design

This month we examine the interesting concept of institutional loops and local area networks, two seemingly different concepts, yet offering a relatively similar service. Or is that the case? With cable, it's called the institutional loop, most prominently featured at franchise time as a business connection throughout the heart of an urban city. The local area network, principally developed by telephone lines takes on a variety of meanings, but is most widely defined as one that "interconnects devices using non-public signal conductors within an area of five to ten miles, often considerably less." In the book *Local Area Networks: Issues, Products, and Developments*, authors V.E. Cheong and R.A. Hirschheim tend to take on a more dramatic definition: "Local area networks, with the growth of interest in the electronic office, are seen as the glue which would cement together the various information technology components of that office."

Dramatic, is it not? But then, the business itself is worthy of that sort of drama. With cable as an active proponent of its own local loop, and with businesses looking for alternatives to bypassing the local BOC, the fireworks are potential. The question that has yet to be answered is what kind of strategy can cable create and ultimately pursue in order to become that bypass source, plus satisfy the demands of the local council seeking a link between businesses, government offices, hospitals and other organizations. *CED* Associate Editor Gary Kim attempts to examine some of cable's possibilities, while exploring the whole issue of local area networks. In addition, Kim interviewed Edward Cooper, manager of cable engineering and consultant for Sytek, considered by many experts in the data industry to be the leading authority on LANs. Sytek is an engineering firm that provides turnkey services for the construction of LANs, and Cooper has personally designed 250 LANs.

Included in the feature on LANs, Cooper has provided a bibliography on local area networks so that the reader can learn more about this system. We plan to offer bibliographies as a regular part of all future features as a service to our readers. We want to keep you informed about services that go beyond the traditional cable sources. By providing additional material for the newcomer, we can help in making that first transition.

Also included in this issue is a special supplement that we hope will become a regular feature. The Society of Cable Television Engineers, under new guidance with Stephen Cox heading up the day-to-day functions of the association as executive vice president, ably assisted by veteran President Tom Polis, is gearing up for its second CableTec Expo, to be held March 5-7 in Nashville. As a service to the society and its membership, we have included a short version of the SCTE *Interval*, the association's newsletter, within this issue of *CED*. Just to let our readers, who do comprise a majority of the SCTE membership, know that there is a contact at the society and that its goals for 1984 and the CableTec Expo and beyond are indeed ambitious, is the purpose behind its inclusion here. We believe firmly in the importance and necessity of the SCTE, and we want to do our part in furthering its ideals and goals on behalf of its membership and the cable industry at large.

Last month we issued a special report on addressability and the response to this report, which featured a number of articles by leading authorities both independent and representing various manufacturers, has been very positive. The path to addressability, as the industry well knows, has been frought with some pain and disappointment, but we have learned from our mistakes and from the experiments. The consensus remains that addressability is beyond a doubt a viable facility for the cable operator, and its potential has yet to be fully utilized.

One additional note on the issue, which is available from our staff at the Denver office (call 303-295-0900 for a copy): we must give credit where credit is due—we inadvertently omitted the bio on Ray St. Louis, well known within the cable industry, but worthy of mention for background information. Ray is president of R.F. St. Louis Associates, an Essex Fells, N.J., consulting firm specializing since 1978 in the design of hardware and software for cable products. His prior experience included 15 years with Blonder-Tongue Labs. We appreciated his material and thank him and all the authors who contributed stories to the report.

Peter Evanow

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Reader Service Number 7

Seminars

February

1-3: A three-day workshop entitled "Networking Personal Computers" and sponsored by the **Data-Tech Institute** will be held in Anaheim, Calif. Contact Data Tech Institute, Nutley, N.J., (201) 661-2300.

2-3: Data Research Corp. will sponsor a seminar on "Data Communications: Advanced Concepts, Products and Services" in San Francisco. Contact Data Research Corp., (609) 764-0100.

6-7: Data Research Corp. will sponsor a seminar on "Data Communications; Advanced Concepts, Products and Services" in Washington, D.C. Contact Data Research Corp., (609) 674-0100.

7-8: The annual meeting of the **Arizona Cable Television Association** will be held at the Phoenix Hilton Hotel. Contact (602) 257-9338.

7-8: The **IEEE Educational Activities Board** will sponsor a two-day entry-level course, entitled "A Practical Introduction to Lightwave Communication," to be held at the U.S. Department of Commerce, Washington, D.C. Contact Robert Wlezien, (201) 981-0060.

8-10: The George Washington University's School of Engineering and Applied Sciences will hold a course on "Communications Satellites Systems—The Earth Station: A Practical Approach to Implementation" in Washington, D.C. Contact Darold Aldridge, (800) 424-9773.

8-10 and 13-15: Magnavox CATV Systems will hold a field training seminar with its Mobile Training Center in Jacksonville, Fla. Contact Laurie Mancini, (800) 448-5171; in New York (800) 522-7464.

13: Hughes Aircraft Co.'s microwave communications products will hold its first 1984 technical seminar on AML local signal distribution systems at Hughes' Torrance, Calif., facility. Contact Seminar Registrar, Torrance, Calif., (213) 517-6244.

14: A meeting of the **International Association of Satellite Users** will be held at the Twin Bridges Marriott Hotel in Washington. Contact Donna McCaughey, (703) 437-5457.

20-22: A **CATA** advanced technical training seminar sponsored by the **Mid-America Cable TV Association** will be held at the Holiday Inn Medical Center, Witchita, Kan. Contact (305) 562-7847.

21-23: A technical seminar sponsored by **C-COR Electronics Inc.** will be held in Dallas. Contact Deb Cree (814) 238-2461.

22-24: The annual convention of the **North Dakota Cable Television Association** will be held at the Holiday Inn, Fargo. Contact Claude Edwards, (701) 280-0033.

23-24: Microwave Filter Co. Inc. will sponsor a terrestrial interference seminar. Contact Bernadette Andaloro, (800) 448-1666.

March

5-7: Cable-Tec Expo '84, sponsored by the **Society of Cable Television Engineers**, will be held at the Opryland Hotel in Nashville, Tenn. Contact (703) 823-1911.

7-9 A **CATA** advanced technical seminar will be held in Orlando, Fla. Contact (305) 562-7847.

11-13: The 19th annual convention of the **Ohio Cable Television Association** will be held at the Hyatt Regency/Ohio Center in Columbus. Contact Daniel Helmick, (614) 461-4014.

12-14: The George Washington University will sponsor a course on Fiber-optics Systems Design, which will be held in Washington, D.C. Contact George Harrison, (202) 676-6106.

13: A meeting of the **International Association of Satellite Users** will be held at the Twin Bridges Marriott Hotel in Washington. Contact Donna McCaughey, (703) 437-5457.

14-16: The annual convention of the **Arkansas Cable Television Association** will be held at the Excelsior Hotel in Little Rock. Contact Floyd White, (501) 898-2626.

22-23: The annual convention of the **Georgia Cable Television Association** will be held at the Ritz-Carlton Buckhead in Atlanta. Contact Nancy Horne, (404) 252-4371.

Looking ahead

March 5-7: Society of Cable Television Engineers Cable-Tec Expo '84, Opryland Hotel, Nashville, Tenn.

March 27-28: Cabletelevision Advertising Bureau conference, Sheraton Centre, New York.

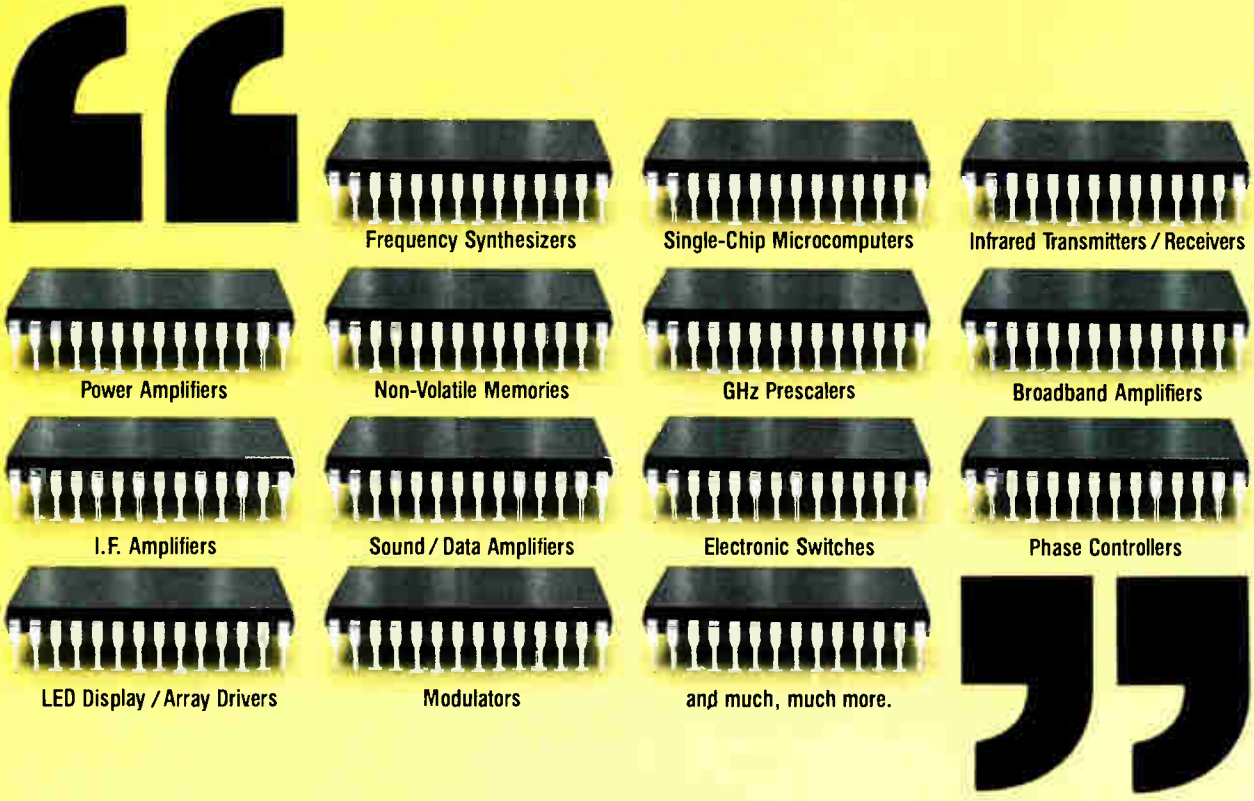
May 9-11: A **CATA** advanced technical training seminar, Best Western Monticello Motor Lodge, Philadelphia, Pa.

June 3-6: National Cable Television Association convention, Las Vegas (Nev.) Convention Center.

June 11-14: Canadian Cable Television Association convention, Capital Congress Center, Ottawa.

July 15-19: The Community Antenna Television Association Convention, CCOS-84, Tan-Tar-A-Resort, Osage Beach, Mo.

SIEMENS



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the INTERVAL

Stephen Cox:
The Vice President's report

The interest for the development of the SCTE's BCE/BCT (broadband communications engineers/technicians) program has received strong support from the industry as a whole. In surveying the needs of the MSOs, engineers and technicians, the consensus leans heavily in the area of well-trained and qualified technical staff to handle systems design and engineering.

The board and staff of the SCTE have consolidated the broader interests of the industry's technical community into a reasonably concise certification program. The real fine-tuning of this program is currently underway and promises to be in a readable format by Cable Tec Expo '84.

Cable Tec Expo '84 is, and will be, one of the hallmarks for the SCTE in years to come. It's real success depends on the reading of the *Interval* and every other cable industry publication. The impact of this event affects the industry at its heart; from the system technician to the senior vice president of engineering. We solicit and endorse your strong support.

Product development and distribution from the SCTE headquarters is now officially on track, and we foresee increases in sales in available training materials and supplies.

It is extremely important to thank my predecessor, Judy Baer, who ran a very well organized system, which facilitated the society's ongoing success. Additional thanks to Titsch Communications and its staff for assisting in the development of our future plans for designing, reviewing and publishing vital technical information for dissemination to the communications family at large.

The strength of any industry is only as strong as its individual contributors. To that end, the SCTE will work to bring pride, technical competence and reliability to an industry whose full potential is still being realized.

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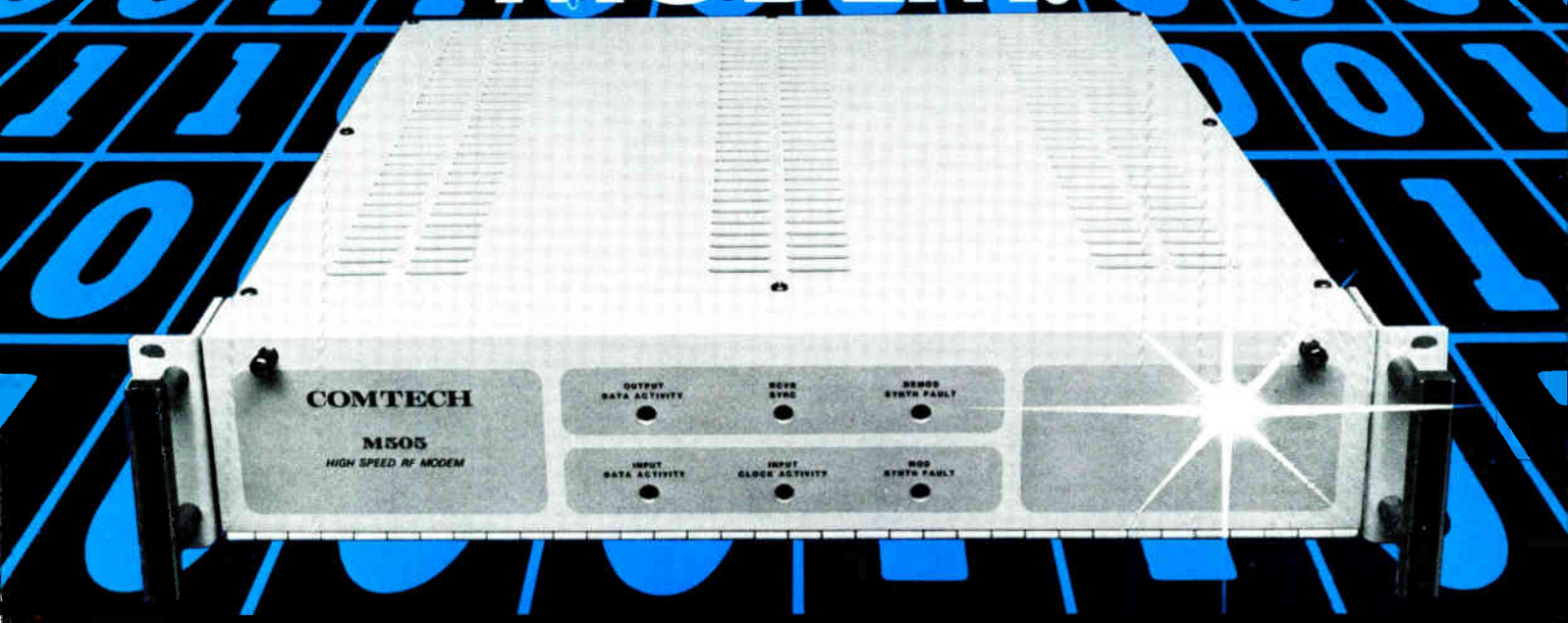

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COMTECH *Data Corporation*

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Reader Service Number 14

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Barrett, Hanna, Daly & Gaspar
2555 M. Street N.W., Suite 100
Washington, D.C. 20037
(202) 293-3204

The SCTE's "Cable-Tec Expo '84"

March 5-7, 1984, Nashville, Tenn.

Technical sessions

FCC Compliance:
Jon Wong
Chris Papas
FCC organization
signal leakage requirements
forms and records
testing requirements

Construction practices:
(aerial and underground)
NESC
OSHA
planning
equipment and tools
handling coax cables

TVRO maintenance:
dish aiming
LNC and LNA
the receiver
testing
overcoming interferences

Amplifier fundamentals:
basic amplifier principles
the hybrid circuit
internal losses
set-up techniques
bench and field testing
the equalizer and pad selection

Installation practices:
installing the drop
entering the home
grounding the drop
converter, FM, VCR install
public relations
NEC

Apartment wiring:
planning
interfacing
cable routing
design
MEC

Test equipment:
types and uses
maintenance and calibration
fundamentals of operation
record keeping

The cable converter:
principles of operation
pretesting
fundamentals of scrambling
fundamentals of addressables

Elements of system design:
how levels are established
effects of temperature
the role of passives
backfeed techniques
drafting and symbols

Using and maintaining feedforward:
principles of feedforward
testing main and correction amps
field set-up
bench testing

Inside the ARRL:
understanding ham radio
effects of signal leakage
ARRL organization—how, who and when?
frequencies assigned

Digital primer:
the bid, byte and nibble
the message
modulation techniques
the modem
applications

Round tables

Manpower training and development
a. what is available
b. developing a program
c. the minority as a resource

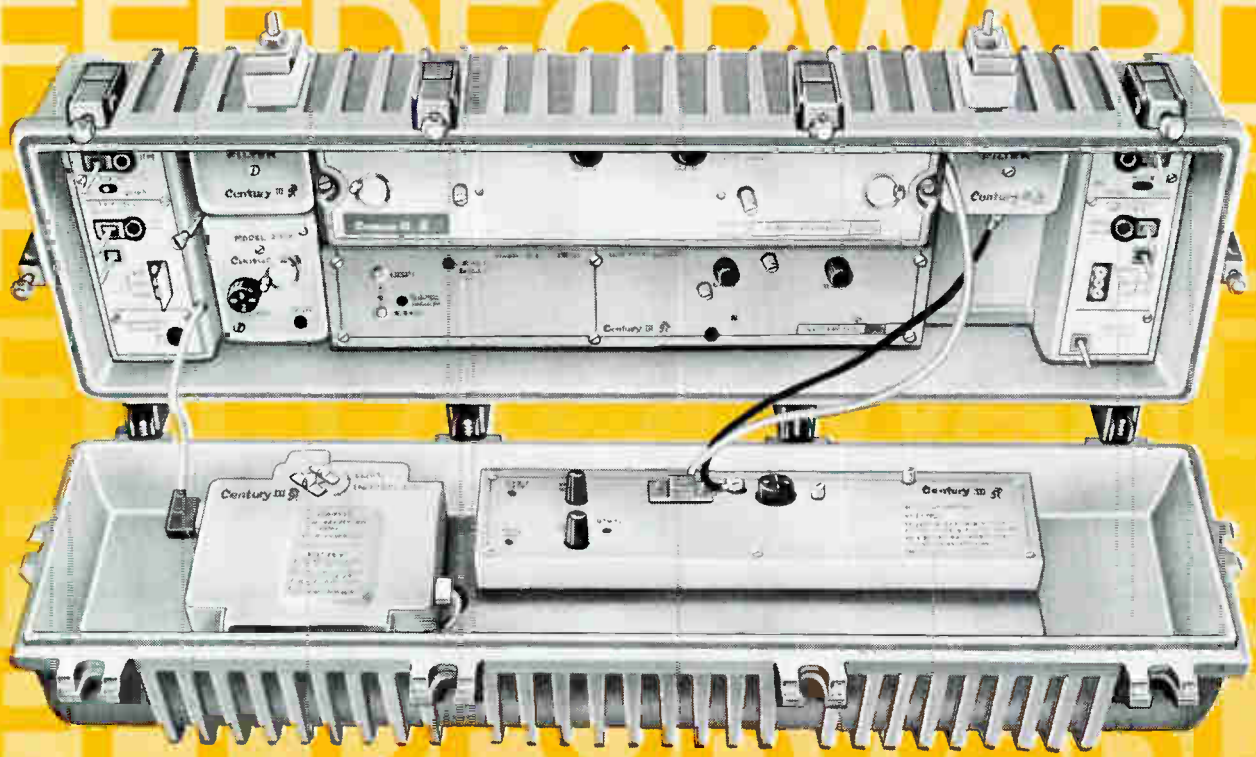
The addressable experience
a. is it working
b. things to watch for
c. training requirements

Super systems
a. new problems in metro systems
b. manpower requirements
c. special construction techniques

Tiering it all together
a. interconnect application
b. noise and data—what you should know
c. integrated systems
d. LAN

CED

FEEDFORWARD



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GENERAL INSTRUMENT

Reader Service Number 13

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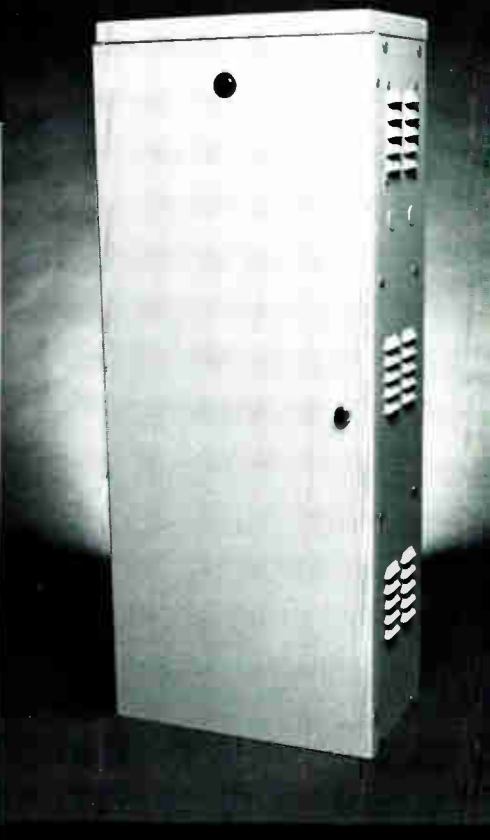
SENTRY II
Features:
- Total modular construction, customized to your needs.
- Automatic switchover when either module is unplugged.
- Auto restart overload protection.
- Constant voltage taper charger.
- Under-voltage protection.
- Top or bottom battery position, optional.
- Accommodates group 31 batteries.
- Ground or pole mount.
- Status indicator lights.
- Metered battery voltage & output current.
- MOV surge protection, standard.
- Optional heavy-duty surge protection available.
- Optional daily battery exercise charge available.

MINI BRUTE
Features:
- 89.4% operating efficiency (tops in the industry).
- Fan cooled for extended life.
- 5% load regulation.
- 1% line regulation.
- Modular design.
- Positive disconnect for added safety.
- MOV surge protection standard.
- Time delay and current limit options available.
- 7″W x 8″D x 15½″H
- Wt.—37 lbs.



ADD-ON STAND-BY UNIT
Features:
- 60 Volts output or optional 30 volt.
- 720 Watts.
- 2 Hr. 20 min. operating time at full load.
- Compatible with any standard make Ferro supply.
- Dual battery operation.
- 5% load regulation between 3 & 5 amps.
- Automatic low voltage shut down.
- Plug-in connectors for simple installation.
- Built in fan for longer life, standard.
- 13″W x 8″D x 33″L
- Wt.—38 lbs. (without batteries).

Reader Service Number 15

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Eyeing local area networks

Sytek's Cooper discusses ways for cable to enter the local area network arena

MOUTAINVIEW, Calif.—Although there are differences between cable institutional loops and private local area networks, the similarity between the two technologies offers the industry new business opportunities, says Edward Cooper, manager of cable design and consulting for Sytek Inc. But service functionality and reliability are critical for success in either arena, and the cable industry has some homework to do on both counts, he says.

And Cooper ought to know. During his career, he's personally designed 250 local area networks, including those in association with Sytek, and is considered an industry leader in broadband technology by most knowledgeable data communications professionals. He recently finished a book called *Broadband Network Technology*, to be published by Sytek Press this year. He also has written for *Data Communications* and *Computer Design* magazines, and has presented papers at the Interface '83 and other broadband technology conferences. He's also active with the Institute of Electrical and Electronic Engineers 802 standards committee.

In a recent interview with *CED*, Cooper predicted continuing growth for the LAN industry, suggesting that one day more broadband distribution equipment will be sold to the LAN market than to the cable industry.

He also explained what the cable industry and cable engineers must do to prepare themselves for the coming business.

CED: What sorts of applications have your LAN customers desired?
Cooper: The primary application has been data communication; both terminal to host computer as well as computer to computer. Other specialized applications are computer-aided design for engineering and development as well as management information systems and inventory control. Some of the large companies ask for time and attendance control systems. A company with 4,000 employees can't rely on time cards to know who's there and who isn't on any given day. Many companies add energy management systems to run their heating and cooling plant. Some companies have wanted TV-type security systems, while others have ordered information and education ability. For example, some employers have agreements with universities allowing their employees to take courses for credit right there on the job site. Some of our customers use their systems to monitor doors, do video or audio teleconferencing and even paging.

CED: Is there a difference between an institutional network and an LAN?
Cooper: There's a big functional difference between the two. Manhattan Cable's institutional loop is a good example of the difference. Typically, the cable on the customer premises is owned by Manhattan; thus it isn't a private, dedicated line. The drawback from the customer standpoint is that since the line isn't yours, you can't do anything you want with it. Maybe the customer gets stuck with a modem that

13 cents of sheer genius.

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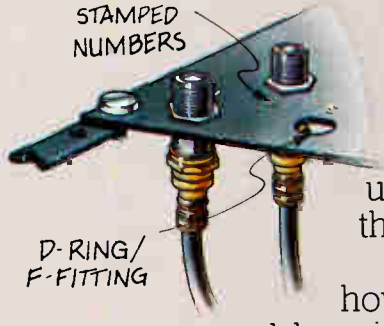

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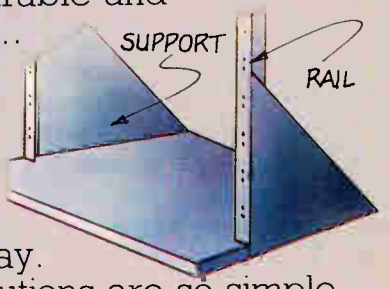

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Reader Service Number 20

the cable operator is familiar with, but which isn't the best for the application desired. The customer can't add new applications at will, so there's little flexibility.

CED: So firms are putting in their own networks?

Cooper: Yes, the trend is for companies to put in dedicated lines that they have complete control over. Then they can tie one building to another through the institutional loop a cable operator might install. The cable operator provides the critical path for connecting discrete multiple networks, in this case.

CED: How about security of the information?

Cooper: You get better security with a private network, obviously. LANs are normally used quite heavily for data transmission, and a bank, for example, wouldn't want to broadcast its data on the equivalent of a party line. An institutional network has to encrypt the information to attract this type of customer.

CED: Is there a role for the cable operator in the LAN business?

Cooper: The technologies are similar. An LAN is like a cable plant in many ways, although a certain amount of maturity is required before a company can make a successful business out of data communications. People who are data-oriented and people who are RF-oriented can learn from each other, although some people say the two can't talk to each other. The cable engineer is used to a systems approach and has expertise in certain broadband applications. What the industry needs is more experience. It needs to take some chances and make some mistakes. I think that the cable industry eventually will design, construct and maintain private LANs. As far as the institutional network is concerned, the future there is in scrambled signals. Data modems which encrypt information are available. As an alternative, some clever use of traps and frequency processors can provide some level of security required. A star approach in design could also provide greater control, monitoring and security.

CED: What must cable engineers and operators do to prepare themselves?

Cooper: The most important thing is to talk to LAN customers and find out about their needs, specifications and problems. You need to find out what applications they require and what they're looking for.

CED: How about equipment?

Cooper: There's a great adaptability of data knowledge to modems, which are real specialized. You need to know which device to use for which applications, and that's where the need for training comes in. You need to know the industry players and suppliers as well. The data world has an International Standards Organization like the cable industry has the NCTA. The ISO sets protocol standards and you need to know their structures and guidelines. Also, the IEEE standards group is looking at the entire communications issue.

CED: How can a cable engineer learn about LANs?

Cooper: John McNamara's *The Technical Aspects of Data Communication* by Digital Press is good. James Martin's *Future Developments in Telecommunications* is good, and I also like *Principles of Communications Systems* by Taub and Schilling. Another is *Data Com Components* by Gilbert Held.

CED: How does the design of an LAN differ from that of an institutional network?

Cooper: An institutional net typically covers many square miles and is exposed to a much harsher environment than a LAN, so the equipment has to be rugged. Since an institutional network

must allow for connection of any business or government organization along its route, it needs frequency conversion or scrambling techniques enabling everyone to use one line. Reliability is a critical issue for institutional nets, whose plant is less-well protected than an LAN. Typically, our LANs don't require redundancy in the critical path, but an I-net must provide it.

CED: Why is that?

Cooper: People don't shoot at an LAN's hardware and our equipment doesn't sit out on telephone poles exposed to the harsh elements typical of today's installations. However, this does not imply that LANs are small in size or need the same redundancy considerations.

CED: Are there other differences?

Cooper: Just about everything in design specification is tighter for an LAN. When a cable TV system is engineered there's more tolerance because the TV dynamic range is not so large and very little return origination is considered. In an LAN, a modem talking at the lowest spectrum range has to communicate with a modem at the highest spectrum range, and because it's a two-way plant, all the error ranges are doubled. Also, every outlet becomes an information and communication provision, not an entertainment provision; thus, loop loose from all points in the system must meet a demanding specification. It's quite a challenge.

CED: Are your systems primarily single-building nets?

Cooper: No, we've got them in all kinds of configurations. Sometimes we wire a single building, and sometimes several floors of a building, but we also have some 100-building installations containing 6,000 to 7,000 RF outlets. We have also built some 100-mile systems, which are almost like a small city.

CED: Can you interconnect LANs?

Cooper: LANs are often interconnected through the Bell network or by microwave. The cable industry, for example, has a long history of connecting multiple hubs by AML or FML microwave, and some LANs also are connected this way. The same technology is involved.

CED: Will the existing cable technical force be prepared to maintain the new networks?

Cooper: I think there'll be some specialization if cable companies get into the LAN business. I don't see the technicians now in place being able to talk intelligently to data processing managers. They'll need to understand business needs and markets. You'll also need a sales and marketing force with some technical understanding. I think you're looking at a different group of people who might come from the Bell system, other players in the telecommunications industry or data processing operations. Maybe eventually, you'd have technicians who maintain the entertainment side of the plant while LAN technicians handle the data side.

CED: What if a customer doesn't want to use the public I-net?

Cooper: The industry can get into the design, construction and maintenance of private networks for a fee. The CATV industry already has experience with construction of broadband nets and knows the products and the problems.

CED: What about competition from Direct Termination Services?

Cooper: LANs can be connected by microwave, but I think what cable has to do is sell quality services at equal or lower prices. You eliminate line-of-sight problems and other atmospheric interference if you connect with cable. The cable plant is an extremely powerful communications tool. I've found that once customers are introduced to broadband, they realize that it's one of the most powerful communication tools they can put in. The other thing cable has going for it is that the system is uniquely flexible. Systems designed 10 years ago are still adaptable to new modems developed today, for example. The broadband plant is adaptable in ways that other media like twisted pairs are not. Many older systems using a point-to-point cable link can upgrade to a multipoint intelligent communications network if they add the right modems. With an RF system you can guarantee a customer that the network will still be adaptable 20 years from the time it goes in with little or no upgrade. With a 10-year-old twisted-pair network, a new PBX with data and voice capability will require completely new wiring.

CED: Cable systems are generally tree configurations. Data nets are more frequently bus, ring or loop nets. Will the existing plant need to be modified?

Cooper: It turns out that a broadband system structured like a tree operates logically as a bus. As far as the modems are concerned, it's a bus network, not a tree. The strength of broadband as compared to baseband is that with RF there are many different arbitration methods that can co-exist on the same medium. On a single-channel network (baseband) everything connected to the net has to operate at the same speed and use the same protocols. That isn't a problem with RF. All kinds of equipment operating at different speeds and proto-

cols can operate simultaneously, which is a real advantage if one company has many different types of vendor equipment.

CED: What's the status of the baseband/broadband debate?

Cooper: It isn't a debate anymore. In 1980 Ethernet was introduced by Xerox, and everybody thought it would become the standard. In contrast, broadband has been used for data since 1973 with point-to-point services. In 1981, intelligent modems and expanded broadband networks were introduced. By the end of 1981, the debate had ended. Customers began to choose a system based on their applications. For high-speed, short-distance, one-channel applications, baseband is fine. For multiple-speed, greater-distance, multiple-site networks, broadband is the only way to go. Both systems will coexist, and the applications required will determine which system is chosen.

CED: Are the equipment needs for LANs very different from cable?

Cooper: Yes. We need complete amplifier redundancy in some cases for both directions. We need lower cost, lower amperage power requirements. We need a seven, not a 14 amp power supply, for example. And we need equipment designed for the internal environment. It has to be quiet and attractive. Status monitoring with feeder disconnect is critical for us. If there has been a failure at any point (not just at the amplifiers), we need to know quickly and accurately. Improved and more flexible return and forward equalizers along with stand-alone equalizers as Jerrold is producing are essential.

CED: What modem speeds are required on I-nets?

Cooper: We've been studying this at the IEEE. Speeds of two megabits or less should be ideal for I-nets. In Boston, for example, several different operators will be linked by regional switching centers, allowing information to pass freely in all areas. Many frequency conversions will be needed, and two megabits or less seems to be the ideal speed. At higher speeds, say 5 or 10 megabits, you lose the ability to transmit for distance, which won't work in that type of environment. One of the neat things about cable architecture is flexibility. Imagine a large city with six hubs. It's possible to have all six support unique data communications requirements and yet share a common headend and information path. Dedicated services can be provided separately at each hub, but common systemwide information can be sent along a supertrunk or AML/FML link. Low-speed modems ought to work just fine for these types of applications. A two megabit signal at three megahertz of bandpass can survive a noisy environment and travel several miles. A 128 kilobit channel can cover 35 miles from the headend, and that should take care of just about any franchise. At 10 megabits, you're limited to less than 3,000 feet from the headend based on certain arbitration schemes.

CED

Correction

In the Winter 1983 issue of *CED* on addressability, we omitted Cable Terminal Services from our converter repair list. The company, which repairs Jerrold and Oak among other manufacturers' converters, is located at 72208 McNeil Drive, Austin, Texas 78729, (512) 258-1606.

In the same list, PTS Electronics' address was incorrectly stated. PTS Electronics' corporate headquarters, which is one of 27 nationwide company owned service centers, is located at 5233 Highway 37 South, P.O. Box 272, Bloomington, Ind. 47402, (812) 332-3236.

Communications Engineering & Design

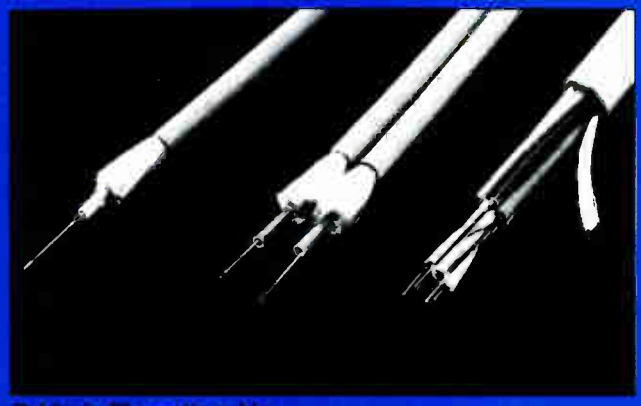
TECH II

CED's feature supplement and Product Profile

February 1984

Evolution of the I-Net

Product Profile: Drop & Fiberoptic cable



Belden's fiberoptic cable

Drop cable

Model	Conductor	Inpedance	Dielectric	Attenuation	Capacitance	Velocity of propogation
Belden						
duobond plus 9057	copper covered steel	75 ohms nom.	foam core polyethylene	450 MHz—4.6 nom. 300 MHz—3.8 nom.	17.3 pF/ft.	78% nom.
dual 9070	copper covered steel	75 ohms nom.	foam core polyethylene	450 MHz—5.8 nom. 300 MHz—4.6 nom.	17.3 pF/ft.	78% nom.
Capscan						
CD 7000	copper clad steel	N/A	foam polyethylene	550 MHz—3.24 dB/ 100 ft.; 450 MHz— 2.91 dB/100 ft.	N/A	N/A
RG 59u 5902	copper clad steel	N/A	foam polyethylene	400 MHz—4.98 dB/ 100 ft.; 300 MHz— 4.27 dB/100 ft.	N/A	N/A
CCS Cable						
29477 series	copper clad steel	75 ohms ±2	foam polyethylene	400 MHz—5.36 dB/ 100 ft.; 300 MHz— 4.40 dB/100 ft.	17.3 pF/ft.	78%
99800 series	copper clad steel	75 ohms ±2	foam polyethylene	400 MHz—2.61 dB/ 100 ft.; 300 MHz— 2.24 dB/100 ft.	17.3 pF/ft.	78%
Channel Master						
9542-500	copper clad steel	75 ohms	foam	213 MHz—3.8 dB/ 100 ft.; 500 MHz— 5.9 dB/100 ft.	16.5 pF/ft.	83%
Columbia Electronics						
C1105	copperweld	80 ohms nom.	foam polyethylene	200 MHz—4.1 dB/ 100 ft.; 500 MHz— 6.6 dB/100 ft.	16.3 pF/ft. nom.	78% nom.
C5780	copperweld	75 ohms nom.	foam polyethylene	200 MHz—3.8 dB/ 100 ft.; 500 MHz— 6.2 dB/100 ft.	17.3 pF/ft. nom.	78% nom.
International Electronic Wire & Cable						
7521	copper clad aluminum	75 ohms nom.	foam	200 MHz—3.8 dB loss/100 ft.; 500 MHz—6.1 dB loss/100 ft.	17.3 mm f/ ft.nom.	N/A
M/A-COM Comm Scope						
Paramedrop foam series	copper covered clad steel	75 ohms nom.	gas expanded polyethylene	300 MHz—4.45 dB/ 100 ft. max.; 450 MHz—5.4 dB/ 100 ft. max.	16.2 pF/ft. nom.	82% nom.
solid series	copper cover clad steel	75 ohms nom.	gas expanded polyethylene	300 MHz—5.8 dB/ 100 ft. max.; 450 MHz—7.0 dB/ 100 ft. max.	20.5 pF/ft. nom.	66% nom.
Scientific-Atlanta						
5-1008 bonded	copper clad steel	75 ohms ±2	foam polyethylene	300 MHz—4.59 dB/ 100 ft. nom.; 543.25 MHz—6.27 dB/ 100 ft. nom.	17 pF/ft.	81%
5-1013 multi-shield bonded	copper clad steel	75 ohms ±2	foam polyethylene	300 MHz—4.59 dB/ 100 ft. nom.; 543.25 MHz— 6.27 dB/100 ft. nom.	17 pF/ft.	81 %
Times Fiber						
RG 59u / 2200 T4 single	copper clad steel	75 ohms ±2	foam polyethylene	300 MHz—4.27; 450 MHz—5.3 dB/ 100 ft. nom.	16.5 pF/ft.	88%
RG6/u 2200 T4 single	copper clad steel	75 ohms ±2	foam polyethylene	300 MHz—3.46 dB/ 100 ft. nom.; 450 MHz—4.31 dB/ 100 ft. nom.	16.5 pF/ft.	88%

Fiberoptic cable

Model	Belden 226401	Belden 229657	Siecor 00144-007001	Siecor 00244-P027001	Times Fiber AF-1233	Times Fiber AF-1235
No. of fibers	1	2	1	2	1	2
Core diameter	100 microns nom.	50 microns nom.	100 μm	100 μm	200 μm nom.	200μm nom.
Cladding diameter	140 microns nom.	125 microns nom.	140 μm	140 μm	250 μm nom.	250 μm nom.
Buffer diameter	N/A	N/A	900 μm	900 μm	450 μm nom.	450 μm nom.
Attenuation	@ 850 nm: 5.0 dB/Km. nom.	@ 850 nm: 3.0 dB/Km nom.	@ 850 nm: 7.0 dB/Km max.	@ 850 nm: 7.0 dB/Km max.	@ 820 nm: 10 dB/Km max.	@ 820 nm: 10 dB/Km max.
Bandwidth	20 MHz-Km	200 MHz-Km	300 MHz-Km min.	300 MHz-Km min.	45 MHz-Km	45 MHz-Km
Numerical aperture	.28	.20	.29	.29	.15 $\pm$ .02	.15 $\pm$ .02
Outer diameter	6.7 mm	6.2 x 10 mm	3.0 mm	9.0 mm	2.54 mm x 3.81 mm	5.08 mm
Weight	30 lbs./ 1000 ft. nom.	40 lbs./ 1000 ft. nom.	7.5 KG/Km nom.	60 Kg/Km nom.	9.8 Kg/Km nom.	26.1 Kg/Km nom.
Max. installation load	500 lbs.	750 lbs.	tensile load: 300 N	tensile load: 1000 N	tensile strength: 150 N	tensile strength: 600 N
Max. long-term load	20 lbs.	30 lbs.	tensile load: 50 N	tensile load: 150 N	tensile strength: 30 N	tensile strength: 100 N
Crush resistance	N/A	N/A	550 N/cm	700 N/cm	50 N/cm	150 N/cm
Min. bend radius	installation: 6 inches; long-term application: 4 inches	installation: 6 inches; long-term application: 4 inches	installation: 5 cm; unloaded (free) installation: 3 cm	installation: 15 cm; unloaded (free) installation: 7.5 cm	50 mm	60 mm
Temperature range	+14° F—+122° F	+14° F—+122° F	storage: -40° C—+70° C; operating: -20° C—+70° C	storage: -40° C—+70° C; operating: 0° C—+70° C	storage: -50° C—+80° C; operating: -20° C—+60° C	storage: -50° C—+80° C; operating: -20° C—+60° C

Evolution of the I-NET

Cable must move quickly to get involved in the business communications market

By Gary Kim

Like a glider pilot searching for a thermal updraft, the cable industry hangs suspended someplace between heaven and earth; above the familiar terrain of one-way video entertainment services and yet far below the promised nirvana of fully interactive business services.

Not yet high enough to soar without fear, the industry finds itself in a turbulent, swirling and fickle sky. Unseen downbursts and gentle thermal chimneys contend. Seeking lift, the industry pilots its craft carefully. Like Icarus, it fears flying too high, too fast and melting its wings.

But some industry observers, like ELRA Group President Dr. Gerhard Hanneman, urge a more aggressive pursuit of data, local loop bypass and other institutional net services.

"Competition in the local loop data business has heated up tremendously," he says. "In the last year, we've probably seen a five-fold increase in high-band, short-haul players."

If the industry doesn't get into the intra-LATA data transport business soon, the window of opportunity slams shut, Hanneman says. Formed as a result of the AT&T divestiture, the local access and transport areas are the province of the Bell operating companies. Inter-LATA traffic is to be handled by AT&T and other long distance providers.

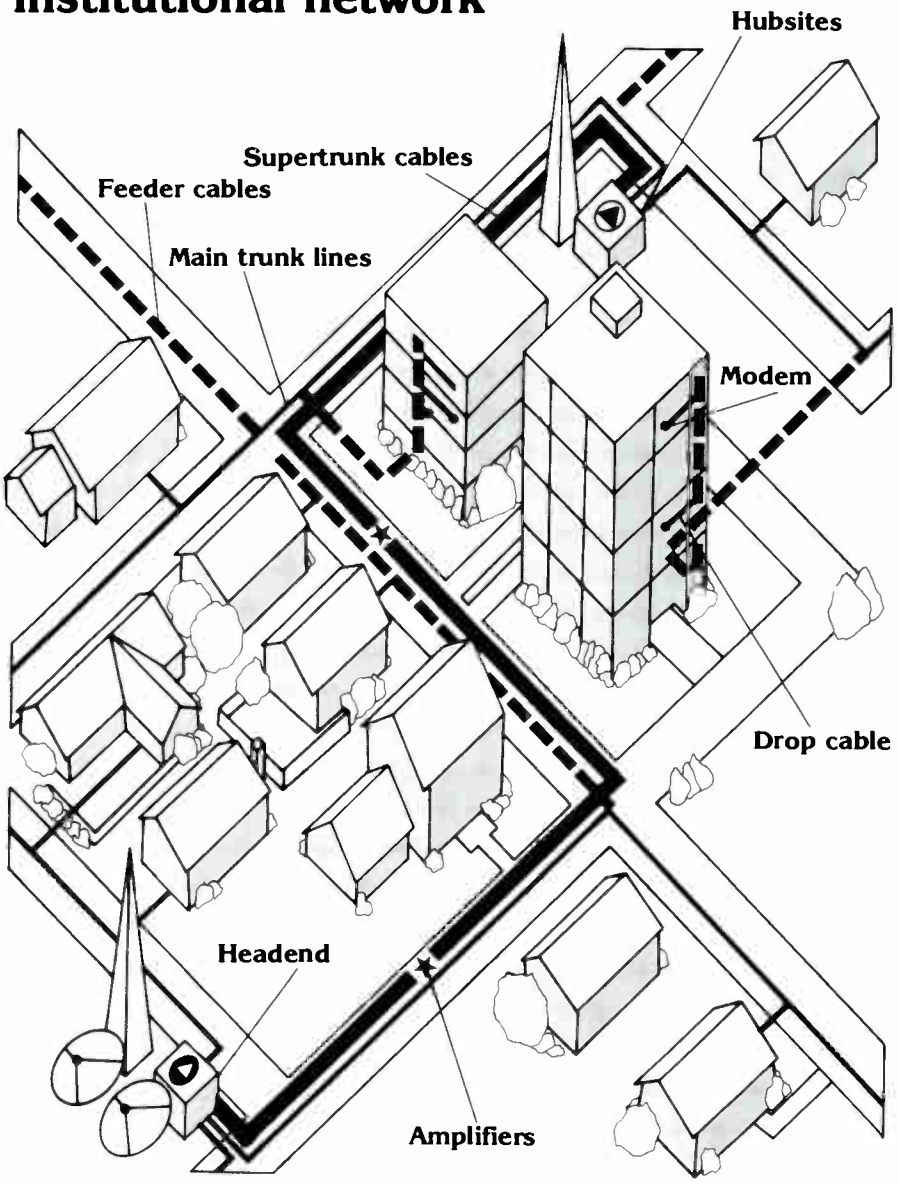
Hanneman estimates that at the outside, the cable industry has 12 to 18 months to get into the business communications market.

On the other hand, some industry experts, like John Dawson, director of engineering at Denver's Mile Hi Cablevision, are staying closer to the ground. While Mile Hi will be constructing a private data and voice network for the University of Denver, the company's own I-net will offer video-only services for Denver schools.

In many cases a plum dangled before franchising authorities, I-nets serving the commercial as well as non-profit client have been promised by operators in many markets across the country. Some nets, like AppleNet, which provides video, voice, data and energy management services for Appalachian State University, serve a single client.

Others, like Manhattan Cable's institutional network or Cox Cable's COMMLINE, serve numerous business clients.

Cox's COMMLINE institutional network



But it may take some time before vast numbers of high-volume clients are signed up on the new 440 MHz loops, according to Hanneman. "Until the convergence of communications and computer technologies is more pronounced, the demand for high-volume data services just won't be there."

So are I-nets just so much blue sky? Maybe it depends on where you think the sky begins: an inch from the ground or half a mile up. Hanneman's gaze is fixed firmly on those thermal chimneys so close to the ground.

The cable analyst sees a definite and substantial role for cable in local loop business services if certain issues are resolved. "The industry is currently

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Reader Service Number 23

fixated on revenues from entertainment services, and isn't certain what the market for data is," he says.

Another problem is that the cable industry has no track record as a provider of data services, and there's the unsettled question of competitors who don't pay franchise fees.

The cable industry will also need to attract experienced telecommunication managers and marketing talent, but the explosion in the local loop bypass industry is sucking them up very quickly.

What public utility commissions will say about cable's role in data transmission is also an obstacle. Another unknown is how cities and states will react if franchise agreements call for data services but state regulatory agencies outlaw them.

To get in quickly, Hanneman calls for joint ventures with telecommunications equipment vendors or unregulated telephone operating companies. "Cable's record in the data business is abysmal," he says. "A joint venture provides credibility for the cable operator, and also brings cash and expertise to the table."

"The regulated telcos won't be able to compete cost-wise for another three to four years if the cable industry jumps in now," Hanneman says.

John Dawson

Although no data services are currently planned on Mile Hi's I-net, Dawson sees no particular engineering problems that would prevent adding voice or data services at a later time. Reliability is a critical issue for business clients, and Dawson insists that "data can sometimes tolerate more ingress than video."

"Our worst case scenario is to make sure the system can handle video signals without degradation," Dawson says.

Sylvia Hack, author of a recent book on institutional networks, agrees with Dawson. "A digital signal can be degraded to a far greater extent than an analog signal and yet still be capable of accurate reconstruction at the receiving end."

Signal integrity may also be enhanced by network design. The typical one-way cable plant is a tree network, ideally suited to the task of delivering signals from a single origination point to many termination points. Within certain limits, a tree network can do so with acceptable levels of distortion and noise.

But problems can arise with the upstream signal in a two-way system. In the downstream direction, each amplifier has only a single input, while in the

upstream direction, amplifiers have multiple sources. Each can add noise and ingress signals.

The usual tree network also tolerates degradation of the signal near the farthest termination points. Shielded cable and low noise amplifiers near the headend are matched by simpler amplifiers and higher-loss cable near the ends of the system.

Problems in the downstream network can be isolated quickly by identifying the portions of the network that are affected. In the reverse path, it is much more difficult to find the source of a problem, since the upstream signals affect the whole network.

In a normal tree-configured system, each of the trunk and sub-trunk split points become points of signal addition in the reverse path. And they also are potential noise and ingress sites as well. But there are ways to improve signal quality on a tree network.

In an addressable bridger system, for example, the signal path from each individual bridger can be selectively activated, eliminating most of the noise and ingress from the revese distribution network. This type of a system also increases network reliability, since ingress problems can be identified within line segments divided by bridgers. Control of the return path in an addressable bridger system lies with the headend computer.

No communications may be initiated by modems or other terminal devices at random times in this type of a system, so all applications are limited to those that can be provided by headend polling.

A further improvement in signal transmission in the reverse path can be brought about by use of a subscriber line-switched system, in which the connection between the subscriber's service cable and the distribution network is controlled remotely by the operator.

Compared to an open tree network, noise and ingress from subscriber service lines and equipment are eliminated. Improved data security can also result, since signals are individually addressed. With addressable frequency translation, an operator can use modems in a variety of frequency pairs. Frequency translation ability would also allow an operator to switch between channels if ingress becomes too big a problem.

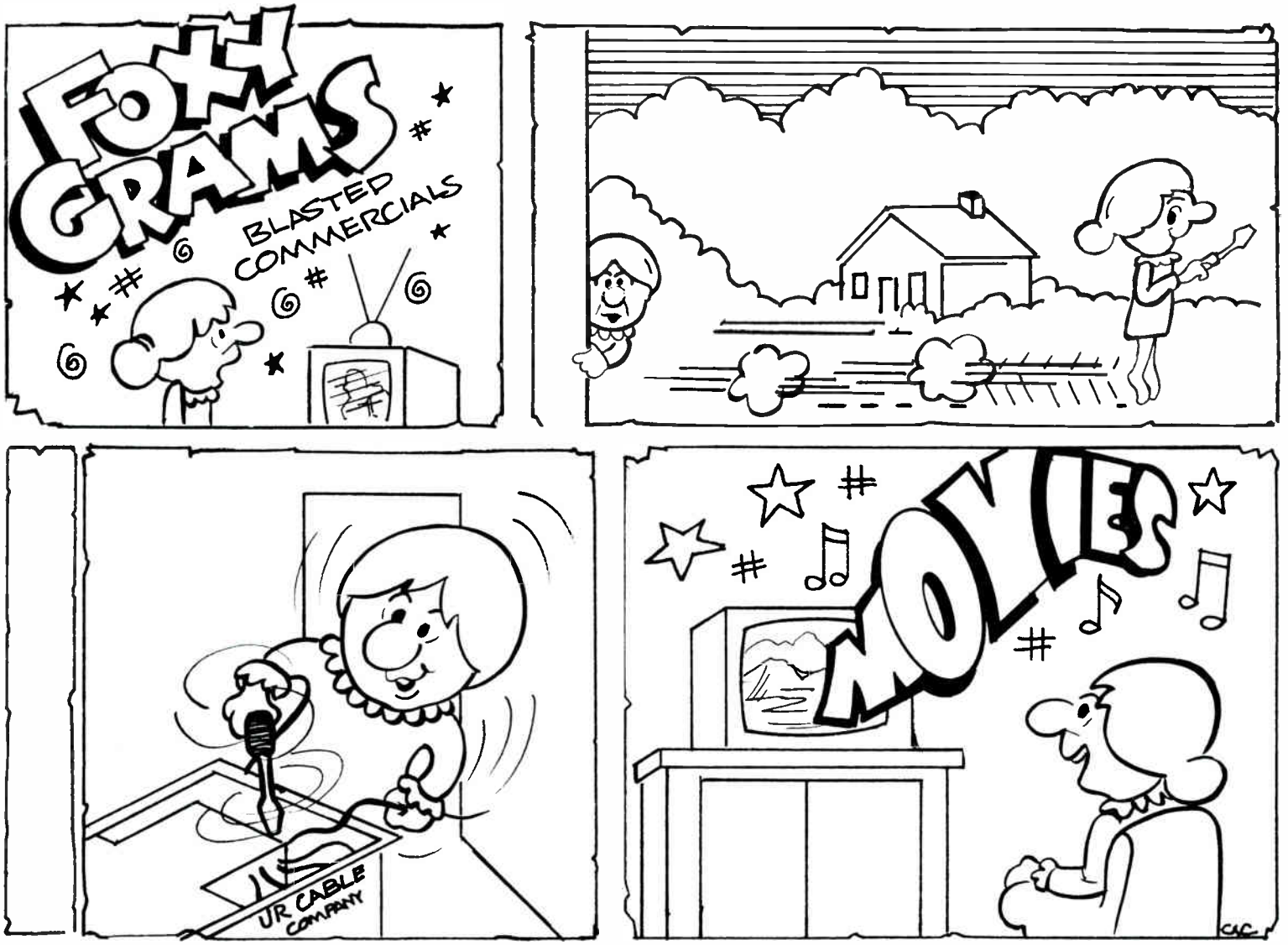
A related typology is the customer switching center network. In this type of system, the trunks connect many distributed switching centers, each serving customers in its immediate area. Each subscriber has an independent link to the local center.

Compared with a line-switched system, there are far fewer interface points, and consequently, even better protection from ingress.

If there is a problem with this type of architecture, it is cost. Compared to a conventional tapped line network, more cable is required.

In a block segment trunk system, which also improves on the tree network, noise funneling in the return path is reduced by frequency division. Usually, a separate trunk runs parallel to the downstream trunk, with all of its bandwidth available for upstream transmissions. At various points in the system, the return line signal is diverted from the main trunk, frequency converted and combined with the return trunk spectrum.

At the present time, I-nets are planned or under construction in over 60 cities, according to Hack. But how those I-nets are used, and whether they'll be used for local data and voice services, remains to be seen. It's one thing to fear a downburst. It's another to ride a thermal as far as it will carry you.



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HYBRIDS: hype and hope

Packaging compatible technologies is becoming way of life for designers

By Gary Arlen

Getting it all together. It sounds like a pop-philosophy phrase left over from the 1960s. But to designers of the new interactive communications services, it's becoming a way of life—packaging of partners, compatible technologies and services through a mixture of facilities. In particular, teledelivery seems to lend itself to such hybrid packaging in an effort to take advantage of lower cost transmission and still make the services seem interactive.

A spate of recent developments underscore the continuing interest in such hybrids—and the hope that many communications companies are placing in these jerry-rigged designs. The flurry of projects also lead to concern that some of these efforts are mere hype, intended to generate attention and possible partners to make the things work someday in the future.

The latest enigma to appear is an Atari-Activision joint venture to deliver videogames and computer software via broadcast technology. The concept is intended to take advantage of the 14 million Atari VCS 2600 model videogame units in American homes; later phases will make game and computer software available to other brands of videogame and computer devices. But the partners won't even spell out whether they will use radio or TV, audio subscribers, vertical blanking intervals or other sidebands to transmit the data—or what type of home receivers will be needed to pick up the teledistributed material. The initial markets for the three-phase roll-out or the identity of participating broadcast stations was not revealed, nor would the partners confirm that the teledelivery system was tested on a Los Angeles area FM station during 1983. Beyond an initial terse announcement, the only thing the companies would say is that the system could be used to preview software before a customer buys it. Atari, the beleaguered videogames/home computer subsidiary of Warner Communications, wouldn't discuss how or if this effort ties into other Warner projects, such as the video retrieval system being developed by Warner Electronic Home Services. Indeed, the sketchy Atari-Activision announcement seemed designed to fulfill minimal requirements of the Securities and Exchange Commission; Activision is going public and must announce major projects like this.

The companies acknowledge that other partners may be added. Among those not likely to be included is Control Video Corp., Bill von Meister's firm, which is developing a phone-based teledelivery service using Atari VCS videogame units as the terminals. Atari apparently believes that CVC's efforts would bring nothing to the current project—although what the current project is remains unclear.

Further venturing

Elsewhere on the hybrid front, several major cable industry firms are joining forces with an impressive roster of financial and service companies (including a telephone tie-in) to develop a teleservices system. Cox Cable, working with Chase Manhattan Bank, will develop a home banking/shopping/education/information system that will go beyond the bounds of cable franchise territories. The service will use Jerrold Electronics' new Communicom terminals, which incorporate NAPLPS videotex technology for high-resolution graphics and other features.

Cox's primary target for the new service is cable homes, but the package is designed to accommodate phone-based systems as well. In addition to installing the service at some of its new-builds, Cox will solicit other system operators to set up the service in their markets. At the heart of the system is Communicom, the $250 unit that functions as a cable and pay TV converter and has videotex capacity. In non-cable homes, the same device—stripped of its cable channel selector components and fitted with a phone modem—will be installed, making it possible to offer interactive services to homes that connect the lower-priced device to the telephone and TV set. Although Communicom cable units would be marketed and installed by cable operators, the phone-based unit would be sold through local electronics retailers.

The new Cox Cable interactive system will replace the INDAX service, which Cox tested for two years in San Diego. The INDAX name will not be used for the new project, apparently reflecting the poor connotation that has surrounded that troubled service. However, Cox will use results of the INDAX test to build its new service. For example, the San Diego experiment found that users are unwilling to pay for at-home banking, suggesting that the new project will be packaged so that financial services are underwritten by the participating service providers.

Indeed the role of banking in this package is vital. Chase Manhattan Bank has long toyed with telebanking plans, preparing to join the ranks of major financial organizations delivering such at-home service. Like other financial institutions, Chase is concerned about structuring its role to stay within Federal Reserve Board restrictions on non-banking activities. Chase plans to recruit the participation of its correspondent banks around the country—a valuable resource since Chase has the nation's largest network of correspondents. It's unclear, of course, how eager those local/regional banks will be to hook into this system rather than the other telebanking services that are not being established around the U.S. (most of them ignoring cable TV altogether in their operations plans).

Cox's strategy in setting up its still unnamed service is impressive. The company's objective is to establish participatory relationships among the firms—not merely set up information provider deals, which have marked most other interactive/videotex systems. One of the bases that Cox intends to cover most strongly is interactive education. Cox is working with the six TV stations that recently received grants from the Annenberg/Corp. for Public Broadcasting fund to develop electronic home education systems. The public TV groups are working with videotex, videodiscs and other technologies to set up a database and library of on-line electronic material—suggesting still more opportunities for hybrids. . . and for hope.

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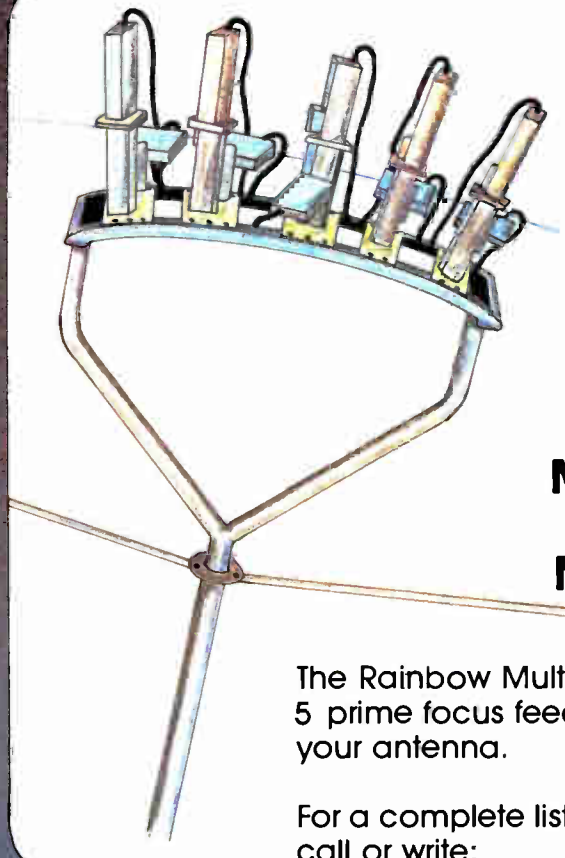

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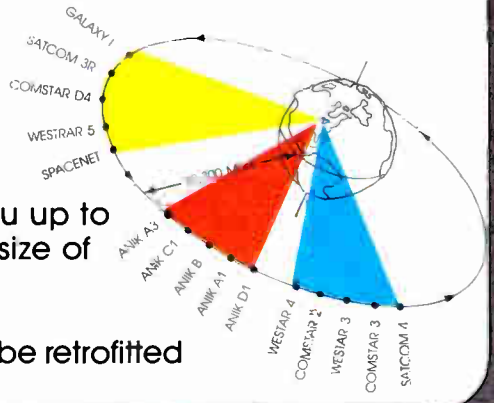

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RG-58/U, 96% shield mil spec	$ 86/M
RG-59/U, 96% shield mil spec	$ 85/M
RG-59/u, 100% foil shield	$ 45/M
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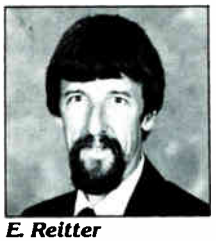
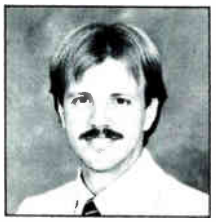
Advertisers' Index

People

Ed Reitter has been named director of engineering overseeing technical development at Katek's five regional converter repair facilities. Reitter formerly was engineering manager with Vitek Electronics. In addition, **Bobby Munroe** has been named plant manager for Katek's new repair facility near Los Angeles in Newbury Park, Calif.



E. Reitter



B. Munroe

Comtech Data Corp. has announced several promotions. **Robert Fitting**, one of the company's founders, was promoted to senior vice president from vice president. **Alan Scharf** was promoted to vice president of analog transmission products; his affiliation with the company began in 1982. **Louis Harper Jr.**, another company founder, was promoted to vice president of digital transmission products. Other appointments include **Jerry Rufener** to vice president of marketing; **Mark Weigel** to director of systems engineering; **Robert Bauer** to director of quality assurance; **Bill Merkes** to director of manufacturing; and **John Stewart** to director of materials.

Carl Schoeneberger has been promoted to vice president, research and development at TOCOM Inc. Schoeneberger, who has been affiliated with TOCOM since 1974, most recently served as director of R&D for the company. Prior to joining TOCOM, Schoeneberger was product engineer for Mostek Corp., Carrollton, Texas.

Pico Products has named **James Quigley** district sales manager for the Northeast U.S. By accepting this position, Quigley assumes sales responsibility for the company's OTAS addressable system as well as for the firm's standard product lines. Previous to joining Pico, Quigley worked as marketing manager for Upstate Newschannels in Syracuse, N.Y.

William Tuxbury Jr. has been appointed vice president and general manager of the R.F. Cable Products Division of Times Fiber Communications Inc. Tuxbury formerly worked for the industrial and electronic cable manufacturer Brand-Rex. At Brand-Rex, Tuxbury held numerous positions.

Dr. Donald King, president of Philips Laboratories Division of North American Philips Corp., has been elected to the position of president-elect for the Institute of Electrical and Electronics Engineers Inc. (IEEE). King will serve as president-elect during 1984. In addition, **Henry Bachman**, vice president of operations for Hazeltine Corp.'s Government Systems and Products Division, was elected executive vice president of IEEE. Prior to joining Philips in 1967, King was director of Electronics Research Laboratory, Aerospace Corp.

D. King

H. Bachman

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For more information, contact General Cable Co., Fiber Optics Division, 160 Fieldcrest Ave., Raritan Center, Edison, N.J. 08818, (201) 225-4780.

'Twin' spectrum analyzers

Tektronix Inc. has added a set of "twins" to its spectrum analyzer line and two measurement options to its 2400 series portable oscilloscopes. The twin spectrum analyzers, designated the 494 and 494P respectively, cover the 10 kHz-325 GHz frequency range, feature a "help" mode that produces interactive instructions on the CRT, and offer a frequency measurement accuracy of ± 13 Hz at 7.1 GHz and ± 27 Hz at 21 GHz. In addition, both the 494 and 494P programmable unit are covered by a three-year warranty and cost $40,950 and $45,950 respectively.

The two new measurement options introduced enable the 2445 oscilloscope, at 150 MHz bandwidth, or the 2465, at 300 MHz bandwidth, to be used in a variety of test and measurement applications, including field service, digital design, physical and natural sciences, education, video design, testing and production. One of the options is the GPIB (IEEE-48), which provides programmability of the scope; and the other is a television option equipped with trigger and vertical functions, which together facilitate and expedite TV waveform displays. These options can be ordered individually or together, but cannot be retrofitted into standard 2400 oscilloscopes after purchase.

For more information, contact Tektronix Inc., P.O. Box 500, Beaverton, Ore. 97077, (503) 627-9000.

Tektronix 494P spectrum analyzer

Mycro-Tek's "Supras"

Myrco-Tek has unveiled second generation character generator products, known respectively as the Mycro-Vision Supra and SupraTwo. Even though both units were built from the same technology as that used in the company's first generation systems, new features were added to each unit to expand their capabilities. One of these additions enables the Supra to communicate with a network of Supras, located either at the same or at remote sites. The Supra system is single-channel, whereas the SupraTwo is two-channel. Features shared by both systems include 240 pages of memory, which can be expanded to 960 pages; an eight font library; a gen-lock function that allows alphanumeric programming to be mixed with either taped or live video; take, pause and manual sequence keys.

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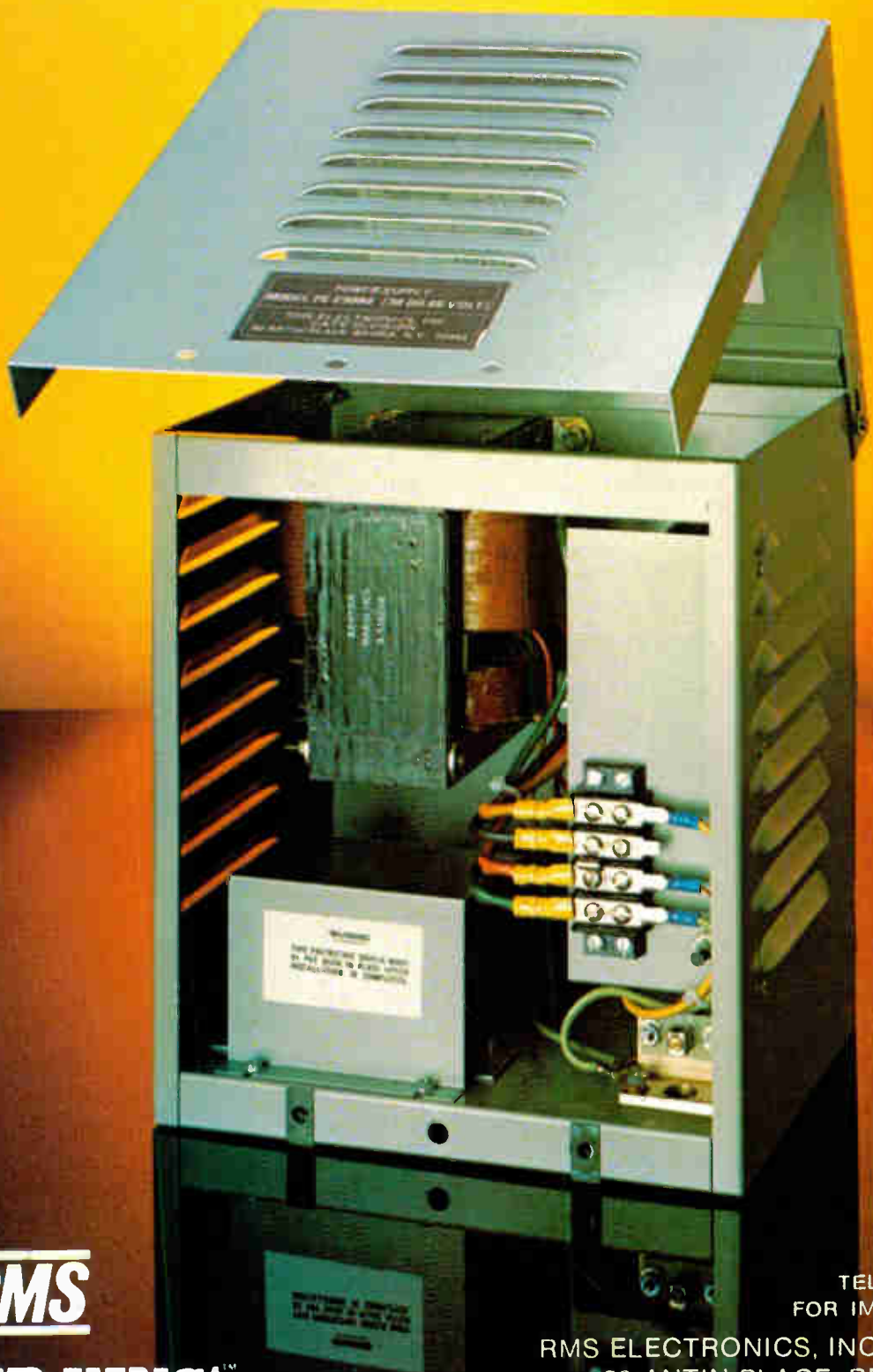

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Cable Jazz Network		24 hrs.	None	8
CBN		24 hrs.	414°/#	8
Cinemax		24 hrs.	None	20 (E,C) 23 (M,P)
CNN		24 hrs.	024°/#	14
CNN Headline News		24 hrs.	635°/#	15
C-SPAN		24 hrs.	None	19
Daytime	Weekdays	1 p.m./3 p.m.	307°/#	22
Dow Jones Cable News		24 hrs.	None	3,6
Electronic Program Guide		24 hrs.	None	3
ESPN		24 hrs.	048°/#	7
Eternal World Television Network	Daily	8 p.m./12 p.m.	762°/#	18
HBO	Daily	24 hrs.	None	24 (E,C), 13 (M,P)
HTN	Daily	4 p.m./4 a.m.	207°/#	16
The Learning Channel	Daily	6 a.m./4 p.m.	192°/#	16
Lifestyle		24 hrs.	None	3
Love Sounds		24 hrs.	None	8
Moody Bible		24 hrs.	None	3
Modern Satellite Network	Weekdays	10 a.m./1 p.m.	243°/# 421°/#	22
The Movie Channel		24 hrs.	None	5
MTV: Music Television		24 hrs.	None	11
National Jewish Television Network	Sundays	1 p.m./4 p.m.	None	16
Nice and Easy		24 hrs.	None	8
Nickelodeon	Daily	8 a.m./9 p.m.	311°/# (E, M, C) 519°/# (P) 749°/#	1
PTL		24 hrs.	None	2
Reuters News View		24 hrs.	None	6, 18
Satellite Radio Network		24 hrs.	None	2
SCAN		24 hrs.	None	6
Showtime		24 hrs.	576°/#	12 (E,C) 10 (M,P)
Spotlight		24 hrs.	None	4
UPI Cable News		24 hrs.	None	6
USA Cable Network		24 hrs.	601°/#	9
USA (during blackout)		varies	295°/# 601°/#	22
Video Concert Hall	Daily	4 a.m./6 a.m.	192°/#	16
WFMT		24 hrs.	None	3
WGN		24 hrs.	None	3
WTBS		24 hrs.	None	6
The Weather Channel		24 hrs.	None	21

Major Communications Satellites Serving North America

Location: Degrees West Longitude	Satellite: Present	Satellite: Future
69		Spacenet II
70		Southern Pacific-2 (Oct. 84)**
72	Satcom 2-R	
74		Galaxy-2 (mid. 84)
79	Westar-2	
83	Satcom-4	
87	Comstar-D3	Telstar-2 (1984)
91	Westar-3	Spacenet-III
93.5		Galaxy-3 (June 84)
94	SBS-3**	
95	Comstar-D1 & D2	
96	Telstar-1	
97	SBS-2*	
99	Westar-4	
100	SBS-1*	
103		GTE-1* (1984)
104.5	Anik D-1	
106		GTE-2* (1984)
108.5		Anik C-1
109	Anik-B** & C3	Anik D-2
114	Anik A-3	
116	Anik A-3	
117.5		Anik C-3
119	Satcom-2	Southern Pacific-1
122		Spacenet I (Feb. 84)
123	Westar-5	
127	Comstar-D4	Telstar-3 (1984)
131	Satcom-3R	
134	Galaxy I	
136	Satcom-1	
139	Satcom-1R	
143	Satcom 5	

* Ku Band
** Dual Ku/C Band

Orbital slots and launch dates often change without notice.

Westar IV

Signal	Day	Start/ Stop	Alert Tone	Transponder
SIN		24 hrs.	None	3X

Comstar D-4

Signal	Day	Start/ Stop	Alert Tone	Transponder
Country Music Television		24 hours	None	9H

Galaxy 1

Signal	Day	Start/ Stop	Alert Tone	Transponder
SIN		24 hrs.	819°/#	6
GalaVision	Weekdays Weekends	4 p.m./4 a.m. 24 hrs.	None	20

Contact programmer's technical department for more information on transponder use and alert tone.

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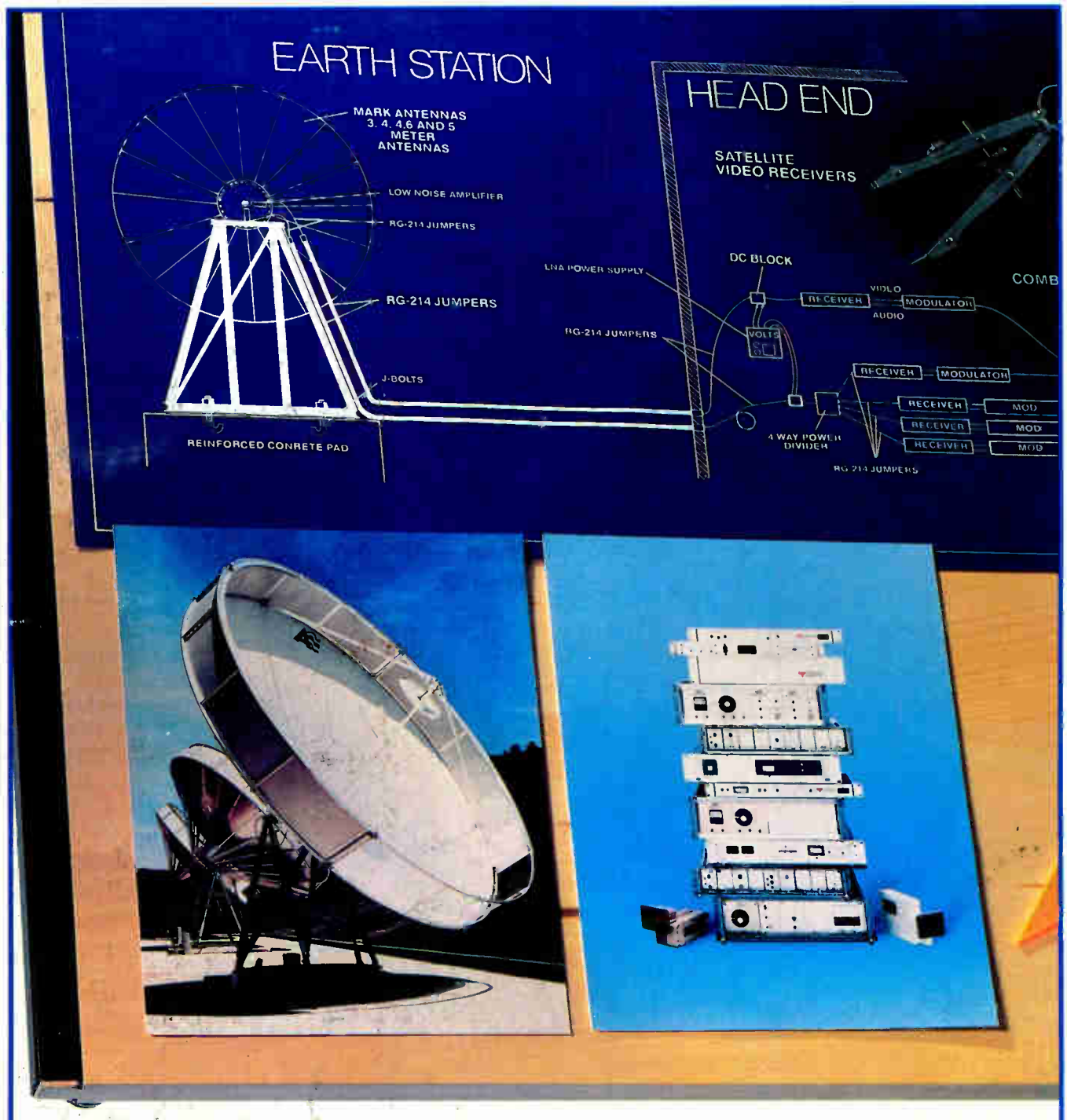

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