COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

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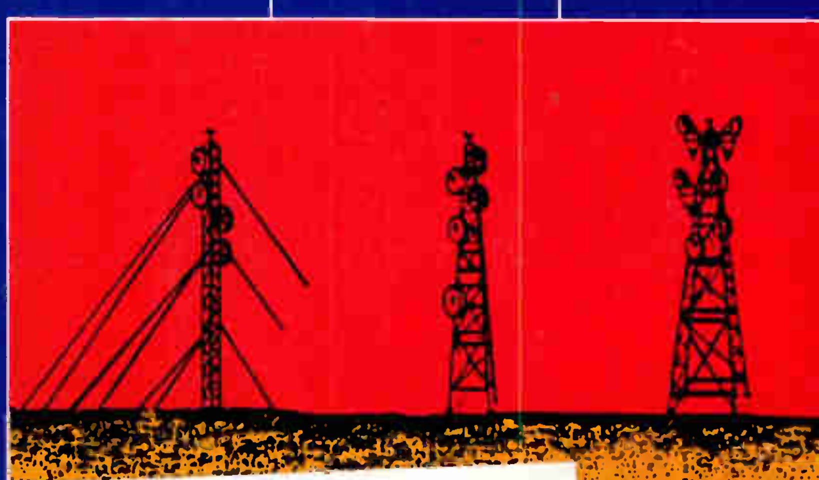

April 1988

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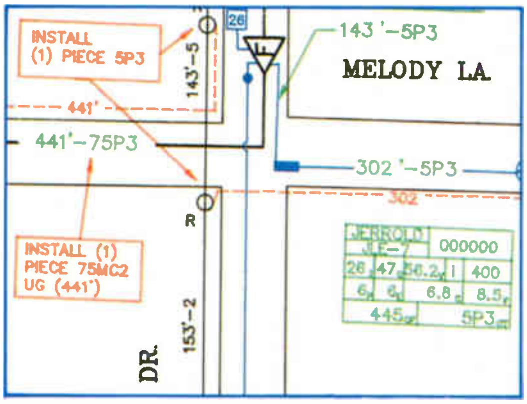

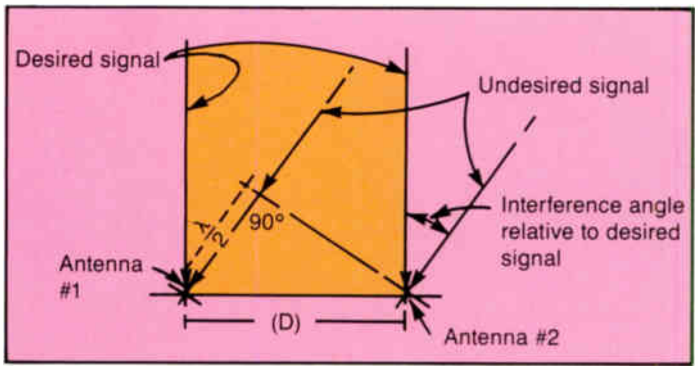

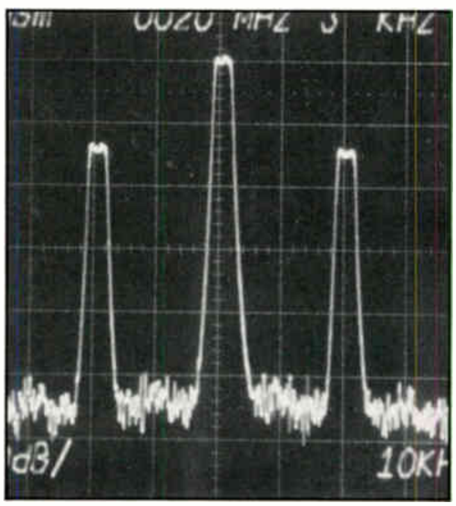

Features

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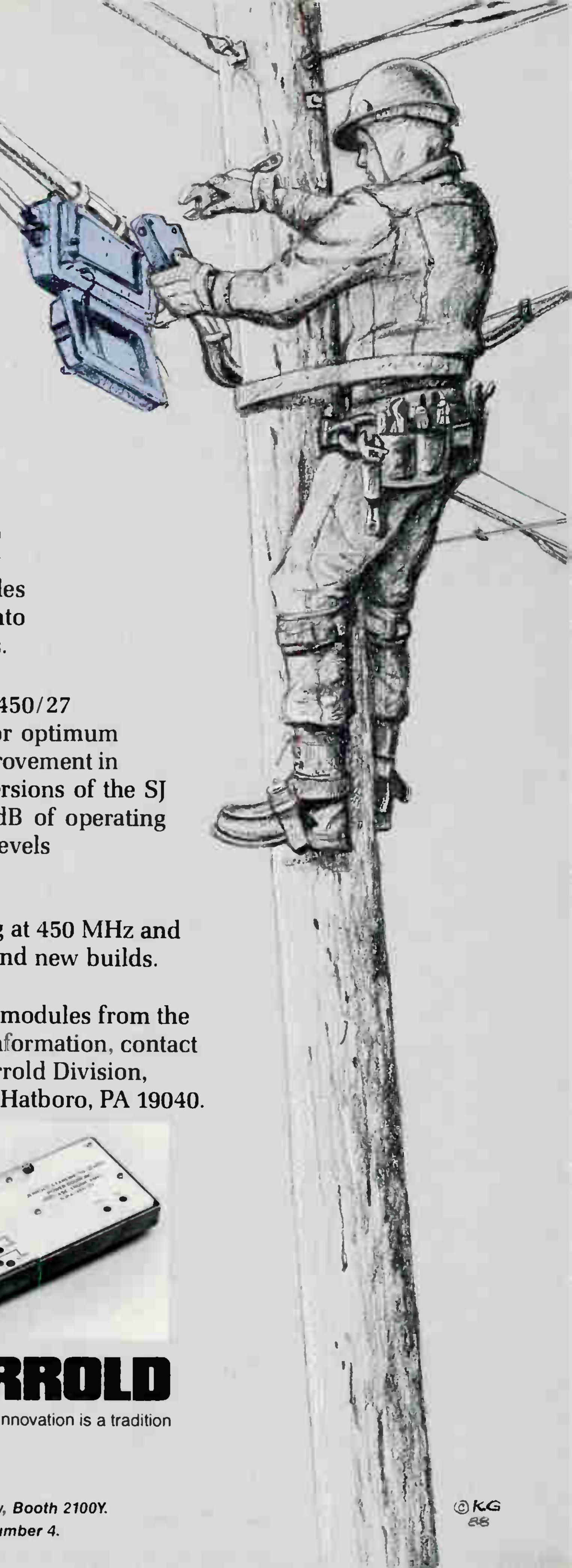

To upgrade your Jerrold STARLINE® 20 amplifiers and J-Series line extenders, simply "drop-in" new Jerrold power doubling modules. No respacing, no replacement of housings, no big rebuild costs. Put new powerful friends—SJPA power doubling trunk modules and JLP power doubling line extender modules—into your existing housings, even if they are in high places.

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Designer originals

In the "construction" of this issue, it struck me as interesting that there were so many *women* working in the design/drafting departments of cable systems. In fact, there weren't many women employed as installers, technicians or engineers. Attending the technical seminars of the Rocky Mountain Chapter of the SCTE are usually two women (myself excluded), both involved in design.

So why are most women in CATV drawn to design and not to other areas? In search of an answer, I asked Sally Kinsman, long-time SCTE member and president of Kinsman Design Associates. "Women tend to make good drafters," she said, "because of the detail-oriented nature of the job. Women are just better at details. And it helps to have smaller hands to do the drafting and operate a 10-key adding machine.

"But you'd be wrong to measure the effectiveness of a good drafter by gender or any physical trait. Instead, measure the person, male or female, by how many miles he or she can map per hour."

On the same topic, Barbara Lukens, director of construction at ATC's corporate office, said, "The real reason why women aren't pursuing the other CATV jobs is simple. If we were installers or field techs, we'd have to do the hard manual labor that comes with the job. As a designer/drafter, we stay clean, so to speak."

And as for being prevented from entering other areas of CATV? "There doesn't seem to be any barriers in what we want to do," Lukens said, "except for the barriers we make ourselves."

According to Pam King, technical training coordinator at Jones Intercable and a former CATV designer, "I enjoyed design since it gave me a chance to be creative. It was fun to try to eliminate active equipment and at the same time maintain technical integrity."

To those entering the design department, she offers some tips: "1) Verify accuracy of strand maps and field information *before* doing the design; visit the site if possible. 2) Optimize the design levels to meet the system's needs. Be actively involved with equipment selection; don't assume the most expensive equipment is the best."

For the record

In previous issues of *CT*, we've run our ad calling for articles. There's one this month, as well. So far we've gotten several responses—and a good number of articles written by readers with knowledge to share will appear in forthcoming issues. However, the most common request is for our editorial guidelines. So, for the record, here they are:

1) All articles should be typed on white paper, preferably double-spaced. Pages should be numbered atop each sheet.

2) The length for feature articles is usually 1,500-2,000 words (or about eight to 10 typewritten pages). Departments such as "Preventive Maintenance" or "System Economy" should be 750-1,000 words (or about four to six typewritten pages).

3) If you have any schematic diagrams, figures, tables, photos or slides, include them when you submit the article (or as soon as possible thereafter).

4) The content of the article should be generic—that is, not touting a particular product or service.

5) The article should be original and not have appeared in any other CATV trade publication. If it was used as a technical paper at a seminar or other event, you should state at the end of the article all the pertinent information.

6) You are responsible for providing on the final page any and all reference materials used in the writing of the article, as well as any supplemental materials. Acknowledge co-workers and others who have assisted you.

7) Deadline for articles is two months prior to cover date. For example, the deadline for the August issue is June 1.

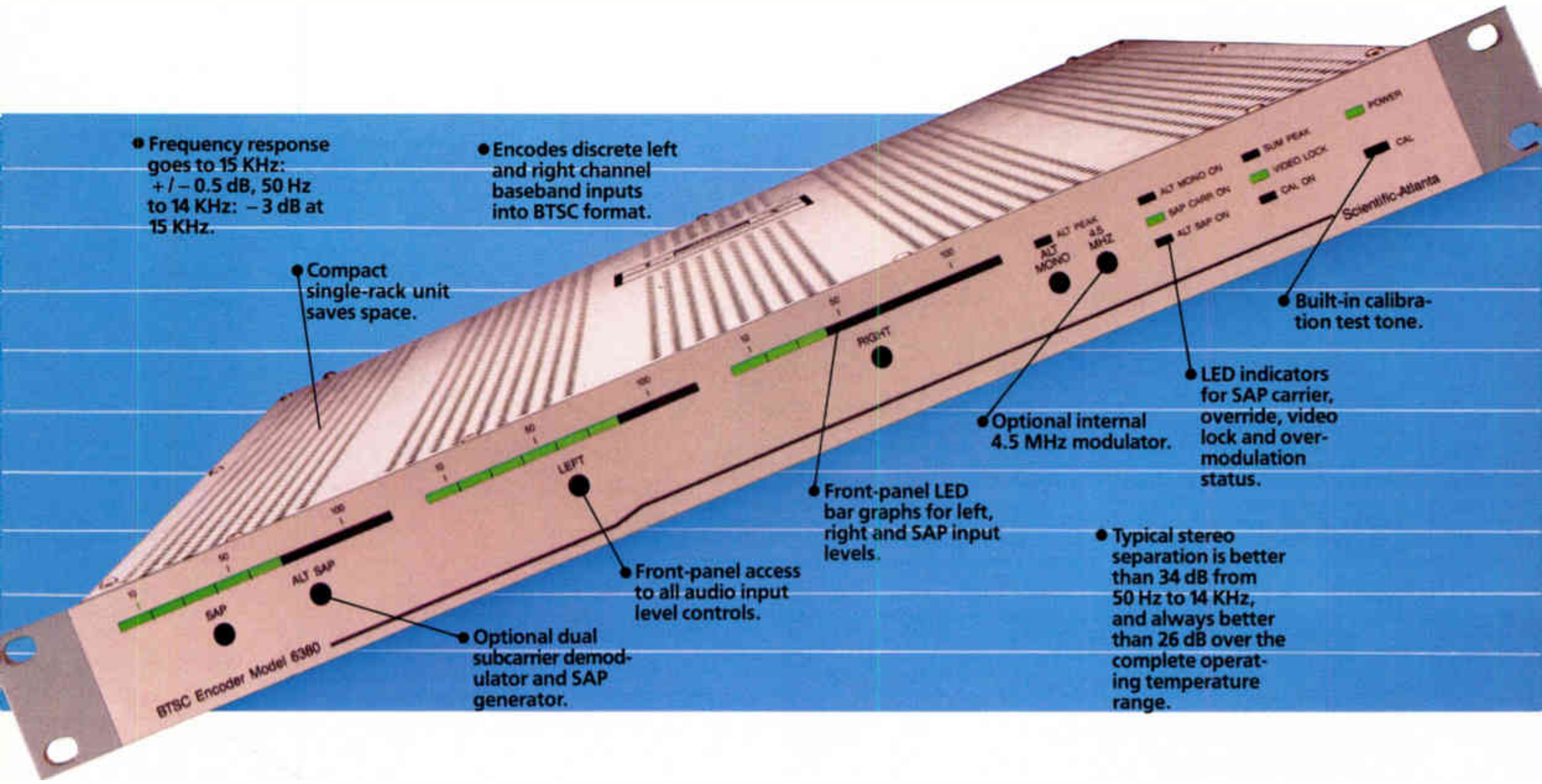
All right, now that you know our style, let's hear your idea. Fill out the form on page 97 and send it in today!

Dates to remember

- April 30-May 3: The National Show. This year's theme is "Seeing is believing," and there's a lot to see at the Los Angeles Convention Center. There are 10 technical sessions with topics ranging from impulse ordering technologies, fiber optics and high-definition television to signal leakage, tests and measurements, and providing quality service. (For a rundown of the sessions and speakers, see "News," page 10.)
- May 1: Nominations for SCTE National Achievement Awards. You can recognize outstanding individuals in the CATV industry (including yourself) by filling out the application on pages 35-36 of February *CT*. If you don't have an application handy, call the SCTE at (215) 363-6888.
- May 2: Deadline for the *CT*/SCTE photo contest. Send us your entry depicting "technical trials and tributions." You might win a trip for four to San Francisco and a free registration to the Cable-Tec Expo. (For more details, see the inside back cover of this issue.)
- May 13: Deadline for preregistering for Cable-Tec Expo '88. This issue of *CT* contains the official registration packet for the expo, beginning on page 84. It's an event you won't want to miss.
- May 27: Deadline for the *CT Daily* for the Cable-Tec Expo. If you have any press releases or new product announcements, please mail them to: CT Daily Editor, P.O. Box 3208, Englewood, Colo. 80155.

Rikki T. Lee

THE STEREO ENCODER SO ADVANCED, IT SOUNDS GOOD EVEN IN PRINT.



You couldn't pick a better time to offer stereo TV. Because there's never been a better BTSC stereo encoder than the Scientific-Atlanta 6380. And the more you hear about it, the better it sounds.

Everything about the 6380 was designed to make your life easier. For example, a built-in calibration test tone allows you to adjust for maximum stereo separation without a lot of expensive test equipment.

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But don't let all these features fool you. The 6380 only sounds expensive. It's actually an economical way of enhancing your service without adding channels. And in the bargain, you get the same Scientific-Atlanta quality that goes into the rest of our full line of headend equipment.

If you think our 6380 stereo encoder sounds good in this ad, you haven't heard anything yet. Call us for more information at **1-800-722-2009** or write to Scientific-Atlanta, P.O. Box 105027, Dept. AR, Atlanta, GA 30348.

National Cable Month
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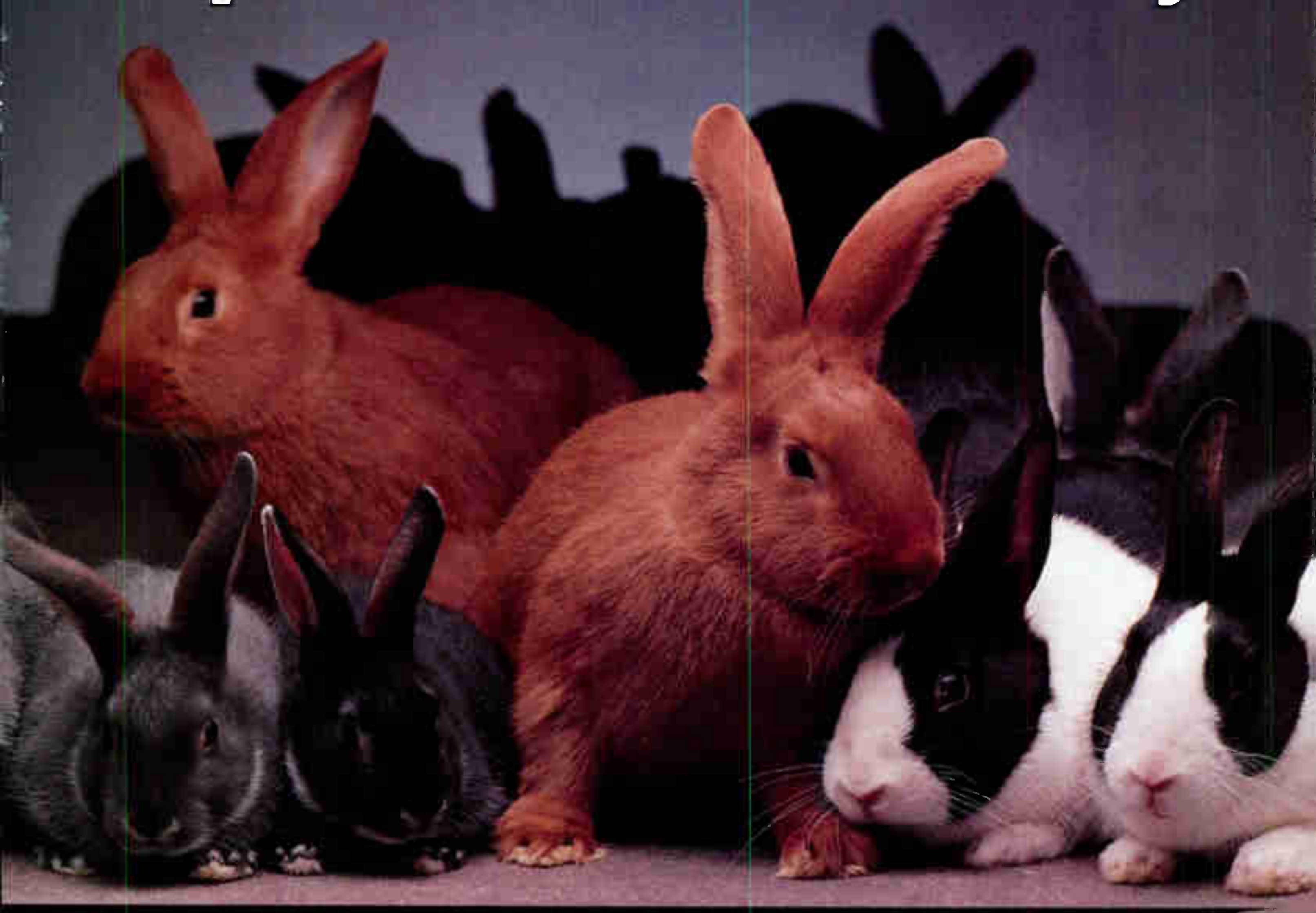
Impressive Inventory



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National Show technical panels announced

LOS ANGELES—"Seeing Is Believing" is the theme of the National Cable Television Association's 37th annual convention to be held here April 30-May 3. Ten sessions geared for a technical audience will run two at a time Sunday, May 1, through Tuesday, May 3, and will cover topics such as fiber optics, high-definition television and impulse pay-per-view. The technical sessions are as follows:

Sunday, May 1
11 a.m.-12:30 p.m.

● Impulse ordering technologies

Moderator: Larry Lehman (Cencom Cable Associates). *Speakers:* Jefferson Corbett (Business Systems Inc.), "ANI as a PPV ordering tool"; David Woodcock (Centel Cable TV Co. of Michigan), "Launching a statewide ANI passing impulse PPV system"; Thomas Neville (Viewer's Choice), "The application of national ANI to pay-per-view ordering"; Robert Dattner (TV Answer), "Wireless TV viewer response"; Dom Stasi (Telaction Corp.), "Interactive electronic home shopping, an update on the Telaction approach."

● Wireless signal distribution—Satellite and terrestrial

Moderator: Matthew Miller (Viacom International). *Speakers:* John Berry (Group W Satellite Communications), "Audio considerations in satellite transmission to CATV systems"; Bruce Elbert (Galaxy Systems/Hughes Communications Inc.), "Next generation C-band satellite systems for cable program distribution"; George Harter III (General Electric Comband Division), "Wireless or wired cable: Comparable technologies?"; Thomas Straus (Hughes Aircraft Co.), "Optimization of subscriber signal quality through local distribution microwave"; Norman Weinhouse (Norman Weinhouse Assoc.), "A unique cable advertising interconnect."

Monday, May 2
9-10:30 a.m.

● Fiber optics and cable: Present and future trends

Moderator: Edward Callahan (United Cable Television Corp.). *Speakers:* William Brinkerhuff (Ohio Bell Telephone Co.), "A point-to-multipoint fiber-optic CATV transport system for the city of Cleveland, Ohio"; Larry Nelson (General Instrument/CommScope Division), "Fiber-optic cables: Installation and maintenance"; David Pangrac (ATC), "Fiber backbone: A proposal for an evolutionary CATV network architecture"; Perry Rogan (ATC), "A technical analysis of a hybrid fiber/coaxial CATV system"; Hermann Gysel (Synchronous Communications), "Composite triple beat and noise in a fiber-optic link using laser diodes."

● Discussions on unique applications in signal transmission

Moderator: Bert Henscheid (Texscan Corp./Communication Product Division). *Speakers:* Gregory Davis (Oceanic Cablevision), "Commercial insertion technology: What to do when your ad sales staff becomes really successful"; Roy Ehman (Jones Intercable), "Improved outage control using a new and unique transient eliminator"; Luis Rovira (Scientific-Atlanta), "FM demodulators for BTSC stereo"; William Woodward (Scientific-Atlanta), "Agile modulator characteristics and their effects on CATV systems"; and Joseph Stern (Stern Telecommunications), "Multichannel compact disc digital audio on cable."

12:30-2 p.m.

● Providing good service doesn't cost...It saves!

Moderator: Ron McMillan (Warner Cable

Communications). *Speakers:* Fritz Baker (Viacom Cablevision), "Service calls are not scheduled if customers don't call. Easy ways to keep customers from calling"; Donald Dworkin (UA Cablesystems Corp.), "'What you see is what you get,' or how to make a proper F-connector"; Ian MacFarquhar (CUC Broadcasting Ltd.), "Preventative maintenance—A new look"; and Larry Richards (Magnavox CATV Systems), "Keeping maintenance records."

- Transmission design considerations for advanced television systems

Moderator: Nick Hamilton-Piercy (Rogers Cablesystems). *Speakers:* Walter Ciciora (ATC), "The trend to digitization"; Rezin Pidgeon (Scientific-Atlanta), "Oscillator phase noise and its effects in a CATV system"; Clyde Robbins (General Instrument/Jerrold Subscriber Systems Division), "High quality television delivery systems"; and Archer Taylor (Malarkey-Taylor Associates), "The vestigial sideband and other tribulations."

4:30-6 p.m.

- HDTV and cable: A review of the possibilities

Moderator: Chris Bowick (Scientific-Atlanta). *Speakers:* Gerald Robinson (Scientific-Atlanta), "Proposed HDTV systems and some technical implications for cable"; William Thomas (ATC), "HDTV: Cable's opportunity for the future"; Yves Faroudja (Faroudja Laboratories), "Super NTSC for super cable"; and Lex Felker (FCC), "FCC overview on advanced TV systems."

- Accurate, usable system tests and measurements

Moderator: Henry Cicconi (Sammons Communications). *Speakers:* Mark Adams (Scientific-Atlanta), "Composite second order: Fact or fantasy"; John Huff (Times Mirror Cable Television), "Time selective swept return loss—A new look at coaxial cable"; David Large (Gill Industries), "The Gill Cable precision true non-interpreting sweep system"; Frank McClatchie (FM Systems), "TV audio deviation: How to measure it, set it right and keep it that way"; and John Staiger (Magnavox CATV Systems), "Composite beat vs. single beat distortion testing."

Tuesday, May 3
9-10:30 a.m.

- If you think CLI is a new pay service, we're in big trouble

Moderator: Ted Hartson (Post-Newsweek Cable). *Speakers:* Robert Dickinson (Dovetail Systems), "CATV leakage aerial surveys"; R. Martin Eggerts (Blonder-Tongue Laboratories), "Radiation measurements—Complying with the FCC"; Victor Gates (MetroVision of Livonia), "CLI—A total proven approach"; William Park (Cablesystems Engineering), "A practical approach to airborne signal leakage testing (CLI)"; and Richard Shimp (ComSonics), "Correlating measurement results made with a horizontally polarized dipole and a vertically polarized monopole in a cable television environment."

● HDTV transmission systems proponents' forum

Moderator: Wendell Bailey (NCTA). *Speakers:* Richard Iredale (Del Rey Group), William Glenn (New York Institute of Technology), Arpad Toth (North American Philips), Yves Faroudja (Faroudja Laboratories), Masao Sugimoto (NHK).

SCTE membership elects board members

EXTON, Pa.—The Society of Cable Television Engineers recently announced the results of its 1988 national election for eight open seats on its board of directors. The new board members are: At Large—Dave Willis, Tele-Communications Inc.; Region 3—Ted Chesley, Rock Associates; Region 4—Ron Boyer, MicroSat; Region 5—Wendell Woody, Catel Telecommunications; Region 7—Dave Spallinger, Continental Cablevision; Region 8—Jack Trower, Wehco Video; Region 10—Wendell Bailey, National Cable Television Association; and Region 12—Tom Gimbel, Wade Cablevision.

The first meeting of the new board will be held April 30 at the National Show in Los Angeles. The directors will elect the SCTE officers for the coming year at that time.

Fiber optics keeps bobsleds on track

CALGARY, Alberta—During the Winter Olympic Games in February, as bobsled and luge teams hurtled down the bobsled run, they were monitored by a fiber-optic video system. This allowed members of the Olympic Committee track security staff to ensure that one competitor safely completed the run and was off the track before permitting another to begin. The entire run was viewed via a network of 37 video cameras positioned along the route and connected to a monitoring room by 18.6 miles of fiber-optic cable. The cable was designed specifically for this purpose by the engineering group of Fitel Corp. of Carrollton, Ga., which also connectorized and supervised its installation.

The cable, which contained up to four Corguide LDF 50/125 multimode optical fibers manufactured by Corning Glass Works, was chosen by the Canadian Ministry of Public Works because of its immunity to high levels of electromagnetic interference existing in Olympic Park. It operated in temperatures as low as −26°F.

NCTA urges FCC to defer standards

WASHINGTON, D.C.—The National Cable Television Association urged the Federal Communications Commission to defer adopting technical and operational requirements for advanced television (ATV) technologies. According to the NCTA, industry participants feel it is too early in the development of ATV and the FCC should wait until more definitive information is available to set comment dates.

In its comments, the NCTA said the commission must consider that any broadcast ATV system must be capable of producing a high quality broadcast signal that can be transmitted effectively over cable, since more than half the country's TV households get their over-the-air signals via cable. It also said that the time may come when direction from the FCC will be required, but "the time for such action has not yet arrived."

● Interface Technology moved its corporate headquarters to 1850 Borman Ct., St. Louis, Mo. 63146. The new phone number is (314) 434-0046.

● Telecrafter Services Corp. reached an agreement with Tele-Communications Inc. to provide direct sales and installation services throughout 1988 for TCI's Central and North Central divisions. These divisions encompass Illinois, Ohio, Wisconsin, South Dakota, North Dakota, Minnesota, Nebraska, Colorado, Wyoming, New Mexico, Oklahoma, Texas and Kansas.

● Comcast Cablevision of Mercer County began offering Jerrold's Cable Video Store to subscribers in Trenton, N.J., March 1. The service utilizes Jerrold impulse technology.

● C-COR Electronics will supply distribution electronic equipment for Rogers Cablesystems in Canada through 1991. Rogers committed to buy C-COR equipment totaling $4.7 million by August 31, with the total value of the commitment at $22 million. The complete upgrade will cover approximately 8,000 total route miles and involve 12 systems.

● Panduit Corp. recently appointed three new sales representatives. Clemick and Associates will sell the Electronic Products group line in Arizona (except Mohave County). The full product line will be represented by Pacific Products in Hawaii and Cody Associates in western Pennsylvania, western Maryland and West Virginia.

● Chipcom Corp. of Waltham, Mass., and San Jose, Calif.-based Excelan signed an agreement whereby Excelan will reference Chipcom's full line of broadband Ethernet local area networking products.

● Microwave Filter Co. reported earnings for the first quarter of fiscal 1988, which ended Dec. 31, 1987. Net sales decreased 0.5 percent, compared to the first quarter of fiscal 1987. Net income decreased 54.4 percent, from $41,342 in the first quarter of 1987 to $18,881.

● Prodelin Corp. of Conover, N.C., was selected to supply earth station antennas to Seeburg Music Satellite Network of Raleigh, N.C. Seeburg will use the .75M, 1M and 1.2M antennas in its Seeburg Direct business network nationwide.

● Oak Industries announced improved operating results for 1987. For the year ending Dec. 31, income from continuing operations was $5.69 million and net income was $8.22 million. This includes an income of $18.2 million from a patent litigation settlement, without which a loss of $12.5 million would have been reported.

Strongest link.

Your satellite receiver is the first link in the transmission chain. And one thing you can always count on — the head-end signal never gets better than it is at the receiver.

Which is a very good reason to specify Standard's Agile 40 C/K Satellite Receiver — but it's not the only reason.

The Agile 40 C/K was designed from the ground up solely for commercial applications. So it has all the features cable operators need most: rock-solid 100 kHz PLL tuning and total flexibility for the most accurate C/Ku-band operation; 70 MHz IF with a front-panel test point to minimize terrestrial interference; and a power supply built for the demands of 24-hour-a-day operation.

The Agile 40 C/K is also the receiver to have when you're expanding your headend. Because our internal 950-1450 MHz active loop-thru design eliminates signal splitters, so you can add up to 16 additional receivers on the same polarity — with no signal loss.

And because it draws only 32 watts maximum, the 40 C/K runs cooler, lasts longer, and saves money year after year. So you'll probably never need our five-year replacement/warranty program.

To get the best signal, start with the peace of mind that only quality equipment can give you. Link up with an Agile 40 C/K.

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Reader Service Number 13.

See us at the NCTA Show, Booth 2024Y.

The eight degrees of charity

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

To engage in a discourse on the subject of charity is to open a door to one of the most complex philosophical mazes in the human experience. Equality of position and fortune is a myth, proclaimed achievable by some visionaries, but never fully realized. Inevitably, inequality is the norm in every form of human society.

It is my view and, I trust, those of others, that charity is the necessary palliative for a surviving society, giving hope to the hopeless and a pathway out of poverty for the poor. Because of our Western civilization heritage, most of the general principles of charity are tied to religious beliefs stemming from the Biblical era. Each of us certainly was aware in our family surroundings that we should give part of our goods to the needy among us. The requirement to give charity was never questioned, only the amount and the method of dispensation.

Maimonides, a 12th century philosopher, rabbi and physician, authored many notable documents interpreting the principles of religious tenets to guide everyday human encounters. Perhaps his most famous principle was the eight degrees of charity as described in the "Laws of the Hebrews, Relating to the Poor and the Stranger" from the *Mishnah-Hatera of Maimonides*.

The following is his "Ladder of Charity," with the eight degrees of charity work arranged in an ascending order:

I. Give grudgingly after being asked.
II. Give even what is insufficient but with a pleasant countenance.
III. Give after being asked, in a sufficiently large amount.
IV. Give before being asked.
V. The recipient knows the donor but the latter does not know the former.
VI. The donor knows the recipient but the latter does not know the former.
VII. The giver should not know the recipient and the recipient should not know the donor. Usually this involves giving to a charity fund, but one should not contribute unless you know the official in charge is trustworthy and knows how to manage the fund.
VIII. The highest form of charity is to strengthen the hand of the person in need, to give him a gift as a loan, or to join him in partnership, or to find him work that he may not become a public charge or beggar.

Examples of charity

I will attempt to clarify the nature of each level with examples from personal experiences.

I. A common reaction to the itinerant windshield washers at the exit from the Lincoln Tunnel into New York, who smear your vision with dirty water and demand a donation in the name of charitable Mayor Koch.
II. The collection for a worthy cause at the office. (What, again?!)
III. Contribution to the local hospital—you might be the next patient.
IV. Yearly pledges to your alma mater. (Particularly suited to a newly emergent "Big Man On Campus.")
V. Gift to a telethon. (The children are so appealing.)
VI. Donation toward the cost of an organ transplant for the child of a widow. (Enough said.)
VII. Gift to the poor through your religious institution. (Not always voluntary.)
VIII. The language for the highest level seems clear enough, but the world has changed its social structure since Maimonides and, lo and behold—who has emerged as the greatest source of charity the world has ever seen? Big business!

"The highest form of charity is to strengthen the hand of the person in need...or to find him work."

Yes, friends, if the highest level of charity is to give the recipient a job, who is better qualified to receive public acclaim for their goodness, sympathy and charity than the money-mad moguls who suffer the arrows and mudslinging from our professional sociologists. Come now, all you do-gooders and tearjerkers, disown your past childish ravings at the robber barons, and worship at the feet of these most charitable citizens. Arise, Sir Big Business executives, and be anointed with the love and fealty your deeds deserve.

Big business, thank you for reaching the highest level of charity according to Maimonides!

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Mapping a rebuild with computer-aided drafting

By David W. Cervone
Rebuild Manager, Viacom Cablevision of Long Island

In early 1985, the management of Viacom Cablevision of Long Island, New York, began talking seriously about rebuilding its entire system. There were several reasons, the main one being to improve the quality of service to our customers. Originally designed in the late 1960s and early '70s, the system grew building block-style, incorporating different vintages of equipment. Only the most recently wired areas could accommodate 1980s technology. A total electronic rebuild of the type the company was contemplating would put the entire system on the same footing. It also would allow us to carry more stations—52 instead of 35, boost our signal quality and prepare us to offer services such as pay-per-view and interactive communications. It was clear in 1985 that this was where cable systems around the country were headed. It was time for us to proceed as well.

The worst part of our system rebuild was the maps. A quick check of the condition and accuracy of the existing system mapping showed that it needed to be completely redrawn. This would require approximately 900 grid maps at 1"=100' scale and, unlike the previous 1"=200' map system, would include underground system detail, amplifier nomenclature, house addresses and generally more design information than was previously available.

With over 2,100 street miles of cable plant to verify, redesign and redraft, it became apparent that a complete system walkout was required to update potentials, pole footages, equipment locations and cable routing, as well as gathering addresses. With that project under way, it was time to figure out how we could efficiently and economically produce the mapping system to be used by the rebuild construction crews, and later as system maps to aid the maintenance technicians.

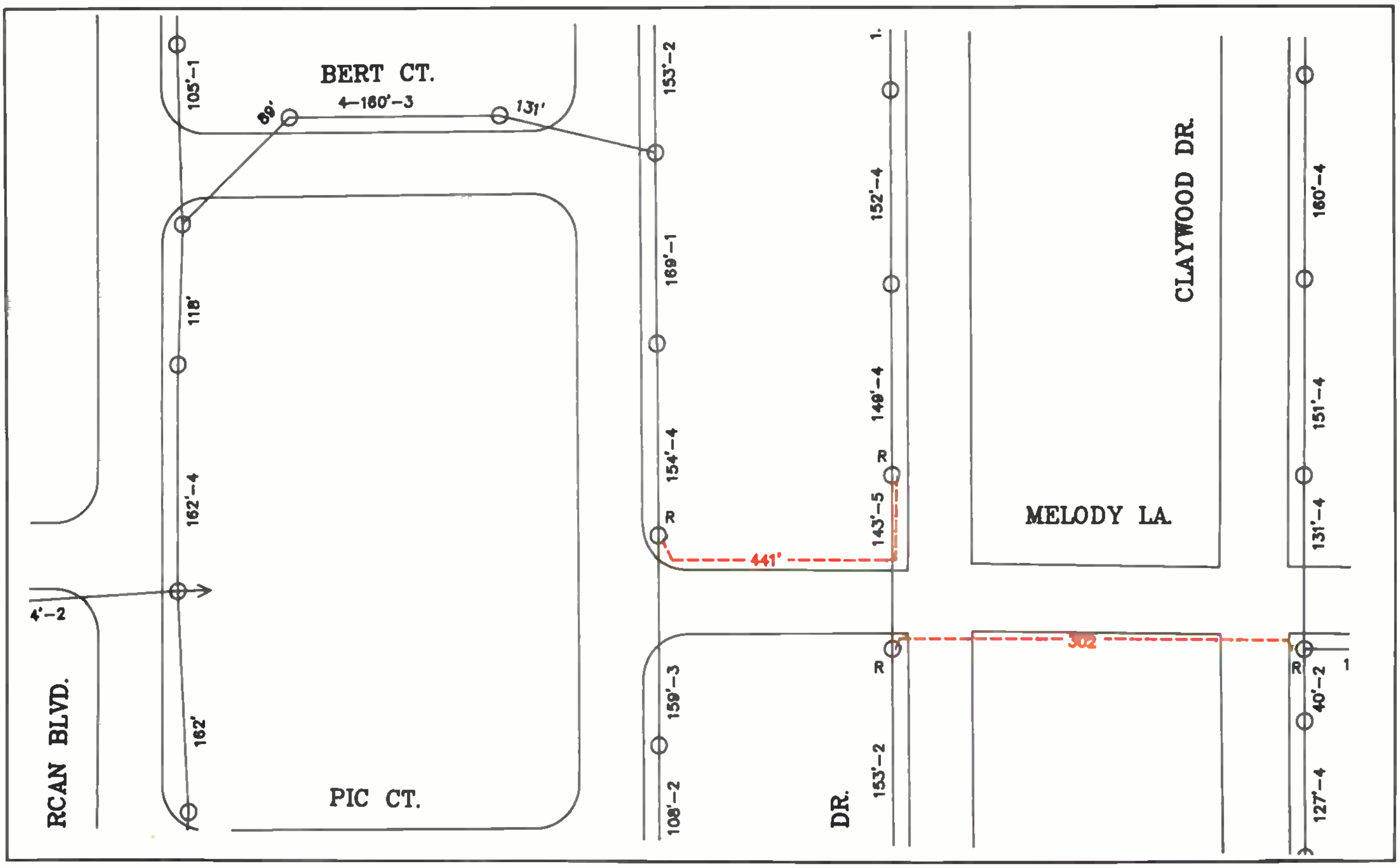
Looking for alternatives

The design supervisor, whose job it would be to produce the design and mapping system, was familiar with current mapping techniques. He offered three alternatives to manual drafting:

1) contract the design and drafting (this would be expensive).
2) hire an army of ink drafters and a designer to complete the 400-plus miles of map per year (this also would be expensive).
3) hire a designer and buy a CADD (computer-aided design and drafting) system.

Once we sat down and discussed the possibilities, we realized that the CADD technology might offer a viable alternative to manual drafting. In addition to providing system maps, the computer might be able to provide bills of materials (BOMs), plant mileages and perform other time-consuming tasks. We knew very little about CADD systems, but we knew we'd have to get smart quickly to be able to convince management that investing in such a system would be worthwhile.

We spent the summer of 1986 researching CADD. We poured over computer magazines, attended local computer shows and finally found the perfect system. The only problem was that it cost $140,000 for a single workstation. We also visited a local computer dealer. We explained to the dealer what we were attempting to do. We'd need a system that could hold all the information on the Viacom system in its present configuration as well as future construction. We would be creating several maps of each location, we'd need to generate a bill of materials, and finally, we'd need to generate complete "as-built" maps of the finished construction, minus construction notes.



Base and strand map generated by CADD system shows streets, poles and strand footages and potentials. Dotted line shown in red indicates underground route.

After going through all this, the dealer introduced us to a mid-range CADD software program that looked as though it would fit the budget, had the capabilities and flexibility to handle our rebuild mapping and would not require our people to become computer scientists. (By the way, when looking at computers, start with the software, rather than the hardware. The boxes are all about the same; it's the software that does the work.)

Once we stopped looking at the $140,000 high-end CADD systems on the market and settled on a personal computer-based system that did basically the same things for under $40,000, management was with us. We all could see that CADD would allow us to do all the mapping in-house, without a significant increase in personnel.

The system

The computer dealer suggested a mix of equipment with custom software as the best solution. Two separate design workstations would share output devices but would have access to the same data base and application software. The following is a list of the individual components of our automated design center:

- *IBM PC/ATs:* These personal computers provide the main information processing of all the street maps and equipment information we enter. They are each equipped with 30-megabyte hard disks providing enough storage for a complete mapping of any given area. The dealer preprogrammed the hard disks with the operating system software and CADD application software, plus a custom data base management program the dealer designed from a format we had set up. Because the software is programmed on the hard disk, when we turn on the computers each day, all the software boots up automatically.
- *Software:* Three software packages are used: system software, to run the computer; menu-driven CADD software, which actually performs the drafting tasks and holds a custom library of cable TV equipment symbols; and data base management software, also tailored to the rebuild and has the task of automatically generating BOM and address index from information contained in the various drawings.

These software packages are off-the-shelf programs that have been tailored to include information and menu commands specific to our job. For instance, the library of shapes in the CADD program already contains circles, arcs, boxes, etc. The dealer added symbols specific to our designs, such as information boxes, amplifiers, taps, couplers, etc. Having these cable-specific symbols at hand in the program menu makes the draftsperson's job easier and the maps more understandable. The data base was similarly tailored.

- Two 36 × 48-inch *drafting table digitizers* with tilt and power lift options.
- 14" *high-resolution color monitors:* The information from the system maps and other drawings are entered into the system by aligning these maps on the digitizer tables and using the digitizer's tracing device, or "puck," to trace the existing drawings. As each line is traced it is being entered into the computer data base and displayed on the monitor in colors that can be selected by the draftsperson. The high-resolution monitors are eye savers, providing an easily readable visual display of the often intricate design information. A different color can be assigned to each map layer or equipment type for quick recognition.
- *Dot matrix printer:* Rough printouts of maps and text documents are produced on a dot matrix printer purchased with the system. The printer provides clear, though not letter-quality, copy and map drawings.
- *Color plotter:* Final map drawings are generated on a multi-pen drafting plotter. The plotter gives clear, non-smear drawings that are easy to read. Finished size can be up to 24 × 36 inches (or D size), which allows us to incorporate a great amount of detail on each map, without losing readability. Output can be on a variety of media. We produce drawings on both mylar-type film and paper. Both make excellent masters for multiple copies and reductions.

Total cost of this system was $35,800. In many ways, the maps drawn on the plotter are of a better quality than those that can be generated using conventional, manual drafting techniques. The CADD maps are easier to read than blueprints and can be easily changed and replotted. We are able to give the construction foreman clear, concise directions, showing precisely where new construction is to occur, where streets do or do not go through, exact distances and cable footage.

Best of all is the fact that we can generate maps quickly. Our draftspeople can draw base maps four times as fast on the CADD system as would be possible for a draftsperson—even a lightning-quick one—to complete manually with ink or mylar technology.

Once the decision was made to purchase a CADD system, the most important step was to configure it in a manner best suited to our application. This job was left to the design supervisor and his group as they were the design and drafting experts. The design supervisor developed a set of mapping symbols to conform with standardized symbols used throughout Viacom. Each symbol is assigned a number of attributes such as connectors, heat shrink, footage, etc. These attributes can be variable or fixed, visible or invisible on the display.

As each symbol is inserted on the map, it carries this information with it, sometimes prompting for footages or quantities to enter in the data base. The symbols are in a custom menu area directly on the digitizer and can be entered in seconds, eliminating the need to redraft symbols each time. The important lesson learned during this phase was: Don't be afraid to call the computer experts that sold you the system; that's what they get paid for. And none of the people in our engineering department had any computer experience. We had plenty of questions when we first began using the system, and it was good to have someone to call who could really help. In the long run, we learned by using the system and putting in a few extra hours to become familiar with its workings.

Making a map

Each map begins with the CADD draftsperson entering detailed street maps that were obtained from the local power authority. These maps provide the designers with every pole location, unlike tax maps. The draftsperson traces the drawings into the computers with the digitizers, and labels each section. Next, the verified system map for that area is entered and conformed to the power company's map. Where street lines do not match up, the draftsperson zooms in on the monitor and redraws the information accurately. This makes for a highly reliable map. The new map is downloaded to the plotter for printing.

The combination of power company map and verified system map forms a base map of the area. These base maps then go to the system designer. At this stage, the designer draws freehand on the base maps each piece of new equipment, new trenches, rerouting and other changes to be made to the system. The map then goes back to the computer draftsperson to enter the new information. This new construction and equipment are drawn in a new layer and laid over the base map. Changes can be made to either layer without affecting the other.

The maps go back and forth between CADD draftsperson and system designer, adding new specifications, new equipment and other changes. As each new map layer is drawn, it is entered in a different color to differentiate it from previous layers. In all, nine layers of information are used in making each map. These separate into base map, strand map, cable routing and types, feeder and trunk design, addresses, and construction notes. After the as-builts are complete, the construction note layer is simply deactivated and the map replotted for a final print. The construction notes can still be recalled if needed for research by simply reactivating that layer.

When all the specifications for new design have been mapped, the draftsperson calls up the corresponding BOMs for that area. This information, along with the maps, are sent to the construction foreman for implementation. By the time a map is finished, it shows the location of all cable, old and new, locations of amplifiers, all active and passive devices and construction notes—color coded and in separate layers. It's a beautiful sight.

'The Book'

Drawing beautiful, clear, accurate maps is really only the beginning of the uses we have for the computer. The system also helps us generate a whole range of organizational materials, making life easier for the engineering department as well as for the construction crews.

The large 24 × 36-inch plotter maps are not what the construction foreman receives. These maps are too large and bulky for easy handling. Instead, the maps—plotted on paper—are sent to a local printing shop, which reduces them to a 11 × 22-inch size that is easier to handle. Because the original CADD-generated map is of such high clarity, each letter and number on the reduction is easily readable. These smaller maps go into "The Book," a compendium of construction maps for each area, cross-referenced with an index containing a variety of equipment and location information sheets that are also generated on the computer system. The indexes are keyed to provide a quick means of identifying a specific location. All streets served by a particular headend are listed. The construction crew can locate any amplifier by simply looking up the location key in the index in the front of the book and then pinpointing that spot as it corresponds on the street map in the back of the book.

Copies of the books are distributed to service technicians, underground install groups and construction crews. The books have become the primary reference guide not only for the rebuild, but for the entire system. As such, they find a variety of uses outside the engineering department. Our marketing department applies house addresses to the index for use in market surveys. Information from our CADD data base also feeds into the system computer. This provides our customer service department the most up-to-date information available on the system. If a certain number of complaint calls come in, service can look up the system key for the

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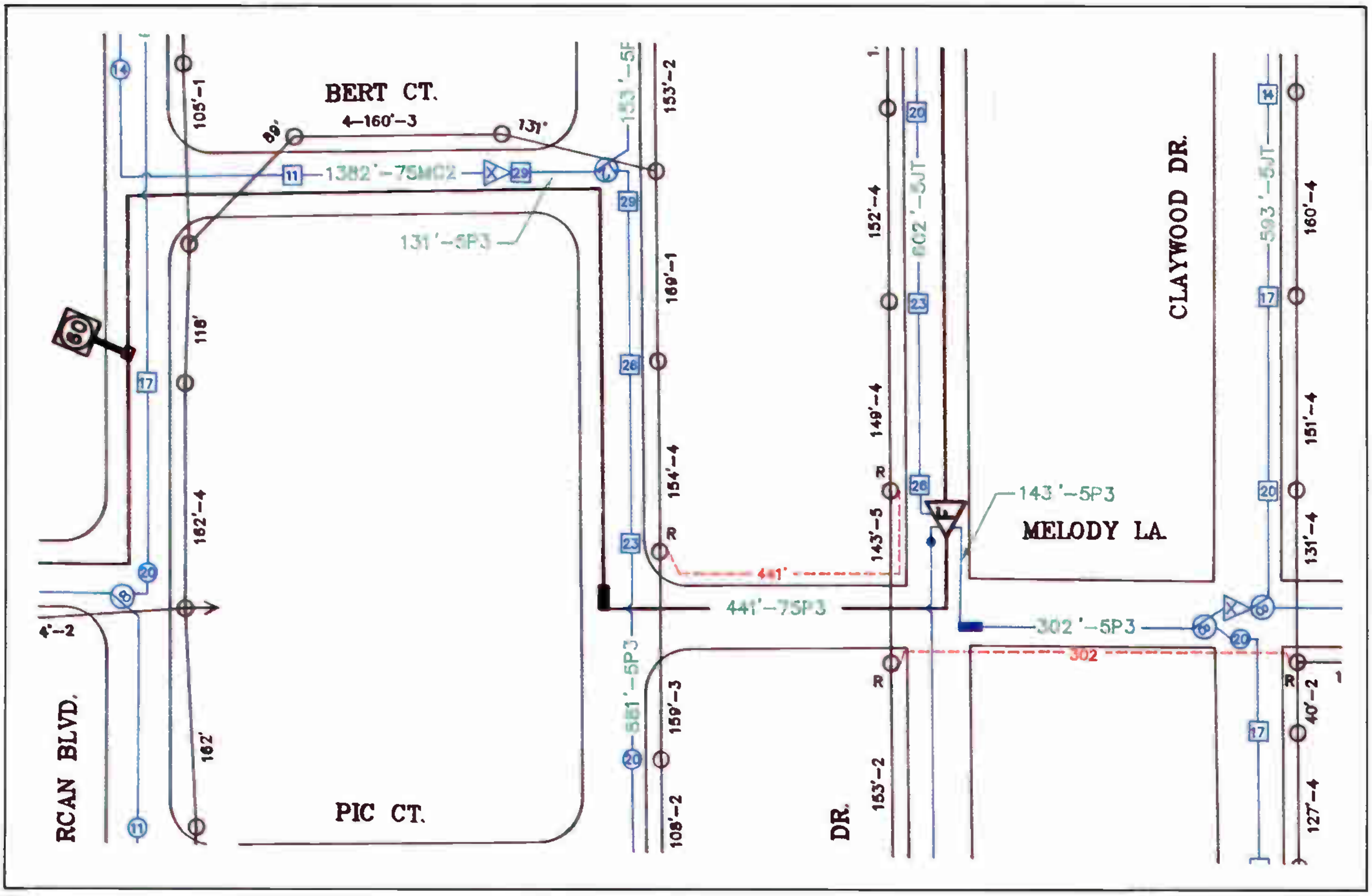
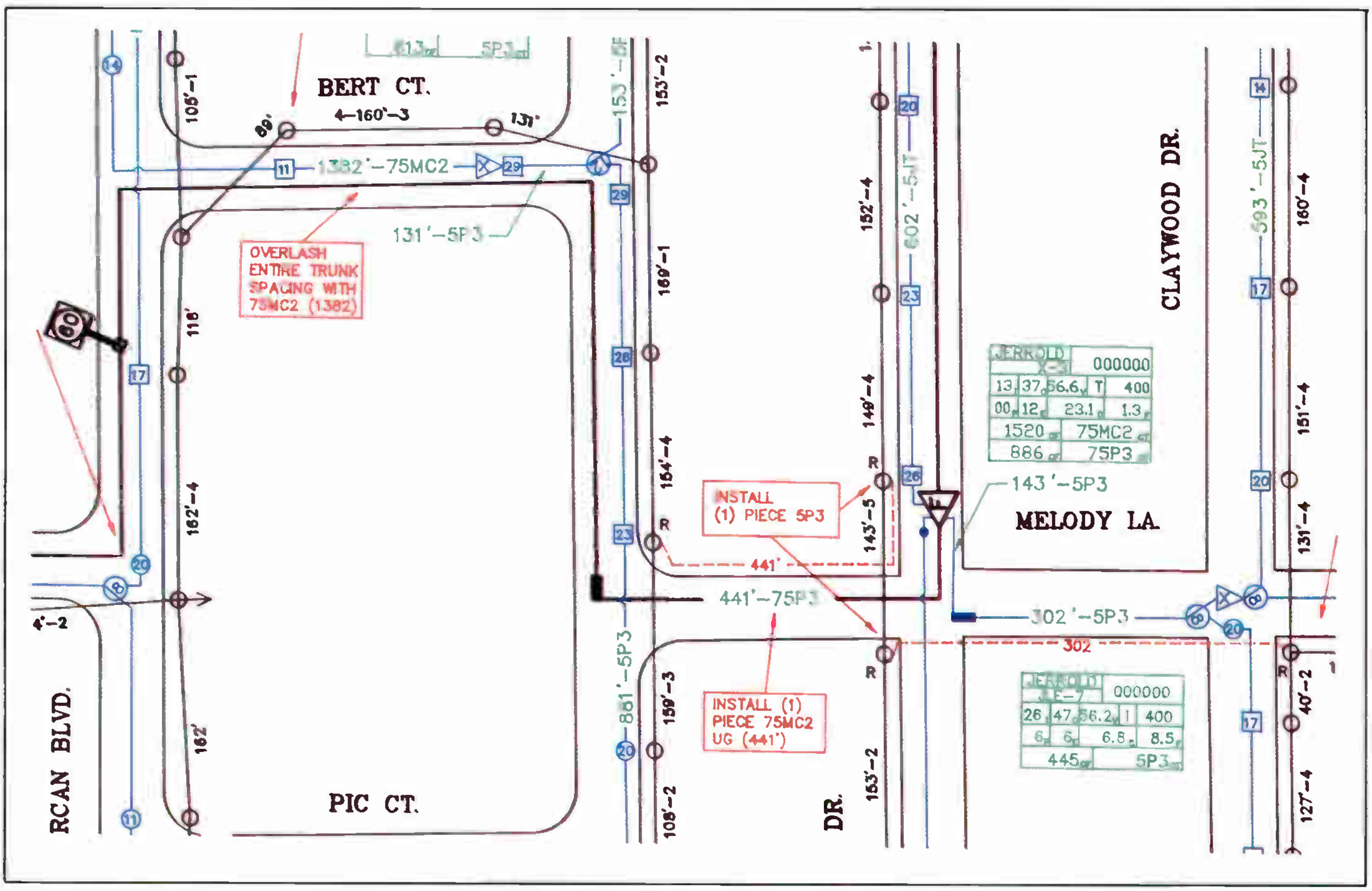


Trunk design, feeder design and new cable footages have been added to base map.



Final rebuild map, incorporating all nine information layers, shows construction notes and amplifier nomenclature.

area from which the calls originate and know exactly where to send technicians to locate a problem amplifier or power supply.

But as wonderful as all this seems, it took some time before we were truly proficient with the system. We redrew the first 10 miles of map four or five times before we got the hang of it. The design supervisor and I received training from the dealer, but that was only enough to get us started. I attended evening computer classes at a local high school. We went to CADD user group meetings, but there was no one there doing the type of flat mappings with which we were involved. The user group was made up of architects, landscapers and others whose primary interest was in dimensional design.

We spent hours playing with the system with the manuals in our laps. It was really the only way we were going to learn how to accomplish our particular tasks. At first the custom symbols were too large. We went through a series of downscaling to get them right. We needed to redefine the rotation points of certain objects to correctly draw them into the design. For instance, should the amplifier symbol be rotated from a point on the tip of the amp or in the middle of its back?

We really became productive by May 1987, nearly seven months after we started with the system. By July, we had verified 25 percent of the system and had 214 base maps drawn. We had completed approximately 90 miles of new design and about 20 miles of construction had been completed in our Islip system. Today we have over 1,000 miles of base map on the system, 380 miles of new design drawn. We are now completing maps at roughly twice the speed as last year.

In Islip, the first township to be rebuilt, we have completed 160 miles of construction. There are approximately 700 miles to go, which we expect to take 18 months. This year we will complete 1,000 miles of base maps and 400 miles of rebuild maps.

This jump in mapping speed is the result of efficiencies built into the process. For instance, the number of times drawings travel back and forth between draftspeople and designer has been cut from five to two. Strand footage is now entered automatically by the draftspeople when they enter the power company maps, rather than waiting for the designer to enter the numbers. We have learned to make use of software capabilities such as the copy command to speed up drawing.

We also have added one piece of hardware to the system: a $99 spooler for the plotter. This allows drawings to be downloaded from the computer to the plotter where they are stacked to wait for printing. A completed new design map can take up to an hour to plot, but the spooler allows the draftsperson to get onto drawing the next map, rather than wait for a previous drawing to plot.

In addition to maps and indexes, we now generate all our departmental forms on the system from capital project requests through construction logs. Plus, we need less room for map storage. All the drawings are in the books or stored on 5¼-inch floppy disks kept in small boxes, rather than in large file drawers. Four maps can fit on a single disk. To date, all the rebuild maps are on about 80 disks, not all of which are full.

Looking ahead

The true beauty of the CADD system is the ability to make changes quickly and efficiently. After the new mapping system is 100 percent complete, we plan to utilize it to eliminate several other time-consuming tasks such as:

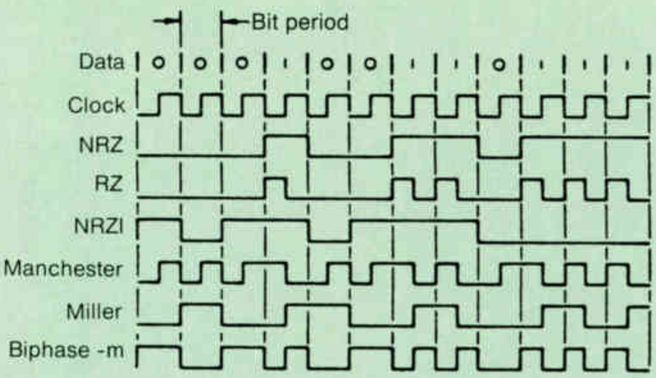
- *Pole license research:* By creating a pole license layer we would no longer search for licenses, as all information would be on the maps themselves (although invisible). The data base could then be used to check license billing accurately.
- *Easement recording* to simplify locating easements that were filed long ago and forgotten over the years.

The reaction of management to our use of CADD has been extremely favorable. As a result of our success with the technology, other Viacom systems that are starting rebuilds are also looking into CADD and will probably purchase a system similar to ours. In terms of both economy and efficiency, our CADD system has been the ideal solution to mapping our rebuild. That would have been enough, but the ancillary uses we have found for the system mean that it will be an integral part of our engineering department for years to come.

Fiber-optic system design

This is the first installment of a three-part series on the design and application of fiber-optic technology. Part II will discuss fine-tuning power and bandwidth budgets.

Figure 1: Fiber-optic coding



Format	Symbols per bit	Self-clocking	Duty factor range
NRZ	1	No	0-100
RZ	2	No	0-50
NRZI	1	No	0-100
Manchester (biphase-1)	2		50
Miller	1	Yes	33-67
Biphase -m (bifrequency)	2	Yes	50

Figure 2: 4B/5B coding

Data	4B/5B Code
0000	11110
0001	01001
0010	10100
0011	10101
0100	01010
0101	01011
0110	01110
0111	01111
1000	10010
1001	10011
1010	10110
1011	10111
1100	11010
1101	11011
1110	11100
1111	11101

By Robert K. Southard

Manager, Systems Technology, Electro-Optics Division, AMP Inc

Optical fiber is irresistible as a copper media replacement for handling the enormous distances and amounts of information traveling across the country or even around the world. Today, optical fiber is becoming the medium of choice for transmission between and within buildings, from machine to machine, in local networks and even within a single piece of equipment.

The local optical transmission applications foster a wide range of new and different components optimized for the developing local environment. The key benefits of fiber in these environments are: superb attenuation characteristics, high data rate capability, electromagnetic immunity, ground-loop elimination, security, small size and expansion capability—an increasingly important factor for justification of investment in a technology of the future. Predictably, improvements in technology will involve changing the electronics only; fiber installed today will undoubtedly serve applications for many years in the future.

System specification

In some instances, fiber directly replaces copper because a new system specification duplicates or enhances existing system performance. Totally new applications will take maximum advantage of optical technology. A well-structured decision-making process needed to define, design and evaluate a fiber-optic system properly is the prime prerequisite.

System architecture concepts address such issues as tradeoffs between system transmission performance and complexity. Digital systems deal with parallel data and decisions regarding the degree of multiplexing vs. the number of fiber channels are important. In some cases, slower parallel optical channels will save sufficient circuitry to justify their implementation. Some situations dictate transmission of data in relatively infrequent high data rate bursts. Tradeoffs between more complex circuitry to buffer the data vs. a simpler, higher speed optical link operating without buffering are needed.

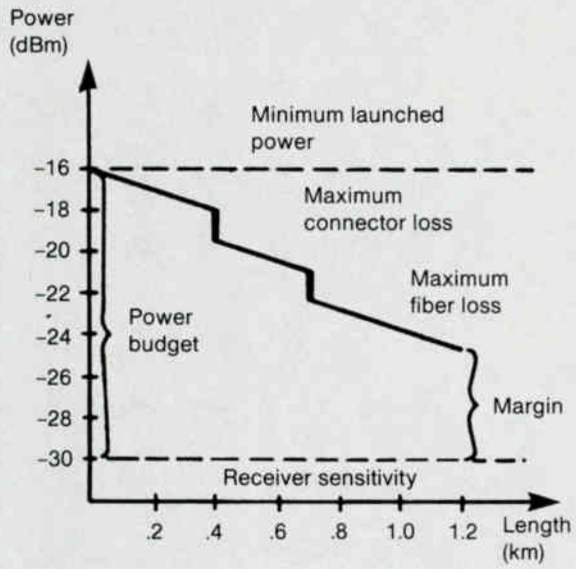
Next, a data rate for the optical channel is established and methods for encoding data are evaluated. Factors influencing code selection include adding signal redundancy to enhance error-free detection, enriching the data stream to ensure minimum data requirement, constraining the duty cycle of the signal as required by the optical receiver and including sufficient transitions to allow clock recovery and synchronization.

Choosing a particular code (Figure 1) is quite significant to transmission system specifications. For example, a 20 Mbps data rate signal encoded by a relatively simple to implement biphase code requires a link with twice the capacity in bits per second, or the same capacity as a link carrying a 40 Mbps signal using NRZ (non-return to zero) code. This effectively doubles the bandwidth requirements on the transmitter, receiver and fiber.

Block codes treat a number of data bits as a set and encode the bits with a slightly larger number of bits. These group codes are specified as "mB/nB codes," where *m* data bits are encoded into *n* bits for transmission. Common types of group codes are the 1B/2B codes, such as the biphase code, 3B/4B, 4B/5B (Figure 2) and 8B/10B.

A system specification also determines optical channel maximum and minimum distance required. Some applications may require longer

Figure 3: Fiber-optic power budget



length but not the throughput or accuracy requirements of most applications. Here, a particular optical transmission system may provide the capability without additional redesign.

The error rate performance of the communication system is factored in. A realistic estimate is placed on the bit error rate (BER) that can be tolerated in the transmission path while retaining overall system specifications. A transmission path carrying voice or video information will have a different BER requirement than a path carrying computer data. Stringent requirements necessitate error-correcting codes. Higher-level system protocols may be used to monitor errors and request retransmission when errors are detected. These factors are considered before establishing the optical link's BER performance requirement.

System design

System design entails evaluation of variables such as: operating wavelength; type of fiber, emitter and detector; and selection of specific transmitters, receivers, cables, connectors and other components. The best solution involves initial assumptions and choices, then analysis and evaluation of tradeoffs.

Many local fiber-optic applications will operate in the 800 to 900 nm optical wavelength window where good performance and relatively inexpensive components are available. Evaluating performance in this wavelength range is a reasonable initial approach.

Multimode fiber is the fiber of choice for local applications because it works well with relatively simple and inexpensive LED emitters and PIN diode detectors, as well as providing good attenuation and bandwidth performance in the 850 nm wavelength range and even better performance in the 1,300 nm range.

System specifications identify appropriate transmitters and receivers based on signal characteristics such as data rate, duty cycle, etc. An application may require 100 Mbps transmission with a given power budget and with a BER of 10^{-9}. A receiver specified at 100 Mbps and a BER of 10^{-12} may operate properly due to a tradeoff between data rate and bit error rate. Engineering analysis may be needed to resolve the issues.

Next, system design analyzes signal integrity through the fiber system. Evaluation of the interaction between optical power and bandwidth is continuously examined.

Power budget

Key elements in power analysis of a fiber-optic link are:

- transmitter power out into a specific fiber, P_T
- fiber attenuation per unit length, A_L
- receiver sensitivity (minimum input power), P_R
- connector and component loss, A_C
- link margin, M

The formula for loss and link margin values in dB and power values in dBm is

$$M = P_T - A_L \times L - A_C - P_R$$

where L is fiber length. Multiple fiber segments are combined algebraically. Transmitter power and receiver sensitivity in units of dBm are available from the data sheet.

Normally, peak power values are used, but sometimes average power based on a 50 percent duty cycle signal is specified for a transmitter or receiver. Either peak or average power may be used but not intermixed within a calculation; inconsistency will cause sizeable errors.

Connector loss, fiber attenuation and length values along with information on transmitter and receiver determine acceptable system margin. Links expected to be extended in distance or to receive additional connectors and components will need appreciably more margin for the additional attenuation.

For example, an 85-micron core fiber is initially selected for analysis. A 100 Mbps transmitter/receiver pair is selected based on data rate. Data sheet information indicates a launched power of -16 dBm for the selected fiber, while receiver sensitivity is given as -30 dBm worst case. Connector loss is expected to be 1.5 dB maximum per mated pair, with up to two connector paths anticipated in the link. An estimate of the required margin is made—for example, 5 dB for component aging and possible link repairs and extensions.

Using the formula reveals:

$$A_L \times L = -16\text{ dBm} - 2 \times 1.5\text{ dB} - (-30\text{ dBm}) - 5\text{ dB} = 6\text{ dB}$$

Here, a fiber-optic cable with attenuation of 5 dB/km allows a link length of 1.2 km, based on power budgeting (Figure 3).

Handling and installing aluminum-sheathed cables

By Rex Porter

About 10 years ago, I wrote a handbook on handling and installing aluminum-sheathed cables. In the preface, I referred to the sag and tension requirements as outlined in the *National Safety Code Handbook*. I recommended then, and continue to recommend, that this document be included in the library of every CATV technician/engineer. Without proper sag and tension, almost every safety point will be overcome because the cable cannot expand and contract along the strand in a proper manner from season to season. For the purpose of this article, we will assume that the strand is properly tensioned, and sag is proper for all varying span lengths and cable sizes and bundles. Also keep in mind that important improvements have been made in the design of cell structure, cable bonding and packaging concepts.

Preventing damage to the cable

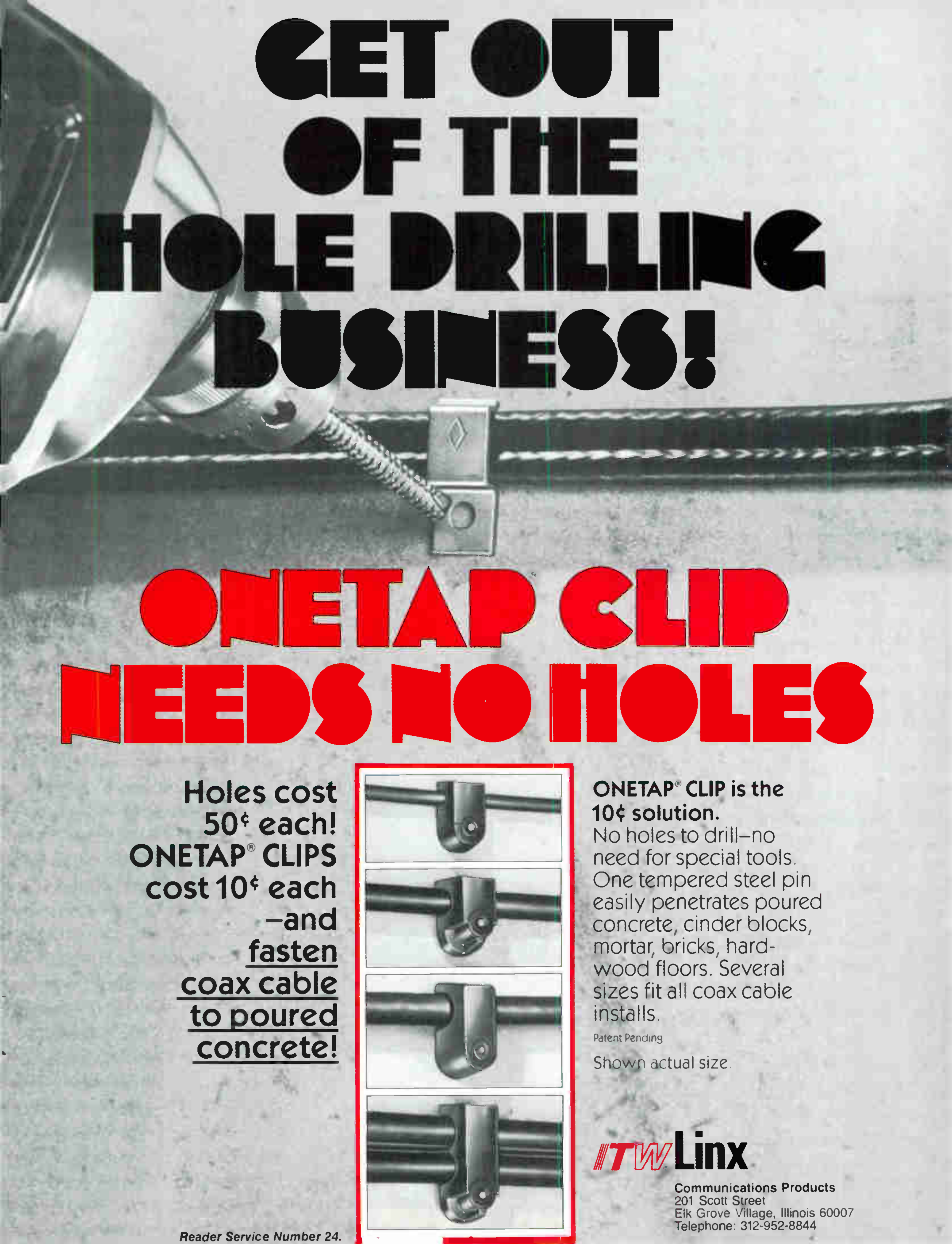
There are, however, a number of times where cable is liable to damage before it is actually put into operation in the cable system:

1) *Shipment from the manufacturer:* When reels of cable are received from the manufacturer or distributor, every reel should be checked for apparent damage or broken or smashed packaging around the reel. If the cable is noticeably damaged, the bill of lading from the carrier should be signed and noted, "X number of reels damaged." If you cannot see actual damage to the cable itself but the reel is cracked, smashed or broken, or the reel's flange-to-flange cover is ripped or torn, then the bill of lading should be signed and noted, "X number of reels subject to concealed damage." When the driver leaves with the paperwork so noted, the carrier has a certain number of days to return and cooperate in an inspection to see exactly how much cable is actually damaged and to acknowledge its liability.

A point of interest concerning the methods of shipping cable: In the past, when dielectrics were softer and aluminum tubes were thinner, it was recommended that all aluminum cables be shipped on rolling edge only. With today's tougher cable constructions and the attention manufacturers pay to lagging and chocking of the reels, cable is probably less likely to be damaged if the reels are shipped on their flats or sides. However, cable should not be accepted from the carriers if large reels are stacked atop of smaller reels or if the reels are not separated by plywood or other spacer materials to protect the reels from damage during shipment.

2) *Unloading of cable:* All aluminum cable should be unloaded with a forklift or a hoist or lowered to the ground on a ramp. Cable should never be dropped from the back of a truck's trailer—even if tires or other cushioning materials are placed at the point of impact. To drop cable reels onto cushions from a truck does not protect the inside wraps from damage even though it may appear to protect the outside wraps.

3) *Warehousing of cable reels:* When cable reels are moved into a warehouse, they should be positioned so they are not lined up with two reel flanges meeting. In the day-to-day movement of reels, it is likely that the flanges will work themselves into the cable wraps of their neighboring reels and flattening or other damage will occur. A more proper method of arranging the cable reels is to crisscross the reels so that the flanges of one reel are brought into contact with the center of the next reel, etc. If the cable is to be stacked on its sides, 2 × 4 sections should be used to place between the reels and placed so that they cross the reel at the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location of the bolts through the core of the reels. This will keep the weight of the top reels from damaging the outer edges of the lower reel's cables.

4) *Transporting the cable to the work site:* When a reel of cable is removed from the warehouse stock, the cable ends should remain uncut and fastened securely until the cable is ready to be pulled onto the strand. If the cable is unfastened at the warehouse and then loaded onto a trailer, the continuous bouncing of the trailer reel bar on the way to the work site may cause the cable to loosen on the reel, resulting in problems with cross-wraps and/or wavy conditions as the cables are pulled into the spans.

5) *Paying off the cable:* The location of the cable reel in relation to the first pole or roller is of extreme importance to the construction crew. When the payoff trailer is located, the center of the reel should be sighted so that the cable pulls from the center of the reel, line of sight, directly into the first roller and along the line of sight of the strand—not at an angle. If the cable is pulled in at an angle, it may catch the flange of the reel and be damaged.

6) *Locating the reel during payout and separation of rollers on strand:* If you've ever visited a cable manufacturing plant, you've noticed that cables are wound and rewound many times at relatively high speeds. This multiple rewinding can be accomplished in the plant because of proper tensioning on the reels and also because the cable reels are located at the same vertical level—something that cannot be accomplished in the field. You can, of course, properly tension the reels but the cable must be pulled at a vertical angle to be drawn into the pole line strand. To keep this angle as small as possible, it has been recommended that the cable trailer be moved 50 feet back from the first pole or contact point with the strand. This will allow the cable to straighten at the reel instead of in front of the reel. The placement of rollers every 30 to 50 feet will still be required to properly support the cable until it is lashed into place.

7) *Reel braking:* Before the cable is pulled into the strand line, the cable reel should be braked to ensure that when the cable is not being pulled, the reel will stop movement. This braking should be against the reel itself or applied to the hub assembly. In no case should any direct pressure be brought against the cable itself. Sufficient pressure against the cable

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When cable reels are moved into a warehouse, they should be positioned so they are not lined up with two reel flanges meeting.

to keep the reel from moving could possibly damage the cable and would vary at different pressures according to the number of wraps of cable on the reel and/or different sizes of cables on multiple reel payoffs.

8) *Expansion loops:* In years past, there was a tendency to recommend that loops be fashioned with wooden boards to form "swag" loops. Today, there are many excellent forming tools that, if used properly, will frame the cable into a long-life expansion loop. It is still recommended that an expansion loop be formed at every pole and every piece of active gear located on the strand.

9) *Jacketed vs. plain cable:* During the years I have designed, operated, engineered and sold products to cable systems, I have concluded that a wise operator would rebuild any cable plant with jacketed trunk and feeder and use shrink tubing over every connector. In the past, people tended to shy away from jacketed cables because of the cost and the fact that jacketed cables absorb heat. This retention of heat created a problem for early equalizers. But with today's excellent equalization capabilities, the added costs turn out to be a savings when one compares the extended life of the aluminum as the result of the protection offered by the jacket and installation of the shrink tubing on the connectors. The returns easily outweigh the increase in cost.

10) *Moisture:* And finally, we should never forget that moisture is still our biggest concern when we consider cable life. The manufacturers ship your cable with the ends capped. When you are pulling cable into place and you do not plan to splice the cable immediately, make sure every cable end is covered with either a treated boot or some other protectant. Otherwise, moisture can penetrate any dielectric and start its journey back into the cable to create high attenuation. The higher the frequency, the higher the attenuation and we need all of the bandwidth available to today's modern CATV systems.

Handle with care

The cable in your system is the one product you cannot easily replace if it is damaged through mishandling. The damage will not likely be noticed until some time after the system is turned on and accepted. After the construction is accepted and the crews are gone, it's too late to start being careful. There are very few things you can do to repair damaged cable—the usual "repair" is to replace it. Cables have improved dramatically over the past five years. The tools to handle cable properly are available. Treat your cable with the care it deserves and read the instructions from your supplier to assure the maximum return on your investment.


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The alternatives of turnkey construction

By Thomas J. Polis and William F. Earle
Communications Construction Group Inc.

The word "turnkey" is defined by *Webster's New World Dictionary* as a jailer or the person or persons in charge or control. With respect to the construction trades, a "turnkey contract" implies that the contractor has taken the responsibility of all aspects of the construction process and will deliver to the customer a final and completed product.

Turnkey construction has in the past been a very popular and effective means of accomplishing the installation of outside CATV facilities. It allowed small and inexperienced system operators to enter the industry without the fear of winding up with an inferior, poorly performing CATV plant. Turnkeys were the domain of the large electronic equipment manufacturers, who not only solved the operator's problems, but also provided a vehicle for the sale of manufactured equipment. Some manufacturers went so far as to maintain in-house construction crews and large-scale field engineering forces, thus developing new profit centers in addition to manufacturing. Another benefit to the manufacturer was that the turnkey provided an extension to the laboratory R&D efforts with accurate and timely feedback of actual field operational problems with equipment.

A typical turnkey service consisted of:

- Headend site surveys
- Installation of towers, headend buildings and receiving equipment
- System strand mapping
- Make-ready surveys
- System design
- Obtaining permits
- System installation
- Electronics alignment and final proof of performance
- Providing all required equipment, tools and work forces

These turnkey contracts were for the most part "fixed price" and were not only popular with the system operators but also with the financial institutions that provided the capital funds.

All of this, of course, was not without a cost premium to the system operator, who could expect to pay 20 to 30 percent more than for non-turnkey. This premium was justified by the risks that the turnkey alternative presented. As the industry matured and the system operators became more sophisticated, the risks of the turnkey diminished, thus driving down the premiums. Other marketplace changes continued to reduce prices for turnkey projects until, in the late '70s, most manufacturers withdrew their offerings, having experienced substantial losses.

In recent years, a new interest in the turnkey has evolved as many systems now require rebuilding. The drive is to minimize the impact that the rebuild project has on the system subscriber base as well as the staff at the system level and to reduce the requirement for top-heavy dedicated management at the corporate level.

Changing structure

The premium that the operator is willing to pay for a turnkey is substantially less than in the past. As a result, the structure of the turnkey contract has significantly changed:

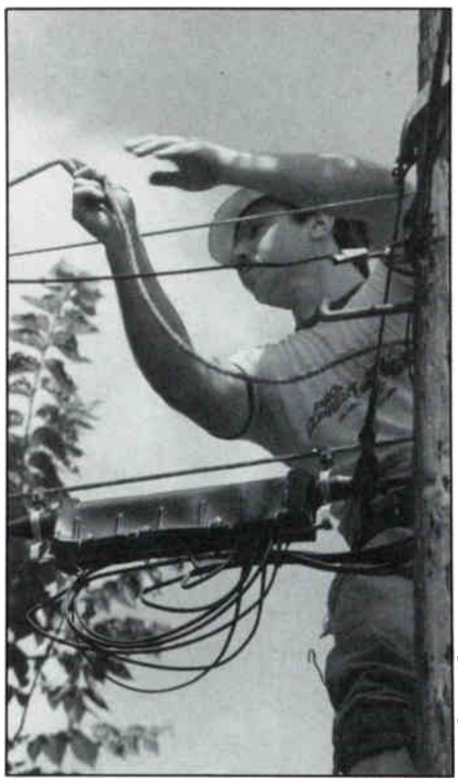
1) Turnkey is more often than not provided by contractors rather than equipment manufacturers.

2) The system operator usually selects equipment, establishes specifications and design criteria, thus sharing in the risk.

3) Contracts usually have limited fixed prices on a per mile basis and contain "menu" variable items billed over and above the basic price.

4) Warranty obligations are split by the contractor and equipment suppliers.

5) Turnkeys are usually limited to the construction phase and do not include surveys, headends or makeready responsibility to the turnkey provider.



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"The flexibility of the management turnkey allows system operators to structure the contract to fulfill their needs at a feasible and affordable cost."

Due to these changes in the concept of the turnkey project, the reference now has become "modified turnkey." Under these contracts, the prime contractor supplies all or portions of the material for the construction and enters into subcontract agreements as required to provide all of the labor forces needed. Since billing is usually accomplished on some sort of progress basis, the contractor is required to carry payable responsibility for material and subcontract labor, thus including in the pricing the costs associated with carrying these payables (i.e., the cost of money) plus nominal profit margins and management costs. As was implied earlier, the premium cost of a turnkey is very sensitive, therefore these added burdens in many cases are sufficient for the operator to totally abandon a turnkey approach.

The system operator is faced with a dilemma. It is extremely difficult, if not impossible, to find a "full" turnkey provider and if one is found the price is usually far too great. Modified turnkeys are easier to find and less costly but can adversely affect the cost of material. Finally, non-turnkey approaches are the least costly but carry a high degree of risk. If the modified turnkey approach did not carry with it the cost penalty for material, it would obviously be the most effective solution to the problem.

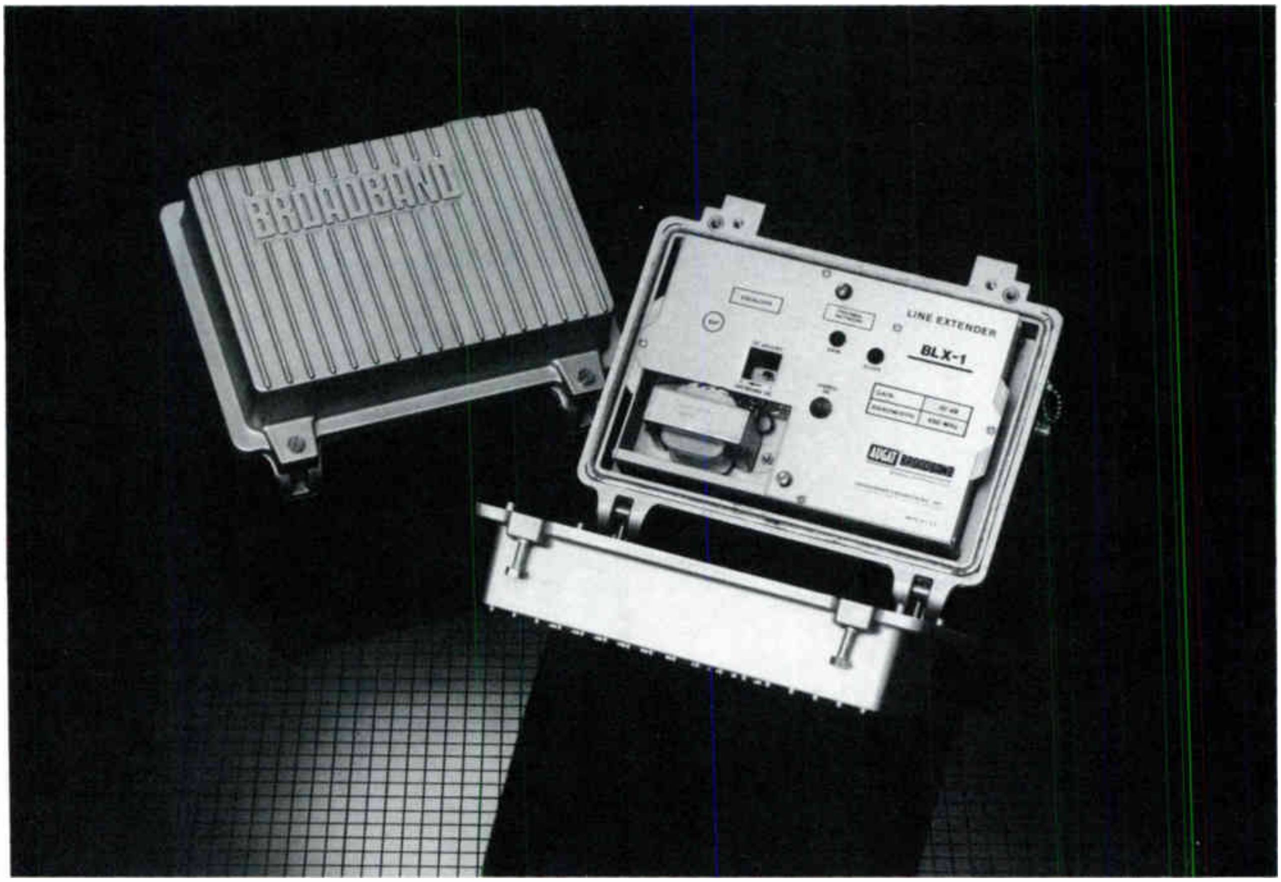
Some contractors and some manufacturers now offer a package referred to as a "management turnkey" that does in fact eliminate the cost penalty associated with the material and enhances the services that can be offered. The management turnkey also offers a high degree of flexibility on structure to allow it to be customized to the particular situation.

Contractor services

A typical management turnkey consists of the following contractor provided services on a fixed price per mile basis:

1) All required vehicles, tools, construction and management work forces.

2) Preparation of materials purchase



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For more information, contact LASER PRECISION CORPORATION, 1231 Hart St., Utica, NY 13502, or call (315) 797-4449, or telex: 646803

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requisitions to the customer for strand and hardware, cable, connectors, electronics, taps and passives. The quantities and types are based on system specifications, materials approved for use by the customer, design criteria and design bill of materials. All quantities include necessary shrinkage and waste.

3) Once the customer places the purchase orders and provides a copy to the contractor with or without pricing (depending on the customer's preference), the customer notifies the vendors that the contractor is to act as customer's agent for purposes of establishing delivery schedules and expediting back orders. Under no circumstances is the contractor authorized to make any changes to customer-generated purchase orders without prior written approval from the customer.

4) Receipt, warehousing and issuing of materials. As the materials are received, a complete inventory is taken to ensure that the shipment is complete and free of shipping damage. Once this is accomplished, quantities are compared to the packing slip. Any discrepancies or damages are noted on the receiving documentation and prompt corrective action is taken. All original copies of receiving documentation are signed and dated indicating receipt and turned over to the customer, usually on a daily basis.

The contractor assumes the responsibility for the materials in its possession and will carry the necessary insurance on the warehouse and its contents. All materials stored in the contractor's warehouse are signed out to the construction crews on a daily basis for installation into the system. Complete and detailed documentation of all materials going in or out of the warehouse is kept for both audit purposes and final project reconciliation.

5) The previously mentioned procedure provides for complete materials tracking, accounting and management. The contractor also provides detailed reports on a periodic basis indicating quantities ordered, received, back ordered and issued, listed by part number. Periodic audits are performed jointly between the customer and the contractor to ensure that reports are accurate and materials waste levels kept to an absolute minimum.

6) Preinstallation testing of cable and electronics as required. All cable is swept in the warehouse prior to installation to ensure that no cable is installed that does not meet specifications. Electronics are bench-aligned and preheated in accordance with the manufacturer's specifications and recommendations. Complete logs and documentation of all testing are kept on file in the warehouse.

7) Field alignment of electronics and final proof of performance. Upon completion of a phase or the entire project, the contractor reconciles the materials against final as-built information and will be accountable for any variances.

The key benefits realized by the system operator include:

1) The cost penalty associated with materials has now been eliminated by direct purchasing by the system operator, taking full advantage of price structures and buying power.

2) The need for additional management and clerical staff at the system level to handle materials has now been eliminated.

3) Excess inventory left over at the completion of the project is now the contractor's responsibility.

4) The cost of the management of the construction is identified in the contract and can be easily budgeted.

Customizing the structure

While this is a typical structure, the turnkey provider will customize the structure to include all or a part of these services and even offer other services the customer requires. The flexibility of the management turnkey allows system operators to structure the contract to fulfill their needs at a feasible and affordable cost.

Turnkey has a long history in the CATV industry and has played a major role in the development of systems. It will, in its new forms, continue to be a viable, cost-effective approach to both rebuild and new-build activities within the industry.

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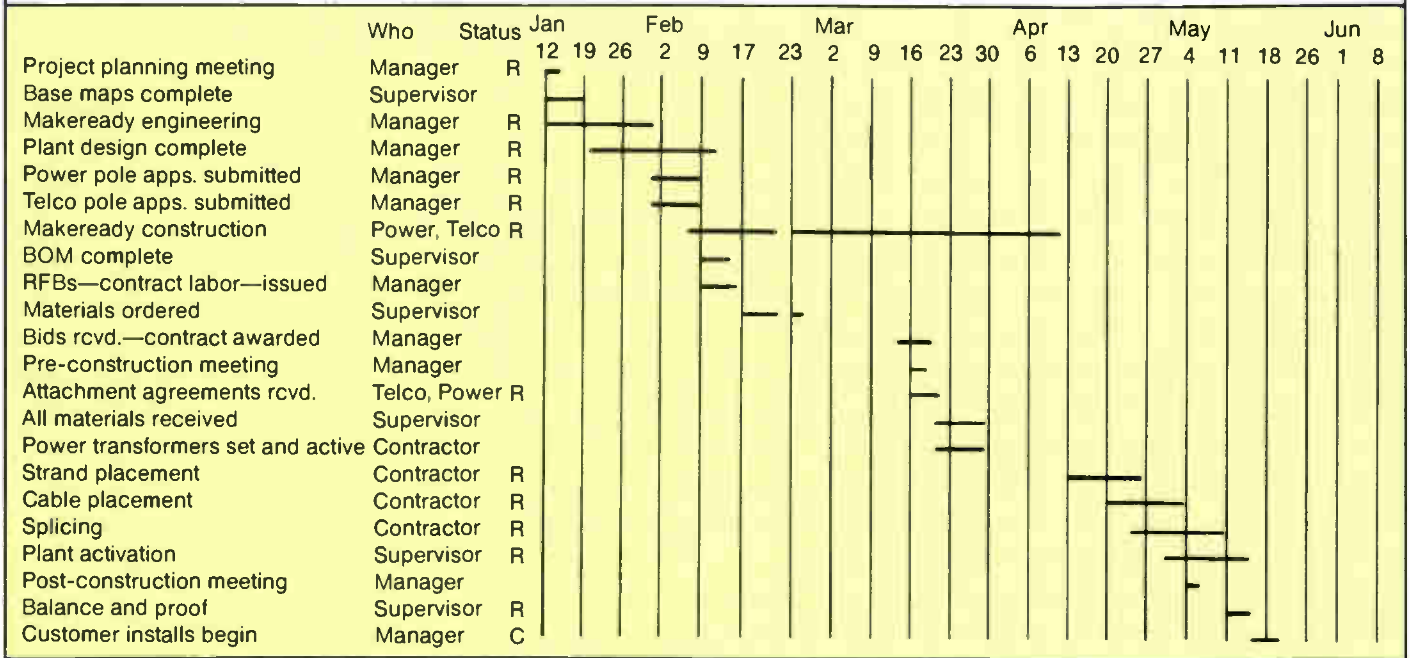
Figure 1: Gantt chart

Schedule name: Typical CATV line extension project
Project manager:
As of date:



D Done
C Critical
R Resource conflict

Project management for CATV engineers

By Steve Hubbard
Engineering Manager, Jones Intercable

All CATV engineers are project managers. On a daily basis they deal with construction, engineering and installation projects. While some projects are very large, taking months to complete and involving millions of dollars, others are significantly smaller. Large or small, projects can be managed using a common set of skills.

The success of a project is generally judged in several different ways:

Money: In the planning stages the manager is asked to project the cost of the project; financial success is measured against that budget. Did the project meet its budgeted cost goals?

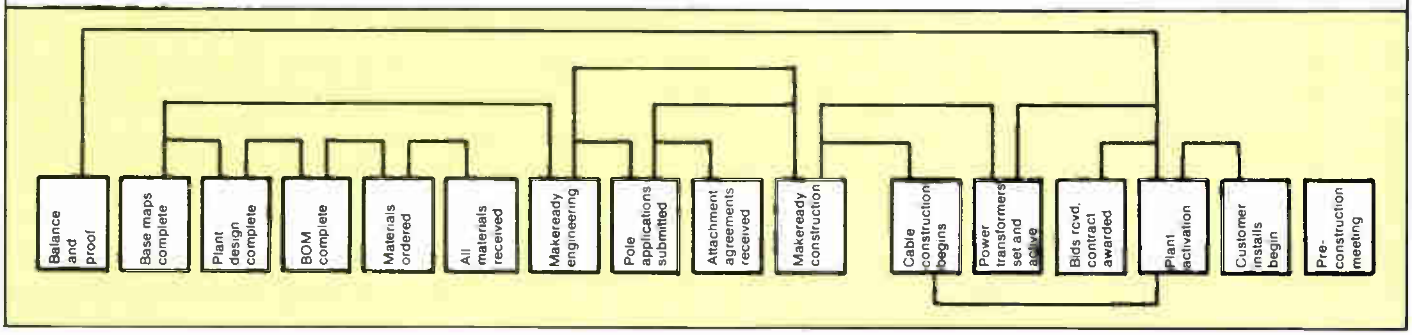
Time: In the pre-planning stage we normally set a time range for completion of the project. Time overruns can often lead to financial

"A common error is to underestimate administrative and quality assurance costs."

overruns, especially in the CATV industry where a system rebuild or channel upgrade might be tied to a rate increase. If the rebuild

Figure 2: PERT chart

Schedule name: Typical CATV line extension project
Project manager:
As of date:



is not completed on time and the rate increase is delayed, the project cannot be judged successful.

Production: Was the volume of work produced acceptable? Rebuilds or upgrades may be measured in miles, drop upgrades in residences and converter changeouts in customers. Whatever the unit of measurement the project should achieve the originally projected production.

Quality: Measurement of quality is absolutely necessary to achieve success in the three preceding areas. If specifications are relaxed and poor quality allowed, expenses can be reduced, production increased and the time requirements lessened—resulting in an *apparently* successful project. If quality has been compromised, however, the project is not successful at all. For instance, all of us are familiar with instances where CATV plant built in the early 1980s is now requiring rebuild, long before the natural life of the plant components expires. This occurred because the original design was faulty or construction technique—craftsmanship—was poor. When selecting equipment, quality must be an overriding concern as well. A poor choice of converters might mean that in five years they need to be replaced with converters featuring current technology. Even with a product like a converter, which has a relatively short life span, such a situation indicates that inadequate attention was paid to the quality of the product.

Tactics to manage each of these areas are similar. Planning is absolutely essential and the detail and depth of planning efforts usually determine success. Monitoring progress is important while the project is under way. When complete, the project must be analyzed to measure success against the goals set in the planning phase. Successful data acquisition is required throughout the duration of the project.

The planning meeting

An example will illustrate these tactics. Suppose we are beginning a cable extension, a common project in any CATV system. A planning meeting is the place to start. The project manager should meet with the general manager, the construction coordinator and marketing manager to discuss the general parameters of the project. At this meeting broad goals are established: the general time frame of the extension, when cable service will be available to residents, when construction will begin, how many homes will be served and approximately how much the project will cost. These are the kind of large-scale planning parameters that involve marketing and operations input as well as engineering expertise.

With these general goals established, more detailed planning efforts begin. The project manager should analyze the overall project and reduce it into component parts. In our example, a number of individual work activities are identified. Base maps must be complete, makeready arrangements engineered, pole attachment applications submitted, highway and railroad crossing permits applied for, system design completed and bill of material generated, hardware ordered and labor sources identified.

Very quickly the project changes from a general concept, involving the few parameters discussed with other managers, into a complex endeavor with hundreds of individual tasks. The project is at a critical stage. The tasks must be identified and recorded now if the engineer is to maintain control of the events that follow.

There are a number of ways to do this. One method is to use a Gantt chart. This shows a schedule, usually in the form of a calendar, across the top of a chart. The tasks that make up the project are aligned along the left margin and lines drawn horizontally to represent the amount of time each task will require. Figure 1 shows a Gantt chart prepared for our example. Note the project manager has identified 22 important tasks that comprise the cable extension and has entered them in the chart. In addition, the name of the individual responsible for each task is noted. During the course of the project the manager will check individual tasks to ensure progress.

Obviously, the Gantt chart is an aid for monitoring progress. But assembling the chart introduces another, less obvious advantage for the project manager. By requiring a careful analysis—breaking down the general concept into specific details—it forces the manager to consider all aspects of the project. As a result, the manager has a better understanding of what must be done. In creating the chart the manager will discover new details, previously unconsidered that are important to the project's success.

For instance, in our example the project manager had originally identified makeready rearrangements as a critical task. During the detailed analysis however, it was realized that both telco and power company rearrangements were involved. In this case they required different application processes and different time frames to complete rearrangements and approve CATV attachments. Each task is therefore entered separate in the Gantt chart and monitored separately. Creating a Gantt chart develops this kind of attention to detail.

The example in Figure 1 shows a chart generated by a software program on a personal computer. Other methods are equally effective. Some chief engineers employ a wall chart, others may use erasable marker boards. The computer version has definite advantages over hand-drawn charts. First, it is simpler to create. The software usually asks the user to input each task and prompts the user for the time required and person responsible. It then sorts the tasks in their sequential order and generates the chart, which may be printed and distributed to all members of the management team.

Another advantage of software-created project charts is flexibility. As new tasks are discovered that need to be added, it's a simple matter to edit the computer file and regenerate a new chart. Tasks may be reassigned to new associates or time added to the calendar if necessary.

Generally the Gantt chart function is part of an overall project management program that includes other charts, budgeting tools and planning assists. Some of these software features should be approached with care. While the basic idea of a chart that graphically displays a project is a good one, and while budgets are certainly necessary, some software packages include so much detail and offer so many different ways to analyze a project that the manager might spend too much time at the PC and not enough time in the field managing the project. The PC should be regarded as a tool that makes products—charts, lists, reports—that are themselves the engineer's primary analytic tools. Its advantage is not that it can reduce the engineer's responsibility to control the project, but that it can save time in producing management tools.

Another useful chart the engineer may choose to create at this time is a PERT (Program Evaluation and Review Technique) chart, an outgrowth of a program developed by the U.S. Navy for managing its Polaris missile project. It displays tasks differently than the Gantt chart. While the Gantt chart shows tasks in their order of beginning, it doesn't show logical connections between them. It simply displays them as apparently random events occurring in the same relative time frame. The PERT chart adds another dimension by establishing dependencies between tasks, indicating which need to be completed before subsequent tasks can begin.

For example, makeready engineering must be complete before makeready construction can begin. While the Gantt chart can graphically display the estimated dates each task is to begin and the duration of each, it doesn't illustrate the dependency of makeready construction on makeready engineering; this is a critical relationship that must be recognized to avoid delaying plant construction.

The PERT chart allows dependencies to be assigned to tasks. Figure 2 shows a simplified

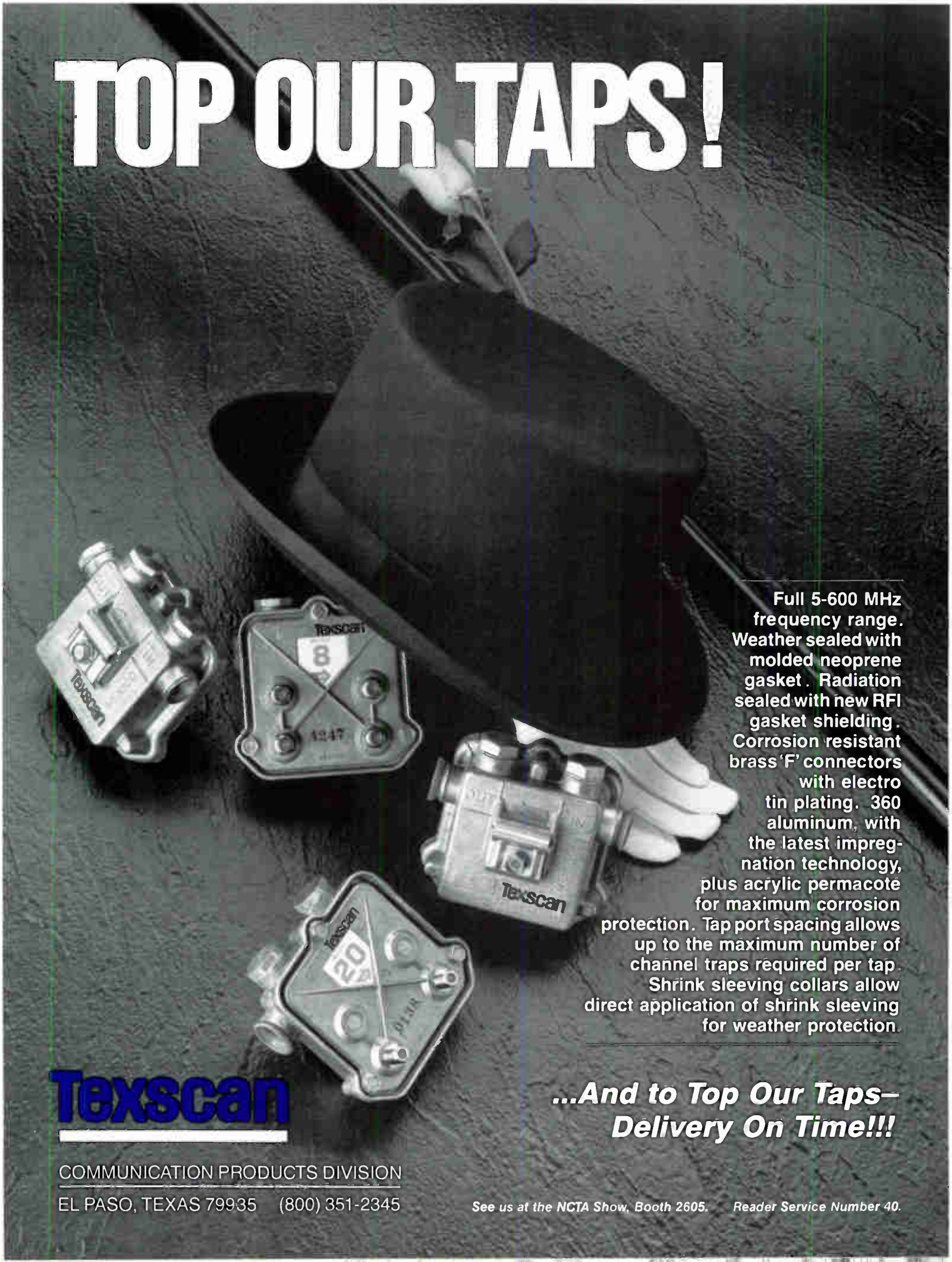

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Figure 3: Quality assurance rating form

SYSTEM: ______________________

HUB: ______________________

DATE: ______________ QA: ______________

LOCATION: ______________________

SAT	NOT SAT	N/A	NOT CHKD	ITEMS	COMMENTS
☐	☐	☐	☐	**TERMINATORS** (properly installed on all unused parts)	POLE
☐	☐	☐	☐	**TRAPS** (properly installed as per work order)	POLE
☐	☐	☐	☐	**SHIELDS** (properly installed on all ports)	POLE
☐	☐	☐	☐	**ADDRESS TAGS** (correct and properly installed)	POLE
☐	☐	☐	☐	**SERVICE TAGS** (correct and properly installed)	POLE
☐	☐	☐	☐	**ILLEGALS** (no obvious illegal service at pole or address)	POLE
☐	☐	☐	☐	**TIE WRAPS** (properly installed)	POLE
☐	☐	☐	☐	**SPAN CLAMP** (proper installation and 24" clearance)	POLE
☐	☐	☐	☐	**OTHER** (specify) ______________	POLE
☐	☐	☐	☐	**J—HOOK** (proper use when absolutely necessary)	POLE
☐	☐	☐	☐	**POLE CLEARANCE** (30" climbing clearance maintained)	POLE
☐	☐	☐	☐	**ROUTING/CLEARANCE** (12" at pole 4" at house from telephone)	HOUSE
☐	☐	☐	☐	**P—HOOK** (properly installed)	HOUSE
☐	☐	☐	☐	**FILTER** (filtered grounding block installed on 2-way systems)	HOUSE
☐	☐	☐	☐	**GROUND** (NEC compliance)	HOUSE
☐	☐	☐	☐	**SPLITTER** (proper mounting)	HOUSE
☐	☐	☐	☐	**EQUIPMENT MOUNTED** (all passives mounted with 2 screws)	HOUSE
☐	☐	☐	☐	**DRIP LOOPS** (properly formed and used where necessary)	HOUSE
☐	☐	☐	☐	**FASTENERS** (spacing and no damage to drop or house)	HOUSE
☐	☐	☐	☐	**HOUSE ROUTING** (neat and good engineering practice)	HOUSE
☐	☐	☐	☐	**FEED THRU** (properly applied and sealed)	HOUSE
☐	☐	☐	☐	**RFI (LEAKAGE)** (no signal leakage)	GENERAL
☐	☐	☐	☐	**F—FITTINGS** (all fitting wrench tight)	GENERAL
☐	☐	☐	☐	**WEATHER BOOTS** (properly used and applied)	GENERAL
☐	☐	☐	☐	**SILICONE** (properly used and applied)	GENERAL
☐	☐	☐	☐	**LPS** (properly used and applied)	GENERAL
☐	☐	☐	☐	**MESSENGER ATTACHMENT** (approved drop messenger attachment method)	GENERAL
☐	☐	☐	☐	**MATERIALS APPROVED** (all materials of JIC)	GENERAL
☐	☐	☐	☐	**CLEAN UP** (no debris or damage to house or plant at site)	GENERAL
☐	☐	☐	☐	**LEVELS** (must be between 0dBmv and +10dBmv at TV input)	GENERAL
☐	☐	☐	☐	**SUBJECTIVE PICTURE QUALITY** (all pictures TASO 4 or better)	INDOOR
☐	☐	☐	☐	**CONVERTER** (properly installed and subscriber instructed on use)	INDOOR
☐	☐	☐	☐	**TRANSFORMER** (300 ohm transformer, JIC approved and properly installed)	INDOOR
☐	☐	☐	☐	**APARTMENT SECURITY BOX** (locked)	INDOOR
☐	☐	☐	☐	**RISER COVER** (properly installed)	UG
☐	☐	☐	☐	**PEDESTAL** (general condition acceptable)	UG
☐	☐	☐	☐	**PEDESTAL LOCKED** (all pedestals must be locked)	UG
☐	☐	☐	☐	**CONDUIT** (under paved area)	UG
☐	☐	☐	☐	**BURIAL** (proper depth)	UG
☐	☐	☐	☐	**OTHER** (specify) ______________	UG

PERT chart for our cable extension. Note that all the tasks listed in the Gantt chart aren't included. (There simply is not enough room.) Also, the PERT chart is a diagnostic tool rather than a listing of all tasks. It is better suited to analysis of progress than day-by-day monitoring. If the engineers select and chart several major tasks—milestones—and note the dependencies of each, as has been done in the case of our example, they can monitor progress by seeing that dependent tasks are complete.

The PERT chart is ideal for distribution to the general manager and marketing manager because it enables them to keep current on overall progress without becoming involved in operational details. Rather than asking if a number of tasks are complete, they can instead focus on key milestones. The critical path method is a diagnostic tool similar to PERT that the manager should consider. Generally, it can be used instead of the PERT approach for some projects. When the Gantt and PERT charts, if appropriate, have been prepared, a major part of the planning phase is complete.

It is attention to detail that determines the success of a project. After all, any CATV project is comprised of many tasks, small in themselves, which must each be completed well for the whole to succeed. The project manager should know as much specific detail about the project as possible. It was stated earlier that the overuse of a PC can inundate the manager in unnecessary analysis and detract from the main purpose—knowing the project. This precautionary note on PCs doesn't conflict with the basic idea that the manager should know specific details of the project. Learning the details cannot be accomplished on a personal computer. It requires the manager's observational ability and presence in the field.

Project budget

A second planning document, the project budget, is usually prepared at this point. A preliminary decision to begin the project has already been made on the basis of its financial merit or political necessity. The basic parameters of the cable extension, including miles of plant, plant cost per mile, and homes passed were probably measured some time before, and these parameters used as a basis for approval of the project.

However, at some stage before construction begins, a final, more detailed project budget may be requested. This is done for three reasons. First, it provides a final check for the feasibility of the project. Because much more data is available at this point than when initial approval was made, the cost estimate will be appreciably more accurate. Changes in data, such as the number of homes passed, will update its status. Second, the detailed budget requires an in-depth analysis of the project. The analysis procedure ensures the project manager has done planning correctly, and the project has the best chance of success. Third, the detailed budget provides a measurement document containing spending estimates to compare with the actual money spent.

Usually the project manager prepares the budget. It shouldn't be an intimidating process, because most of the work was already in the preparation of the Gantt chart. Probably the easiest method is to consider the project in its component tasks as were entered in the Gantt, and estimate labor and material costs for each action item. Simply combine the results for a total project budget.

A common error is to underestimate administrative and quality assurance costs. Be sure to include wage costs for all employees involved in the project. This can be a surprisingly large amount. Not only is the chief engineer's time dedicated to the project (at least partially), but the wages of the person preparing pole attachment applications, requesting underground utility locates (if such activities are not included in contractor's activity) and, most importantly, the wages of the person who implements a quality assurance check on the project also must be included.

Budgeting quality assurance as a separate line item is necessary. It demonstrates the manager's commitment to quality and also details the actual cost of quality. If you set a benchmark that 10 percent of all craft-related work is to be inspected to ensure overall quality, it follows that a substantial amount of money will be spent for quality. Although it's difficult to express ranges, one can reasonably assume that quality assurance wages, as contrasted with production-

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and administrative-related wages, could constitute 5 to 10 percent of total labor costs.

In the case of a cable extension, quality assurance includes a visual checking of cable construction techniques in 100 percent of the project, in taking apart a selected percentage of taps and connectors to verify proper installation and cable preparation and in measuring all other parameters that have an effect on the performance and longevity of cable plant. The depth of buried cable should be checked on a systematic basis, using an electronic cable locator that can measure depth or simply digging up the cable. The quality assurance technician should have a standard check form for the rating of each parameter. (See Figure 3 for an example of a quality assurance rating form.) The field reports can be organized into summary reports on each phase of the project and each craft-related task. Problems should be traced to individuals or contractors and replacement of the deficient plant should be required.

The quality assurance documents, along with the Gantt chart, budget and PERT chart allow the engineer to track progress.

When the labor costs of employees are totaled, usually the only labor left to include is contract labor. Most cable extensions use contractors to one degree or another. If the cable operator has an in-house construction crew, they may provide the labor for short extensions. But in nearly all cases extensions of more than a few spans are constructed with contract labor.

Makeready engineering and construction, base map drafting, base map field verification, plant design, cable placement, and activation and balancing are usually completed by contractors. Their costs are usually easy to budget, since they are unit price-based and the operator has already measured the footage of the extension. The budget preparer simply multiplies the unit prices for placement, splicing and activation by the distance of the extension. If the operator has negotiated a contract that includes hourly charges for certain activities, such as traffic control or placing cable in rocky soil, an allowance for those activities should be included in the budget.

Finally, material should be estimated. Most operators estimate construction material costs by developing a model based on an average mile of underground or aerial cable plant. The model is then adjusted according to the characteristics of the project. If the average length between poles is greater in the extension than in the model, for instance, the material cost for pole attachment hardware must be decreased.

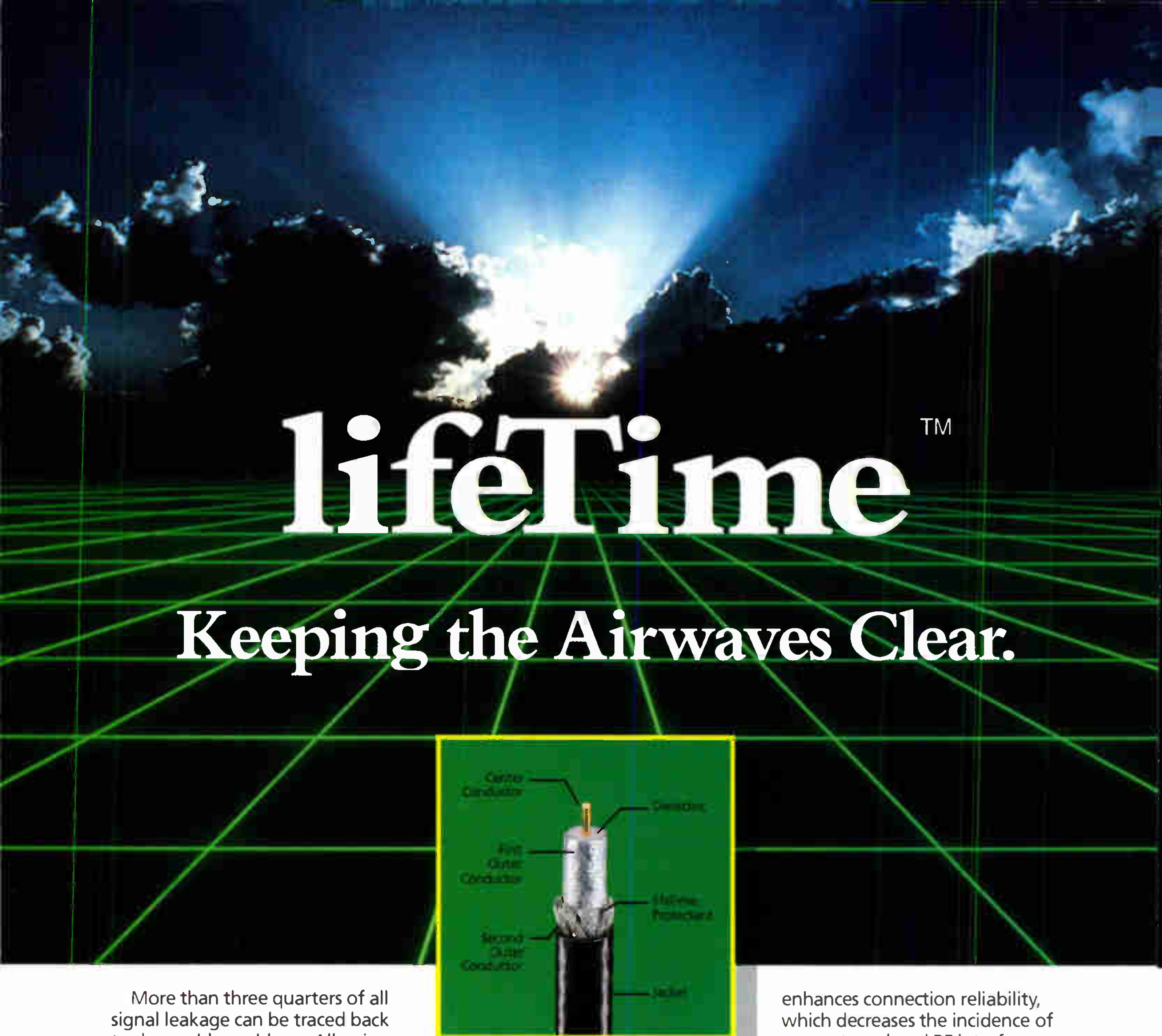
If plant design has already been complete, a bill of materials (BOM) should have been generated along with the design. This BOM forms the basis for materials budgeting and usually for order placement to equipment vendors. When the budget is complete it forms another management tool, along with the Gantt and PERT charts, for monitoring progress.

By completing the steps outlined—the preplanning meeting, the project analysis, Gantt chart, budget and quality assurance forms—the project manager is assured that there is very little about the project that he does not know or cannot measure. Throughout the duration he conducts weeky meetings with key project participants, reviewing their reports and soliciting their comments on progress. In addition, he spends a substantial amount of time in the field, exercising the cable equivalent of "management by wandering around," observing the cable crews in action and maintaining a close contact with daily progress.

Debriefing

The project should end much the same way it began—with a meeting of the principals of the cable system. This time, however, the topic is more in the nature of a debriefing. The engineer can present summary reports on the actual cost of the project compared to budget, on the production standards that were achieved, on the timeliness of completion, and on the quality of construction as measured by field inspections.

In the future the project manager will be called upon to manage new projects. He should build upon the base of his success, improving performance each time.



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More than three quarters of all signal leakage can be traced back to drop cable problems. Allowing RF energy to escape into the atmosphere not only can incur financial penalties from the FCC, but also degrades customer picture quality. New regulations concerning system radiation have been passed and will be in force by July, 1990. The CLI rules have been legislated in order to protect aircraft navigational and emergency airwave systems from disruption. Environmental interference from cable systems must be controlled.

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Fundamentals of spectrum analysis

As a continuing service to BCT/E candidates, "CT" is reprinting excerpts from various bibliographic sources that may not be readily available. This application note from Tektronix is listed in the Category I bibliography. This is the first of a four-part series.

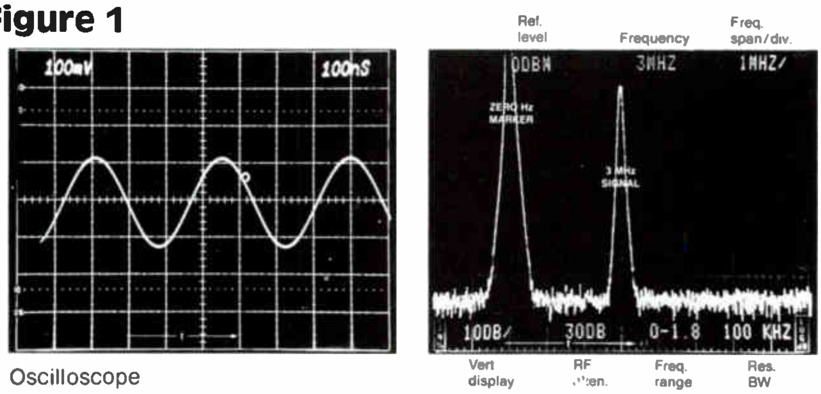
By Bill Benedict
Engineering Operations Manager
Frequency Domain Instruments, Tektronix Inc

All electrical waveforms or signals are composed of a combination of sinusoidal signals of varying amplitudes and frequencies. The combination of sine waves can be observed in the time domain with an oscilloscope or in the frequency domain with a spectrum analyzer. The oscilloscope enables observation of the amplitude and shape of an electrical signal during the measurement interval with respect to time. Likewise, a spectrum analyzer permits observation of the amplitudes and frequencies of the various discrete sinusoidal signals during the measurement interval. In both cases, the results are displayed on a cathode-ray tube (CRT) with the vertical axis being the amplitude scale and the horizontal axis being the time scale for an oscilloscope or the frequency axis for a spectrum analyzer. Figures 1, 2, and 3 show various waveforms as displayed on both an oscilloscope and a spectrum analyzer.

In the first example, a sine wave is displayed. The oscilloscope displays the peak-to-peak voltage (vertical axis) of the signal with respect to time (horizontal axis). The spectrum analyzer shows the same sine wave where the positive peak (vertical axis) indicates the amplitude of signal and the single signal (horizontal axis) indicates there is only one frequency or sine wave present. (You will note the presence of a 0 Hz marker. It is present due to system design of a spectrum analyzer and is present regardless of the input signal. All signals to the left of the 0 Hz marker are not negative frequencies as one might think; they are images or reflections of those signals to the right of the 0 Hz marker.)

The second example (Figure 2) is a modulated carrier where both the modulation frequency and carrier frequency can be determined. The spectrum analyzer indicates the carrier as the larger signal and the modulation as the two smaller signals (upper and lower sidebands).

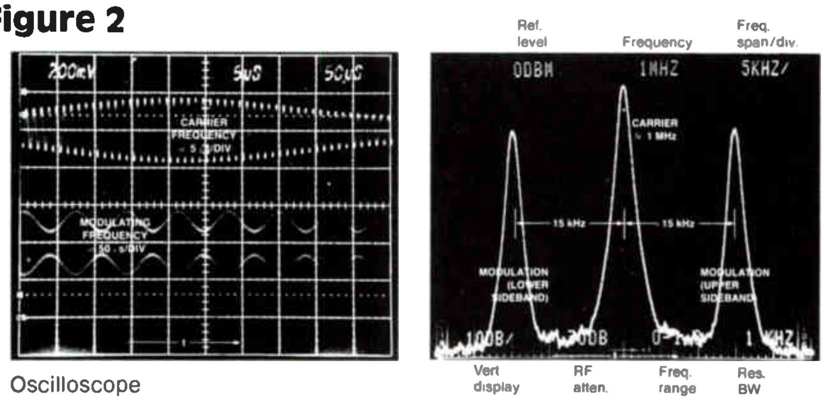
Figure 1



Oscilloscope

Spectrum analyzer

Figure 2



Oscilloscope

Spectrum analyzer

The third example (Figure 3) shows the signal appearing on the oscilloscope as a square wave. The spectrum analyzer displays a "fundamental" sine wave at the same frequency as the square wave and the other frequencies of diminishing amplitude (as the frequency increases) that make up a square wave. These other frequencies are identified as the third, fifth, seventh, etc., (odd) harmonics of the fundamental frequency.

Composite voltage waveforms are displayed by an oscilloscope. The spectrum analyzer, as the name implies, analyzes the composite waveform and displays the individual frequency components and the relative power each component contributes to the total waveform. Since the spectrum analyzer has this characteristic, it is well suited for work that involves oscillators, RF carriers, RF spectrum surveillance, etc. With an analyzer, it is possible to observe:

- an oscillator
- RF carrier
- amount and frequency of modulation
- unexpected modulation
- carrier suppression in single sideband radio
- harmonic level of oscillators and RF carriers

With a sweeping oscillator or "tracking generator," filter response, amplifier frequency response and antenna standing wave ratio (SWR) can all be checked, along with other measurements.

Primary controls: Amplitude

The spectrum analyzer has two major amplitude controls. The first controls the vertical scale factor (volts/division or dB/division) and the second determines what input signal amplitude is necessary to produce a signal display up to the top line on the CRT, called the *reference level.*

Scale factor (vertical display):

Most oscilloscope graticules are divided vertically into eight major divisions. Each major division is further divided into five minor divisions. Thus, a signal of one minor division in amplitude can be accurately measured and another signal of eight divisions in amplitude can be measured and compared to determine the larger one as being:

All electrical waveforms or signals are composed of

$$\frac{8 \text{ div } (5 \text{ minor div/div})}{1 \text{ minor division}}$$

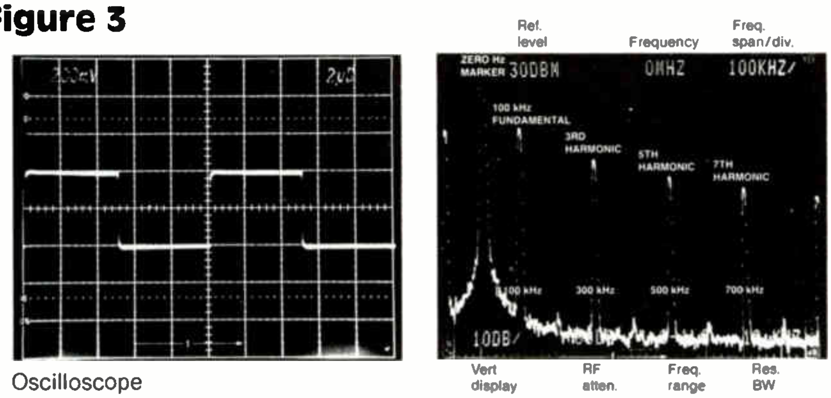
= 40 times greater than the smaller signal.

To determine this ratio in dB, use:

$$\text{dB} = 20\log \frac{V_2}{V_1}$$

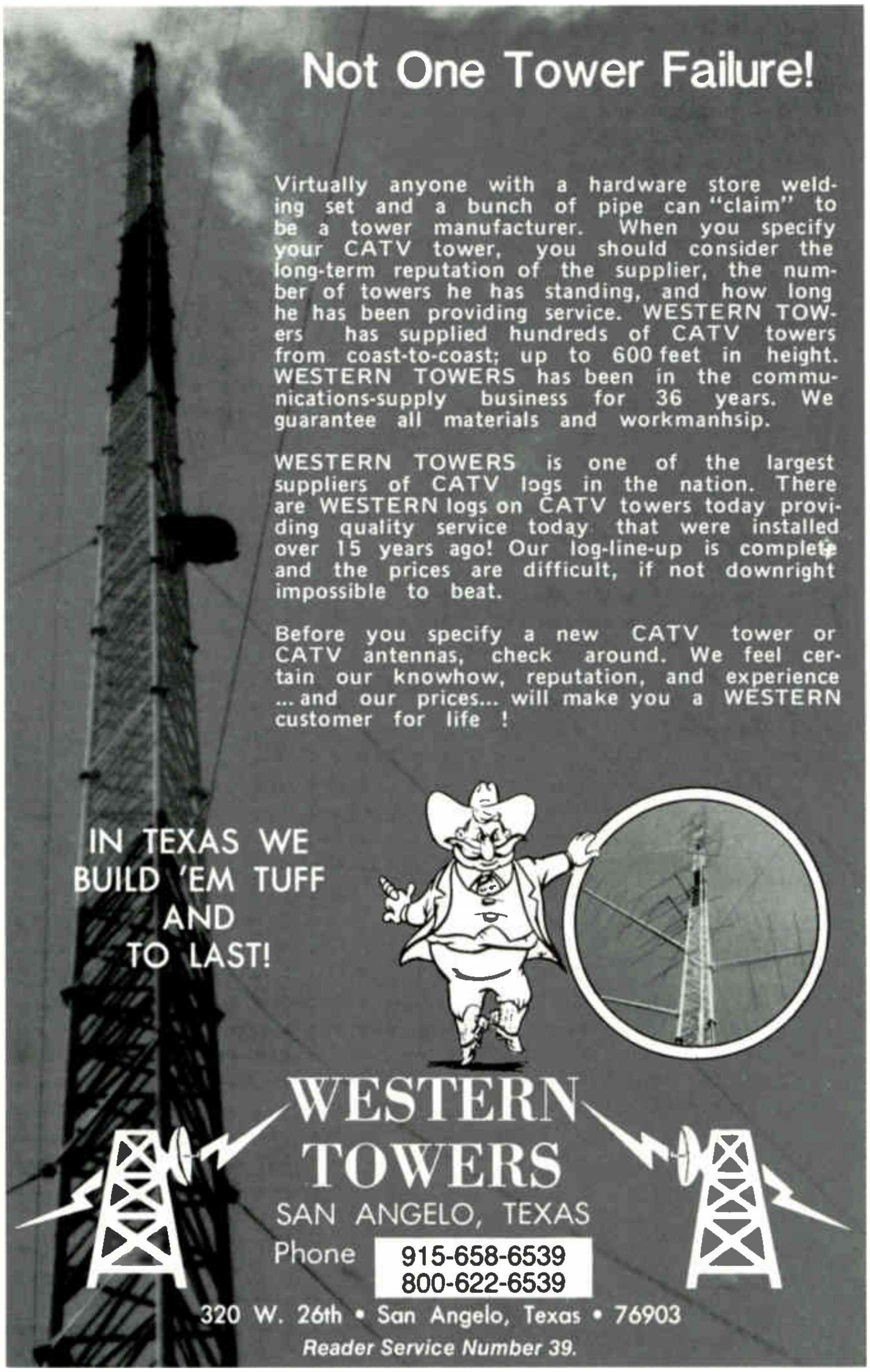
$$= 20\log \frac{40}{1} = 32 \text{ dB}.$$

Figure 3



Oscilloscope

Spectrum analyzer



Since many spectrum analyzers are capable of displaying ratios of 80 dB on screen, either a different scale factor is required or a CRT display with 2,000 major vertical divisions is required! The obvious solution is to use a logarithmic scale of 10 dB/div with the standard eight-division screen to display 80 dB of range. As an example, with 80 dB of on-screen range, two signals can be measured simultaneously; one of 1 W (+30 dBm) and the other of 0.01 +W (-50 dBm). That is a voltage ratio of 10,000:1, far greater than the 40:1 ratio possible with the oscilloscope. (Before going further, note the basic equations that can be used to convert to dB, dBm, dBV and dBmV. Once you begin to use the spectrum analyzer, you will find that most measurements will be in dB or dBm and no conversion will be necessary. It is not important that you conquer these equations before going further.)

Signal ratios are expressed in dB:

$$\text{dB} = 20\log\frac{\text{Voltage (2)}}{\text{Voltage (1)}} \text{ or}$$

$$10\log\frac{\text{Power (2)}}{\text{Power (1)}}$$

Power into a known load (50, 75 or 600 ohms, etc.) is expressed in:

$$\text{dBm} = 10\log\frac{\text{Power}^*}{1\text{ mW}}$$

*(at specified impedance)

$$\text{dBV} = 20\log\frac{\text{V (1)}^*}{1\text{ V}}$$

$$\text{dBmV} = 20\log\frac{\text{V (1)}^*}{1\text{ mV}}$$

*(volts are RMS volts)

The obvious problem with having a scale factor that allows such a large range of signals on screen simultaneously is that two signals appearing close in amplitude may in reality vary significantly in amplitude. As an example, assume there is one signal of 1 mW and another signal of 2 mW power. Using the equations, it is apparent they are:

$$10\log\frac{2\text{ mW}}{1\text{ mW}} = 10\log 2 = 3\text{ dB}$$

apart in amplitude, or 1.5 minor divisions with a scale factor of 10 dB/div. To allow accurate measurements of signals of close amplitudes, an analyzer typically has a display mode of 2 dB/div where, as in the previous example of two signals being 3 dB apart (2X), the display would indicate 1.5 major divisions of separation. A third common display mode is linear scale factor, where the RMS value of the signal is displayed with a calibration of volts/div.

Reference level:

The reference level is one of the three main controls of a spectrum analyzer. The purpose of this control is to obtain an adequate display

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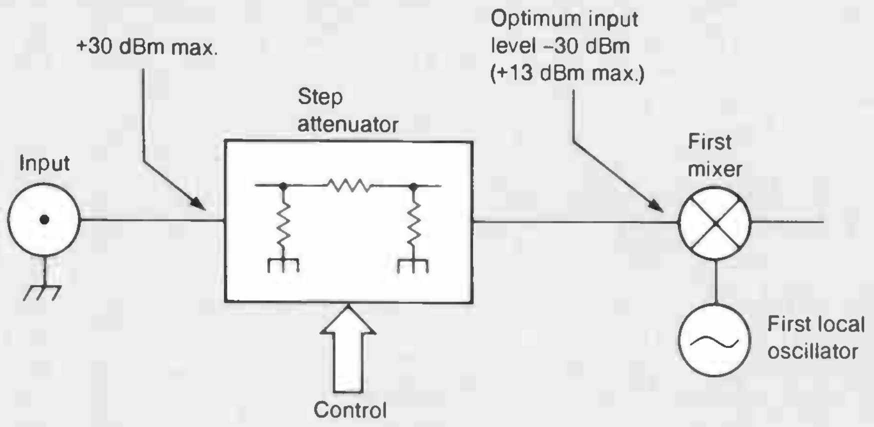
Figure 4: Spectrum analyzer input indicating point of optimum input level



of signal amplitude on screen. This control sets the level of the signal necessary to produce a full-screen deflection (i.e., the top of the screen is the reference line). Thus, if the reference level control is set for 0 dBm with a vertical display of 10 dB/div, a 0 dBm signal would rise to the top CRT graticule marking. A -20 dBm signal would be 2 divisions down from the top

0 dBm-2 div (10 dB/div) = -20 dBm

Some analyzers separate the reference level control into two individual controls. Together they represent the reference level, but separately each controls an individual section of the analyzer. The two independent sections of the analyzer are the RF attenuator control and the IF gain control. The RF attenuator control selects the amount of RF attenuation the signal experiences just after it enters the analyzer. For optimum analyzer performance, the input signal must be attenuated to a level specified by the manufacturer for the first mixer (optimum input level, see Figure 4). For example, Tektronix 490 Series spectrum analyzers have an optimum signal level for the first mixer of -30 dBm. Therefore, if the signal being measured with the analyzer is -10 dBm in level, the RF attenuator should be set for 20 dB of attenuation. The first mixer would then see: -10 dBm (input) -20 dB (attenuation) = -30 dBm (first mixer level). The IF gain control selects the proper amount of gain within an amplifier stage to keep the instrument within amplitude calibration. This control does not have any restrictions for proper operation.

Some analyzers contain a microprocessor that selects the proper ratio of RF attenuation and IF gain, depending on the reference level selected. This eases operator responsibility, because the operator is only required to keep the signal at or below the top graticule line by selecting an appropriate reference level.

All analyzers have a maximum input level that must be observed. Typically, this level is +30 dBm (1 W). It is extremely important to observe this limit, because extensive and expensive damage may occur to the input circuitry. Usually, both the RF attenuator and the first mixer have a maximum input level, and quite often they are not the same level. The RF attenuator can handle a significantly larger signal level than the first mixer without damage. Therefore, if you are unsure of the level of the input signal, select the largest RF attenuation available. Once the signal is displayed on the screen, the attenuation can be removed one step at a time to bring the largest signal to the top of the screen. Typically, if the input is less than 0 dBm, the analyzer will not be damaged regardless of how the reference level controls are set.

Reprinted with permission from "Fundamentals of Spectrum Analysis," Tektronix Application Note 26W-5360-1

Log-periodic antennas for CATV

By Steven Zahn
CATV Design Consultant

Cable TV is in part an alternative distribution system for broadcast TV. Often, CATV provides high quality and reliable transmission of off-air signals by optimizing the received electrical characteristics of specific broadcast channels. Broadcast channels are arranged into three groups: VHF low band, VHF high band and UHF band. The VHF low band consists of Channels 2 through 6 with a frequency range of 54 to 88 MHz. The high band includes Channels 7 through 13 spanning a frequency range of 174 to 216 MHz. The UHF band contains Channels 14 thru 69 occupying the frequency spectrum of 470 to 806 MHz. Propagation of TV frequencies is modeled by the equation

$$E = E_0 \left[2\sin\left(\frac{2\pi h_t + h_r}{\lambda d} \right) \right] \quad (1)$$

where:

$$E_0 = \frac{\sqrt{30 g_t \ P_t}}{r}$$

Free space field strength (volts/meter) and

r = radial distance from source of transmission (meters)
g_t = power gain of transmitting antenna referenced to an isotropic radiator
P_t = power transmitted in watts
h_t = height of transmitting antenna (meters)
h_r = height of receiving antenna (meters)
λ = wavelength (meters)
d = distance from h_t to h_r (meters)

From Equation 1, E is the resultant signal strength that can be expected at a specific receive location. The equation is idealized and does not consider other factors that influence actual field strength. In practice, statistical evaluations or propagations (TV service contours) are employed for a more accurate prediction of expected field strength at a given location.

The free space propagation equation is presented to demonstrate an important point. The signal voltage present at the output terminals of a receive antenna is the vector sum of the direct ray (r_1) and the reflected ray (r_2) as shown in Figure 1. Changes to d, h_t and h_r will result in an increase or decrease of antenna output voltage. In an effort to demonstrate the reflected signal path in Figure 1, a single reflected signal is shown, yet in reality several or more reflected signals can exist caused by surfaces other than the horizontal surface (Earth). The resulting antenna output voltage is again the vector sum of radiated energy from all signal paths. If the ratio of direct signal energy (r_1) is not sufficiently large over reflected paths ($r_2, r_3, \ldots r_n$), multipath signals or "ghosting" will appear at the antenna output.

Power levels

The dBmV is a familiar decibel voltage reference used by the CATV industry. For purposes of antenna performance evaluations it may be helpful to convert decibel voltage measurements to the decibel milliwatt power reference. The dBmV-to-microvolt relationship is given by

$$20\log\left(\frac{E_2}{E_1}\right) = \text{dBmV} \quad (2)$$

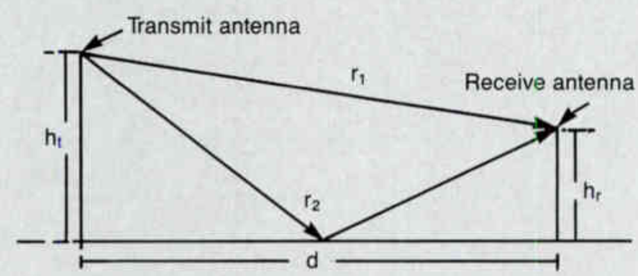
Note: $E_1 = 1{,}000 \times 10^{-6}$ volts

$$\log\left(\frac{E_2}{E_1}\right) = \text{dBmV}/20$$

$$\frac{E_2}{E_1} = 10^{\text{dBmV}/20}$$

$$E_2 = (1{,}000 \times 10^{-6} \text{ volts})(10^{\text{dBmV}/20})$$

Figure 1: Direct and reflected signals



E_2 is the measured voltage across a 75-ohm impedance. By Ohm's Law: $E_2/75 = I_2$ (current induced in the 75-ohm impedance) and $P_2 = (E_2)(I_2)$. Power P_2 is in watts. By using the relation

$$10\log\left(\frac{P_2}{P_1}\right) = \text{dBm} \quad (3)$$

Note: $P_1 = 1 \times 10^{-3}$ watts

the initial voltage measurement is converted to dBm. The importance of this is that power is independent of a system's characteristic impedance. This means that a 75-ohm antenna will provide the same output power as a 50-ohm antenna of the same design characteristics (gain, beamwidth, sidelobes, etc.). Power levels can be added directly during calculations without concern for system impedance. It should be noted that the dBmV and the dBm references differ by 48.75 dB. Simply subtracting 48.75 from a given dBmV level will yield the correct dBm value.

Dipole array

Within the CATV industry log-periodic antennas appear singly or in geometric groups (arrays) elevated for reception of broadcast TV. Log-periodic antenna structures can be configured from single-channel units to an entire frequency band coverage with minimal sidelobes and low VSWR (voltage standing wave ratio) throughout a desired bandwidth. This allows for a small number of antennas needed to receive signals from a common location. Valuable tower space is not used unnecessarily, leaving access for other communications equipment.

In design the log-periodic antenna scales (proportional changes in design size as the bandwidth is increased or decreased) in relation to a scaling constant (θ). The element lengths of a log-periodic antenna are determined from

$$\frac{1}{\theta} = \frac{L_{n+1}}{L_n} \quad (4)$$

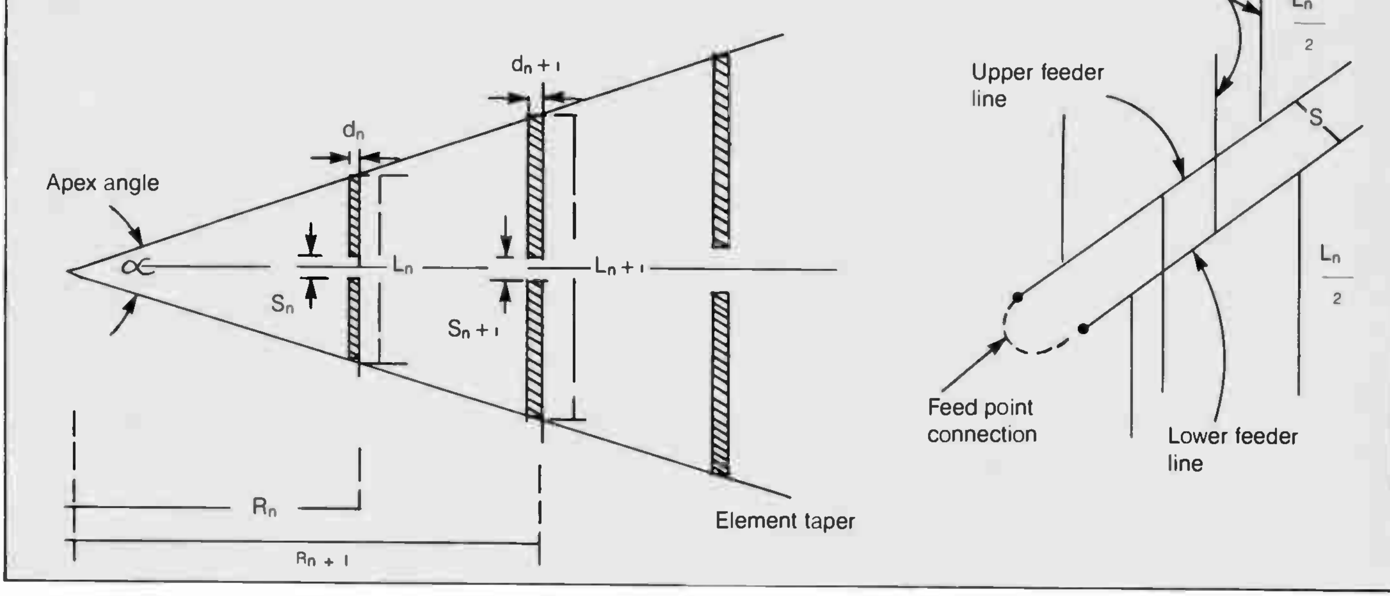
The relation implies that element lengths (L), which are related in size by frequency, are related to the scaling constant (θ) by the logarithm of the frequency. As a log-periodic antenna is viewed from a distance, it is observed that the gradually decreasing element length from rear to front conform to a uniform taper that intersects at a point beyond the feed point of the antenna. It is this point of intersection that is defined as the apex angle (α).

In Figure 2 the basic representation of a log-periodic antenna is given. Element spacing is related to θ by

$$\frac{1}{\theta} = \frac{R_{n+1}}{R_n} \quad (5)$$

which indicates that the lower frequency elements are (longer elements)

Figure 2: Log-periodic dipole array



spaced farther from one another and located toward the rear of the antenna structure.

Element diameters are determined from a similar relationship.

$$\frac{1}{\theta} = \frac{d_{n+1}}{d_n} \qquad (6)$$

From the ratio it is noted that longer elements are designed to have a larger diameter. This is done to maintain some form of continuous length-to-diameter ratio throughout the antenna structure. In some cases the manufacturer follows this method of element optimization while in other cases (length-to-diameter ratios at higher frequencies experience little change) an average element diameter is chosen for practical reasons. Changing element diameter to maintain a constant length-to-diameter ratio is important at frequencies above 30 MHz.

Log-periodic antennas require a balanced feedline at the antenna output terminals. Connection to an unbalanced feedline is accommodated through a modification to the antenna structure. A broadband balun is constructed by running the coaxial cable through the lower feeder line boom (the length of the antenna) from the antenna rear to the feedpoint end. At the feed point the shielded part of the coaxial cable is connected

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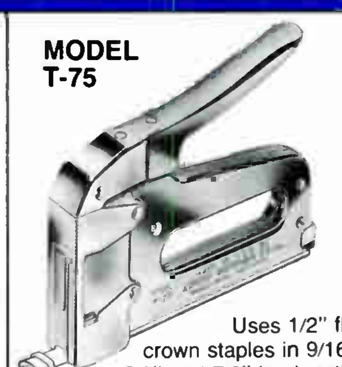

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to the lower feeder boom. The insulated center conductor is extended to a connection at the upper feeder line boom. Upper and lower feeder line booms divide the length (L). One-half of a given element length (L) is connected to the upper feeder line boom while the lower boom is connected to the remaining element half. In Figure 2, L is considered to be a single element. Yet in terms of the diagram two elements are shown, each of length L/2. In this configuration no two adjacent elements are mounted on the same feeder line boom. Spacing between the feeder lines is governed by

$$\frac{1}{\theta} = \frac{S_{n+1}}{S_n} \qquad (7)$$

Spacing between the feeder lines increases as the element length is increased. Practical log-periodic antenna design is far more complex than simply comparing ratios to a single design constant. Successful designs require the use of several design constants to relate other parameters. The electrical specifications of beamwidth, gain and bandwidth depend upon the geometric relationship to the design constant. For this reason an antenna can be designed for any bandwidth and maintain consistent response, making the log-periodic design superior in TV reception.

Practical applications

The most effective method to evaluate the performance of broadcast signal reception at a receive site is through measurement. The following example may help to demonstrate an important component to received signal levels, the carrier-to-noise ratio (C/N). A broadband 75-ohm output impedance test antenna produces 10 dBmV at Channel 5. Converting this to a dBm power reference:

$$10 \text{ dBmV} = [10 - 48.75] = -38.75 \text{ dBm}$$

In this basic example the carrier-to-noise ratio is described:

$$C/N = \text{power received } (P_r) - \text{noise input power } (N_i) \qquad (8)$$

It is now important to calculate noise input power for the video bandwidth of a single TV channel.

$$\begin{aligned} \text{Noise input } (N_i) &= kTB \qquad (9) \\ &= (1.38 \times 10^{-23} \text{ joules/Kelvin})(290K)(4 \times 10^6 \text{ Hz}) \\ &= 1.60 \times 10^{-14} \text{ watts} \\ &= 10\log(1.60 \times 10^{-14} \text{ watts}/1 \times 10^{-3} \text{ watts}) \\ &= -108 \text{ dBm} \end{aligned}$$

At the antenna output the carrier-to-noise ratio is:

$$\begin{aligned} C/N &= -38.75 \text{ dBm} - (-108 \text{ dBm}) \\ &= 69.2 \text{ dB} \end{aligned}$$

If a transmission line loss from antenna to headend is 1.5 dB and the single-channel processor has a noise figure of 10 dB then the noise figure of the receive antenna is

$$\text{Noise figure } (F_i) = 10 + 1.5 = 11.5 \text{ dB.}$$

$$\begin{aligned} \text{Receive system } C/N &= (P_r) - (F_i) - (N_i) \qquad (10) \\ &= (-38.75) - (11.5) - (-108) \\ &= 57.75 \text{ dB} \end{aligned}$$

Completing some preliminary calculations, it is important to consider signal reflections that may be visible within the television picture. Reflected signals can arrive at the antenna via horizontal and vertical paths. Moving the test antenna vertically may determine the existence of vertical reflections. If the angle of an interfering wavefront and direct (desired direction) is known, two identical antennas can be separated by a distance (d), causing a 180° phase shift to the undesired signal path. This is accomplished by the fact that an off-axis signal will encounter antenna #2 one-half wavelength before the interfering signal has intercepted antenna #1 as in Figure 3.

This ensures that the interfering signal will have opposite components at each port of the antenna combiner, resulting in cancellation at this point.

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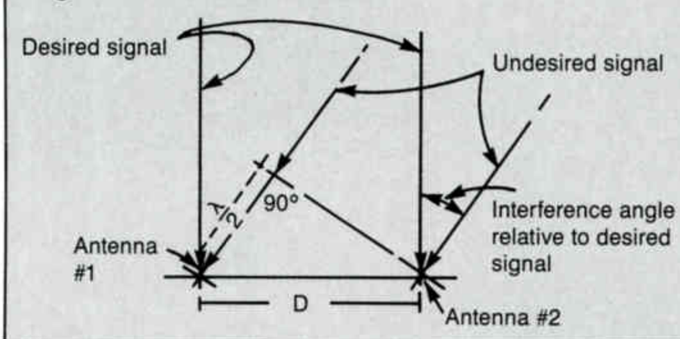
Figure 3: Antenna spacing for signal cancellation



On-axis signals induce equal voltages that appear at the input ports of the signal combiner in phase and add within the combiner. This method is effective at eliminating horizontally originating reflections when the antennas are spaced in a horizontal plane. The same effect is successful at eliminating vertically traveling signals when the antennas are separated in a vertical plane. For a known angle the required spacing distance (d) is determined from the equation:

$$d = (\text{wavelength of interfering signal})/2\sin(\text{angle}) \quad \textbf{(11)}$$

Note that the interfering signal will be the frequency of the received signal when multipath rejection is desired.

Returning to our example, it is necessary to consult antenna specifications from manufacturer's data. A single log-periodic antenna covering Chs. 4, 5 and 6 would provide adequate performance. It may be interesting to introduce a second condition to the example. Ch. 2 is transmitting from the same location as Ch. 5 and is received with slightly more signal power. A second C/N calculation could be performed for Ch. 2 and a log-periodic antenna covering Chs. 2 and 3 would be selected as the second receive antenna. Each single-channel antenna has a horizontal beamwidth of 60°. A single broadband low-band antenna could be used to receive both Chs. 2 and 5 but this would result in a horizontal beamwidth of 70° and approximately 3 dB lower C/N at the output of each channel processor due to splitting loss within the headend. Further investigation of the antenna specifications reveals another approach to the solution.

A dual-antenna array or horizontal array of log-periodic antennas covering Chs. 2 through 6 provides improved performance over single-channel antennas. Specifications indicate that this array has a beamwidth of 36°. This much narrower beamwidth will reduce the amount of reflected signal energy that would otherwise be present at the transmission line input. The antenna spacing equation can be used to determine the locations within the antenna array where off-axis signals would be cancelled.

$$d = \text{wavelength}/2\sin(\text{angle})$$
$$2\sin(\text{angle}) = \text{wavelength}/d$$
$$\sin(\text{angle}) = \text{wavelength}/2d$$
$$\text{angle} = \sin^{-1}(\text{wavelength}/2d)$$

Given d = 140″ from specifications: Ch. 2 cancellation will occur at: $\sin^{-1}(213.77/280) = 49.77°$ from feed point. Ch. 5 cancellation will occur at: $\sin^{-1}(158.89/280) = 33.09°$ from feed point.

The output impedance of each antenna is indicated to be 50 ohms. (In some cases, it may be necessary to use impedance matching devices to convert to 75 ohms.) Since the receiving power level is independent of characteristic impedance, each antenna (assuming similar electrical specifications to the test antenna) will produce an output power of −37.75 dBm and −38.75 dBm on Chs. 2 and 5, respectively. The power each antenna develops in terms of watts:

$$\text{dBm} = 10\log(P_2/P_1) \quad \textbf{(12)}$$
$$10^{\text{dBm}/10} = P_2/P_1$$
$$\text{Ch. 2: } P_2 = (1.0 \times 10^{-3})10^{-37.75/10} = 1.67 \times 10^{-7} \text{ watts}$$
$$\text{Ch. 5: } P_2 = (1.0 \times 10^{-3})10^{-38.75/10} = 1.33 \times 10^{-7} \text{ watts}$$

When combined, output powers produced by the antennas add within the antenna combiner and the following power levels prevail.

$$\text{Ch. 2: dBm} = 10\log(2)(1.67 \times 10^{-7})/1.0 \times 10^{-3} = -34.75 \text{ dBm}$$
$$\text{Ch. 5: dBm} = 10\log(2)(1.33 \times 10^{-7})/1.0 \times 10^{-3} = -35.75 \text{ dBm}$$

Receive system C/N (including splitting loss)

$$\text{Ch. 2: C/N} = (-34.75\text{ dBm}) - (1.5\text{ dB} + 10\text{ dB} + 3.0\text{ dB}) - (-108\text{ dBm}) = 58.75\text{ dB}$$
$$\text{Ch. 5: C/N} = (-35.75\text{ dBm}) - (1.5\text{ dB} + 10\text{ dB} + 3.0\text{ dB}) - (-108\text{ dBm}) = 57.75\text{ dB}$$

Benefits of array

The dual low-band log-periodic antenna array provided a higher output power level to overcome splitting loss in the headend resulting in a power gain equal to that of the single antennas. The antenna array has the added benefit of narrower beamwidth for added rejection of reflected signals over the single-channel antennas. This analysis can be expanded to evaluate the performance of four-bay antenna arrays. Separate consideration is given to the vertical portion of the array in the same way the previous horizontal performance was evaluated. The realized power output at the antenna combiner would be four times the individual contributions, or a power gain of 6 dB. This additional gain may be used to provide a signal margin during selective fading.

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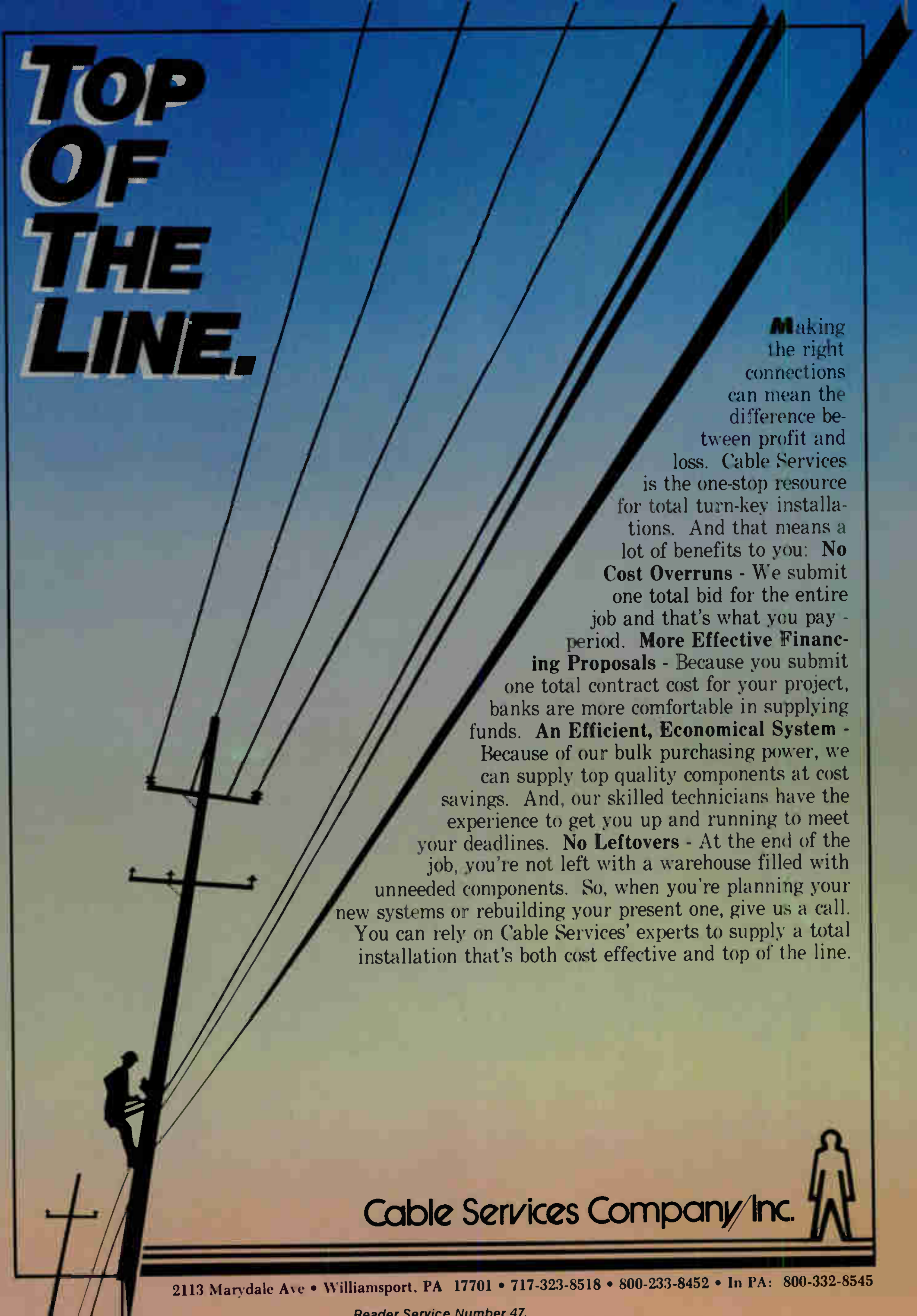


Reader Service Number 47.

State and local regulations of microwave communications

This is the second article of a two-part series. The first, which appeared in January, was concerned with federal regulations of microwave.

By John Rowe
President, Telecommunications Development Corp

The ideal means to avoid constraints caused by improper location of telecommunications land use and facilities is through preliminary planning in the field and area research. Scouting the route should be done as route engineers attempt to specify route corridors. Route engineers should have the benefit of being in the field in order to clarify what their maps say. The maps are dated and often do not include many recent developments found on the land. Someone should always be working in the field to verify conditions.

Identification of transmission corridors that meet the microwave technical and cost requirements and minimize adverse impacts on the surrounding environment should precede the site selection process. The purpose of route selection is not only to develop the most efficient transmission network but also to consider alternatives and firmly establish the need to locate proposed relay station sites in specific communities.

The identification of locations for microwave relay stations that are not only feasible and cost-efficient for the cable company but that are least intrusive on the local community is essential for gaining local permit and zoning approvals. In addition, it is essential that the process used for selecting the site be clear, understandable and defensible.

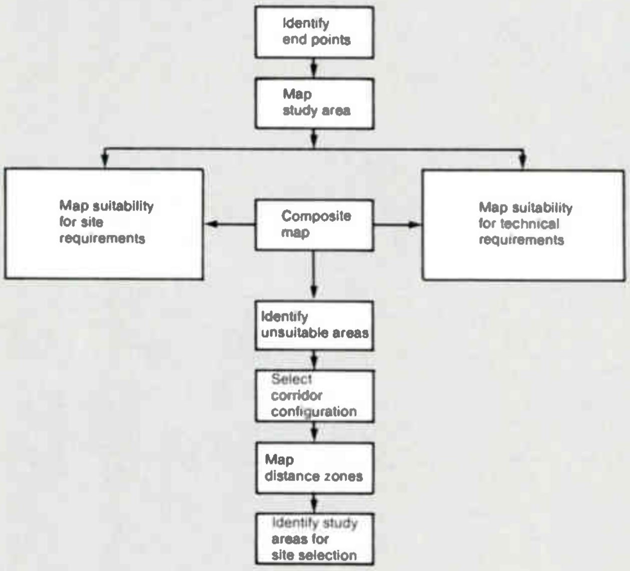
Major differences between the factors considered in route selection and site selection are the scale and level of detail. Figures 1 and 2 are flow charts representing the processes and factors in route and site selection, respectively.

Scouting the route

The primary objective of the scouting mission is to specify areas that are suited to route development. The two main investigations of scouting research are land use controls and construction feasibility. Depending upon which sites are being analyzed, office engineering may or may not be able to determine local site feasibility.

Ideally the scout is the first person to work in the field on the development of a microwave route. The route engineer and the land agent discuss the directive and, before any further action, the agent performs a scouting tour of the route. In the course of this exercise the agent researches the land use controls as they affect route development. Visits to regional planning authorities, county zoning offices and local building inspectors are necessary. In order to make efficient use of time, the agent begins with the level of authority that encompasses the most territory in question. In scouting a route one draws a straight line between the two end points and then studies all the geographic jurisdictions within 40 miles either side of the line.

Figure 1: Route selection flow chart



The most feasible jurisdictions are identified.

Of course, this is a quite rudimentary method of planning a routing corridor. The concept is advanced, however, in that there is in fact a most desirable corridor within which to develop the route. Such a routing considers all elements of technical feasibility, environmental influence and land use control.[1]

Two types of zoning information must be obtained while on the scouting mission: information on existing zoning rules and documentation that zoning does not exist. Where no zoning or building codes exist that restrict or regulate construction, a letter from the jurisdiction, signed by an authorized official, should be obtained. Ideally, the documentation is dated and states that no building permit, zoning ordinance and/or land use controls exist in the jurisdiction and, therefore, construction may proceed at the company's convenience. The letter serves as documentation that a request was made and permission granted for construction to proceed.

Three types of local law regulating commencement of telecommunications construction are building, environmental and zoning or land use codes. A zoning code divides an area into districts and specifies how land is used for each district. Each district has a general purpose, and land use within the district must be compatible with this purpose. Land use not compatible with the purpose of a district may not receive permission. A building code specifies the structural and workmanship requirements necessary to ensure safe and reliable buildings and structures in the community. There are several building codes that are accepted as standards throughout industry. Most local building codes assure quality standards for construction of local buildings. Land use codes are similar to zoning codes except that the jurisdiction is not separated into districts. Instead, each application for a building permit must be accompanied by a unique land use application approved by a local board of authorities. The land use permit system is a relatively new concept in this country. Environmental law ensures project impact is considered in the permit process.

Public hearings are generally required in situations that involve zoning, environmental and land use applications for permits. Building permit applications do not require public hearings, unless for the purpose of approving environmental analysis, zoning or land use. Where codes for land use or zoning do exist, it is necessary to research the ordinance to specify the district and classification of intended use.

Route scouting is beneficial to all concerned because it enables the cable company to locate the optimum land for its microwave route repeaters and transmission corridors. In many cases this may eliminate the need to develop one alternative only to later realize the necessity to relocate. Routes should be scouted for potential environmental impacts (specifically to historical districts, wetlands, recreational, wildlife and wilderness parks) and for zoning (or land use) regulations. The impact should be noted and fed back to route engineering as a means to identify least and more desirable routing for eventual permit acquisition purposes. Where codes do exist a copy of the regulations should be procured for research of the intended use and its classification. In the research phase, contact may be made with regional and/or county planners, who have knowledge and experience of local land use and political conditions.

In the process of determining feasibilty and suitability of sites, it is vital that the methods used are defensible; that is, to ensure all pertinent factors are incorporated and all potential alternatives have been explored in the route development program. In order to elaborate on this process, two steps are outlined: identifying transmission corridors for route selection and then specific station locations for site selection. Two types of methodology are available for combining information and aid the decision making function; these are graphic overlay and computer format.

Evaluation of environmental impact is most appropriately accomplished by experienced environmental impact consultants. Environmental planning consultants propose processes for site selection. Such suggestions should incorporate two concerns: 1) the organization and interpretation of data to accurately predict the feasibility and suitability of site locations, and 2) the acquisition of public authorization to build and operate facilities in local communities. In obtaining public authorization, the most effective way to facilitate permission and minimize opposition is to combine interests of the local community and its environment together with the microwave technical and cost guidelines in planning the route.

State jurisdiction

State laws enabling land use controls complement rather than impair federal regulations. In other words, the FCC regulates interstate microwave communications while states regulate environmental, intrastate microwave communications and land use issues.[2]

The National Environmental Protection Act of 1969 was intended for application to projects sponsored or licensed by the federal government only. States, however, were encouraged to develop their own environmental protection laws. The jurisdiction question involves the requirement of who authorizes permits or licenses. If no federal agency is required to license a given activity, the federal government has no jurisdiction to protect the environmental impact. In such a case, the environment is not protected, unless state laws exist.

While interstate microwave communications are regulated by the FCC, intrastate are not. All states have authorities that regulate public service companies excluded from federal regulation, commonly known as public utilities. Public utility facilities are constructed exclusively for public need and operate under the concept of "public interest, convenience and necessity." Some states regulate cable as a public utility; some do not.

Many states have acts that foster the development of local laws. Zoning is one area reflecting the influence of state enabling acts on local communities' increased control land use. It is not uncommon to find zoning ordinances that exempt public utilities from regulation. On the other hand, environmental law does not ordinarily exempt public utility projects from scrutiny of their environmental impact. This environmental inquiry is done by the governmental agency (under such environmental law jurisdiction) issuing licenses.

The National Historic Preservation Act is administered by state historic preservation officers. When the impact of a proposed construction affects historic resources in or eligible for the *National Register of Historic Places,* the specific impact must be defined. Certain state laws allow local historic districts to be established by individual communities. Impacts on districts or structures registered in or eligible for the *National Register* may be judged as directly or indirectly adverse. Mitigation may eliminate the impact a proposed construction has on historic landmarks.

Some states have enacted environmental conservation laws in an effort to consolidate evaluations of impacts. In New York state, for instance, the State Environmental Quality Review Act (SEQR) ensures that all agencies assume their responsibilities as stewards of the air, water, land and living resources. SEQR's purpose is to include environmental factors in the planning, review and decision-making processes of state, regional and local governments. Agencies must determine if the actions they undertake, fund or approve might significantly affect the environment. Significant effects require environmental impact statements.

Local jurisdiction

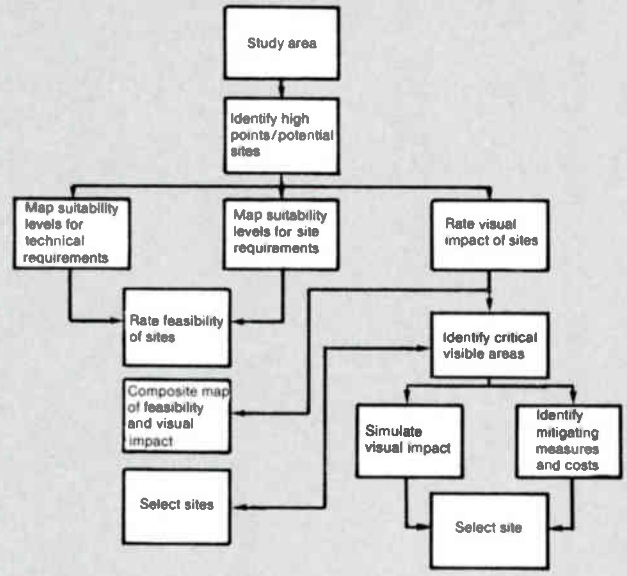
Taxation, environmental issues, aviation, commerce and historical districts affect regulation at the local level just as at the federal and state levels. The locale of a project is, of course, the region of greatest consideration in a project proposal. While a local community enjoys the service brought by the project completion it must also endure any unattractive features of the project. Local control over the use of land for development is most often exercised via zoning and/or building regulations.

Commonly, a local zoning authority receives applications for project construction. When a project proposal has to have an effect on the environment, the zoning or other local government authority may evaluate the environmental impact statement. Unless the project sponsor demonstrates effort to mitigate the environmental impact of its construction/operation, the application may be dismissed. Environmental law requires that a notice of determination be filed with other government agencies. A determination of non-significance states that no impact of significance is caused by the proposed project. The name and address of the lead agency and the name and phone number of a contact should accompany a brief description of the nature, extent, location of the action and reasons supporting the determination.

Land use will generally fall into one of several categories:

Use not mentioned: If the specific type of land use is not mentioned in the local code, it could mean several things. First, the agent did not look hard enough to find a category that applies. Second, the land use will require a variance from the regulations, meaning proof to support an application is imperative. In other words, the use was not intended for the area and is in conflict with area plans for development. Third, sometimes permits for a particular land use are granted to applicants because no governing authority claims jurisdiction. This occurs because public officials consider cable companies to be public utilities. (Microwave repeaters are most often constructed and operated by a state-regulated telephone company treated as a public utility. Public utility status is received by telephone companies under regulation of state licensing authorities.)

Figure 2: Site selection flow chart



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If the zoning or land use ordinance does not cover the proposed land use at all, then the *form* of the land use regulations will be of critical importance. If they permit the specified uses and prohibit all others, then the omission of the proposed land use means that the company must obtain some sort of amendment of the zoning or land use ordinance if it is to be able to proceed with construction lawfully. On the other hand, if the ordinance simply prohibits the uses that are specified, or prohibits those uses unless certain conditions are met, then the effect of omission is that the company may proceed without further ado so far as this zoning or land use ordinance is concerned.

Permitted use: When radio towers, microwave repeaters, transmission stations, public utility uses or anything similar are permitted in an area, little more than a building permit is required. A hearing is not usually required if the use is permitted. Sometimes a use is permitted upon site plan review. Simply, this means that the authorities reserve the right to evaluate the site plans to ensure quality engineering design.

Conditional, special or *allowed use:* These classifications require approval by the local planning commission and/or zoning board of appeals (or adjustments). Requirements vary with each code but in difficult cases notification, and sometimes approval, of all nearby landowners may be the case. Modifications of site plans may be required, making permission of these uses contingent on such modifications.

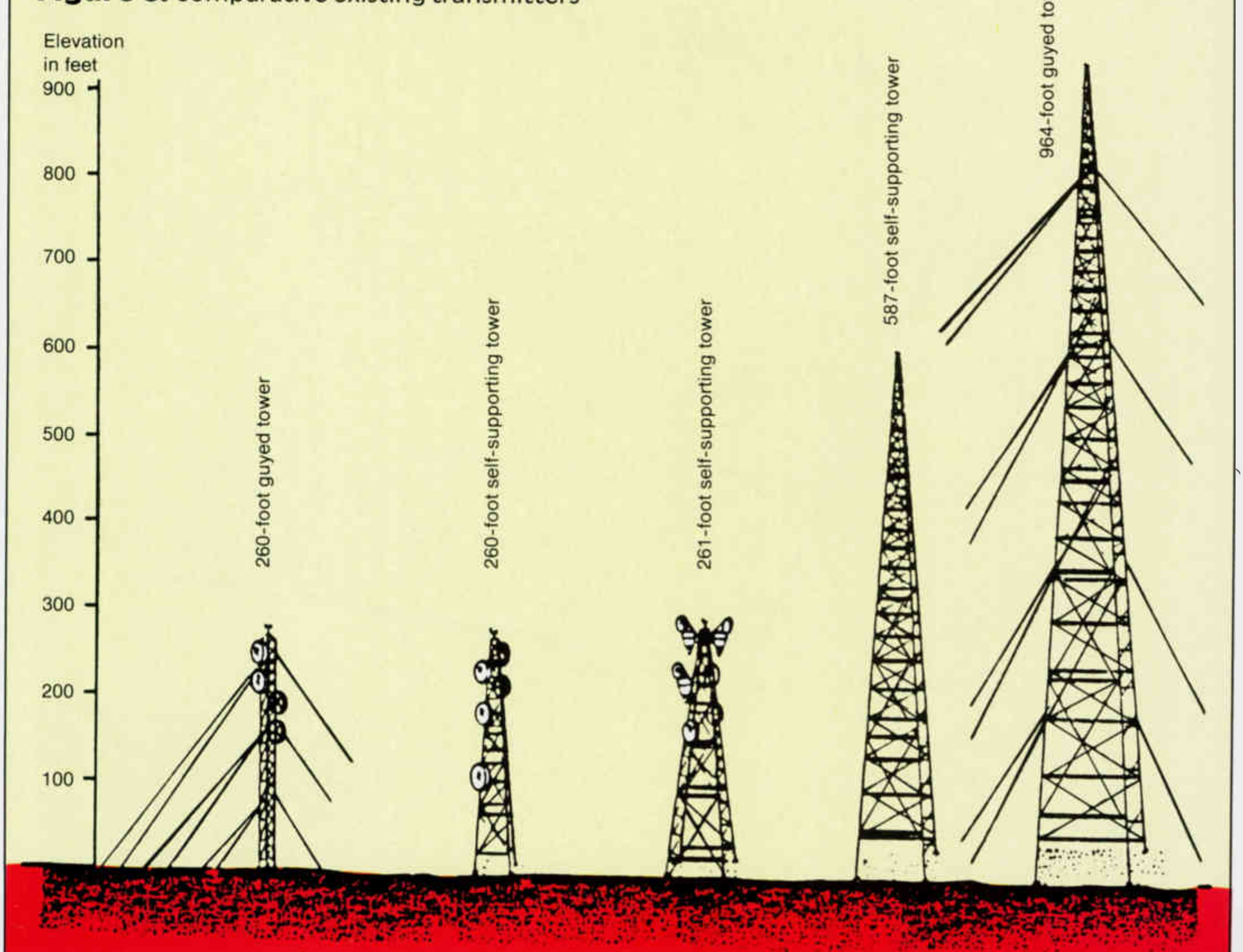
Setback requirements: Many ordinances require that minimum distances be observed between property lines and buildings constructed on the property. Requirements are most common in residential neighborhoods where all homes have the same amount of front lawn. Setback requirements at tower sites are specifically related to tower height. Many codes will require that towers be set back from all property lines, a distance at least equal to the height of the tower. The usual premise for this regulation is that should the tower fall, there would be enough land so no harm is done to persons or property. Other land uses are prohibited within the setback area.

Height limitations: Most land uses contemplated in local ordinances are building-related, causing the height limits to be reflected in the anticipated number of stories that the planners feel are acceptable. A height limit of 35 feet, therefore, may be represented by a two-story house with an attic. Often the height limit will be 35 or 50 feet above ground and a variance is required to construct a taller structure.

Some ordinances make exception for certain kinds of structures. Some exceptions to height limitations have included church steeples, grain elevators, transmission towers and belfries. Figure 3 depicts 260-foot guyed and free standing towers compared to typical broadcasting towers. It is not uncommon for broadcasting towers to be over 1,000 feet.

Subdivision requirements: Many times, subdivision requirements are enacted to ensure that community development occurs according to a plan. Commonly, the subdivision code requires that parcels be sold in sizes above a set minimum, such as one acre or five acres. If the parcel involved is for sale, and it does not meet subdivision regulations, the county authorities will not allow the deed to officially transfer.

Figure 3: Comparative existing transmitters



Zoning districts

Usually, country sites fall into agricultural zoning districts. Other kinds of districts (industrial, manufacturing, commercial and residential) are referred to as town districts. The advantage of a microwave facility being placed in town districts is twofold. First, the use is most often permitted with the least zoning restrictions in these districts. Second, site construction and access costs are usually least due to proximity to local services and paved roads.

There are several disadvantages of location in town zoning districts. First, the zones are limited in geography affecting site location, flexibility and moves necessary to make the site compatible with adjacent stations. Second, frequency coordination is difficult due to the existing presence of microwave traffic in the town. Third, property values of these districts are high. Fourth, while permitting public utility use, the intentions may not really be for construction of a 200- to 300-foot tower in these districts. Fifth, the population is dense, thus creating an opportunity for greater public opposition. Sixth, elevations are not often compatible with path engineering requirements. Generally, the agricultural site is accepted if zoning conditions are the same for agricultural and town districts because of seclusion and the geography.

Zoning conditions vary according to region; the most stringent states on approvals are in or adjacent to New England, Florida, the rest of the East Coast and the Pacific Coast. Equally difficult are permit approvals in larger cities and their fringe areas. Fringe areas are often inhabited by individuals who have moved away from the city limits to enjoy a rural, non-citified environment. Applications in these areas sometimes threaten citizens with a "bringing of the city to the country." Permits granted on a conditional use basis frequently require amendments for site modification and, possibly, another hearing by the local board.

The building permit is the final license required before actual construction begins. Building codes have been established to ensure that safe building and structural design is used in the planning and implementation of a project. Usually a building inspector ensures a project is built according to approved specification and recognized safety standards. Local officials may be interested in the possibility for mishap.[3] Microwave towers are obliged to comply to Electronic Industries Association (EIA) standards for structural construction.[4]

Although it may appear as though no other permits are required, be certain. Some states require notification of new construction and anticipated energy consumption. Some states have state building ordinances in addition to local codes. Usually, the local building permit is not issued until other requirements are fulfilled.

If a site requires plumbing, a septic system, a well, a driveway entrance to a county or state highway, or an electrical permit, be sure these are obtained. Nothing is more embarrassing than for a project to be halted due to lack of sufficient permits. The burden of inquiry is on the developer.

Finally, building and other permits may only be valid for limited periods. If the construction is not completed within this period, the permit expires and becomes invalid unless renewed periodically. ■

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Vehicle and equipment maintenance

By Arnold Cisneros
Construction Manager, Heritage Cablevision

As a cable technician or construction supervisor, have any of these incidents ever happened to you: A wheel comes off the trailer you are pulling and passes you on the road? A boom on the bucket truck suddenly drops four or five feet because the hydraulic fluid is low? The boom suddenly goes up while you are driving because of faulty, unchecked electrical wiring? Or you get in a truck at midnight to go to an emergency and find the headlights don't work?

The cliche "an ounce of prevention is worth a pound of cure" is very true and applies to every phase of the cable TV industry, whether it be headends, towers, vehicles or equipment. If every technician would take one hour a week or one day a month to perform preventive maintenance on all equipment in the vehicle, the company's savings would be sizable. Management prefers an employee who plans ahead to one who copes with problems and doesn't do anything to prevent them.

Vehicle maintenance

There are two ways of setting up a scheduled maintenance program for vehicles: 1) The driver is responsible for the vehicle and should see that everything is checked on a scheduled basis. Also, mileage is monitored by the driver. 2) Everybody turns in gas tickets with the mileage noted, and someone is responsible for setting up regular maintenance visits to the shop.

Frequent oil changes are one sure way to extend the life of the engine as well as improve performance of the vehicle. Checking transmission fluid and axle grease also should be part of your program. After driving a vehicle in deep water, have the front wheel bearings checked, since water deteriorates the grease around these bearings, causing costly damage as well as danger for the driver. Brakes should be checked periodically and changed when they make the high-pitched squeaking of metal rubbing against metal (the drums on the wheel or rotor may be severely damaged). Some brakes have wear sensors that make the same sound.

Safe driving habits are also necessary to make a truck last a long time. For example, riding the clutch will result in quick wear on the clutch plate. Also, make sure all the lights are working. Always check the hydraulic oil level in bucket trucks and the hydraulic hoses for wear and cracking or leaky fittings or connections. When driving a bucket truck examine marker lights, as they are easily knocked by low-hanging tree branches.

A little "walk-around" maintenance will save you big bucks. Look at the tires, check the oil dipstick, the lights, marker lights and the belts.

Equipment maintenance

The jobs performed by a construction crew are so diverse that there are many different types of equipment in use, from trailers and trenchers and everything in between. Let's start with trailers; they carry everything from trash and heavy equipment to wrecked-out cable. Three important items to check on trailers are the lights (very important in traffic), the tires and the wheel bearings. With bad bearings or worn tires, expensive accidents often occur. The hitch and safety chains need to be checked often as well. Techs often back up, forcing the trailer into a very sharp turn that might damage the hitch.

Most new subdivisions keep all utilities underground, so trenchers play a large role in new construction in these areas. Make sure the oil level in the trencher is checked before each use, and that it is tuned up periodically. The digging chain must be tightened to the right tolerance and all the belts should be confirmed in working order.

The trencher has several grease fittings, so make sure after every job is completed that it is greased. The operator of the trencher should do that when it is stored in the yard. Often dirt will get caked underneath the boom; if it gets packed in tight enough, it will eventually break the hydraulic piston that drives the boom up and down. If the trencher will be sitting in the yard for a few weeks, wash it to remove all the excessive dirt and grease.

Chainsaws are used to clear the way for the strand to go through on top of trees or to top poles; clean the saws after every day of use. Additionally, most chainsaws need a mixture of gas and oil to run, so having the right mix is critical to the life of the saw. It's also important to keep the chain sharpened.

Equipment today is getting better and better. The new power or gas drills make it handy for linemen to frame poles in easements where there is no access for the bucket trucks, making these drills worth the money. Convenience and speed are the top advantages of gas-powered drills, but they need maintenance. Keep them clean and greased, and you will extend the life of these drills.

Cable construction equipment also includes the gas-powered anchor drivers. These run on a two-cycle engine that needs the same type of maintenance. Also, like the gas-powered saws and drills, the anchor drivers have a very high-frequency vibration that can loosen parts. If you have a gas-powered tamper, it needs to be checked every three months and greased after every use. The bouncing and thumping on the ground tends to loosen some screws or bolts, so check these for tightness as well.

Another important piece of equipment is the lasher. After every other project that you use a lasher, make sure all screws are tight, that it is lubricated and the front rollers aren't worn. By keeping the lasher properly lubricated, you will not only extend its life, but you'll make the job easier and less strenuous for the person on the pole using it.

In-house construction involves other tools that need maintenance, including simple tools like shovels. Keeping shovels sharp and free of rust makes the job easier. Hand saws and tree pruners need to be sharp and kept out of the weather to prevent rusting. Climbers should be properly sharpened and leather straps conditioned to extend their life and make them safe for the tech using them.

Meters

An accurate meter is definitely needed for setting levels on a trunk run or line extension. It is easy for a meter to become inaccurate. To prevent this, have it calibrated weekly, and keep it charged. SLMs are delicate electronic instruments and should be treated as such.

Carry meters in the front seat of your truck, as opposed to throwing them in the back of the pickup. Bouncing around in the back of the truck can affect calibration and may cause internal damage.

Business Directory

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Reader Service Number 87.

Planning cable installations for MDUs

By Jerry Trautwein
Consultant

When it gets right down to planning a new-build or rebuild in a system, it seems the pulse goes weak and budgets dry up. For the most part we often avoid the dreaded multiple dwelling units (MDUs), the forgotten stepchild of CATV. MDUs should be the backbone of a build, but to date they have taken a back seat to residential areas with single-family dwellings.

Contrary to popular belief, an MDU is more cost-effective to wire, service and install per passing than single-family residences. Many systems start MDU builds at four units and over. It's a good start, but not good enough. It should be for two units and over, with design considerations allowing for a small lockbox (LB) to service both units. This allows the person in charge of rights of entry to obtain a five- to 15-year contract for rights to install cable on the owner's property.

When preparing to purchase equipment for the MDU, don't look for the best buys but the best products for the life of the system. You may have a good relationship with your cable vendors, but put them to work for you. For instance, when they want you to buy plastic molding, ask them for the UV rating on the product. If they can't show you warranties that will last for the life of the system, you need not bother to purchase.

Serious damage can result from unstable plastic molding attached to the exterior of MDUs. For example, I have seen molding warp and crack off at the anchors and fall off high rises, creating hazards for unsuspecting victims. I highly recommend metal molding since it facilitates re-entry or rebuilds and apartments not accessible during postwiring of the building.

The neighborhood or location of the building also determines what kind of lockbox you elect to buy. Most boxes are within the same price range. Design concepts also are similar, such as the "sliding lid" box for low security and the "box within a box" with added features such as locking mechanisms, tap racks and splitter panels for high security. Look for a manufacturer who will design a box to fit your particular needs, such as a full tap vs. a tap in a pedestal with active drops to a splitter configuration. Place the box eight feet from the ground (step-ladder height) on an exterior build. Keeping it out of reach will substantially reduce your problems.

Anchors away

The surface you are working with will determine the type of anchoring to use, relating to the design for placement of equipment. When working with a brick or concrete surface, use a two-inch sleeve anchor with a fender washer, not less than ¼ inch in diameter. Try to avoid lead shields with lag bolts; they just don't last over time like the sleeve anchor.

When on a wood surface, lags work well but 3/16-inch toggles have a greater holding ability and will work well with stucco. These take a little more effort to install, unless you can find a stud. In this case, you can use half lag and half toggle.

For the moldings in stucco, use plastic shields and #8 to #10 hex-head sheetmetal screws. One-hit plastic anchors can be used in brick and concrete but tend to shatter delicate stucco upon installation.

For wall plates use hollow wall anchors. However, if you are really pinching pennies, the plastic shield and a #6 straight slot flat-head sheetmetal screw is adequate. Be cautious about using cheap plastic anchors.

If design calls for the roof to be used, don't avoid this option as many do. Prior to walking all over the roof, call a qualified roofing company to do an inspection. For $50 to $75, the company will provide a written report with advice on whether or not to proceed, limiting your risk. It can mark the roof in all the places you shouldn't walk or install materials.

"Contrary to popular belief, an MDU is more cost-effective to wire, service and installer per passing than single-family residences."

Installing a cable system on the roof is not uncommon and has many advantages, such as hiding drops, PVC and molding from the tenants. By using good quality PVC LBs with removable covers, PVC junction boxes with male adaptors and lock rings to make a sealed system, re-entry will be possible. Your PVC should be a minimum of Schedule 40 and placed on wooden blocks or metals stands, allowing it to stay in one place on the roof. It may be advisable to paint the PVC for UV protection.

Finally, always design the system for 100 percent hookup. Make sure all the units are accessed and wall plated; otherwise, the system is left vulnerable to the "creative" installer who always has a lot of "good ideas" on how to complete the job.

JUST HOW GOOD IS THE MODULATOR YOU ARE USING?

If the manufacturer of the modulator you are now using says that
...there is an additional charge for Hyperband operation and that
...to guarantee meeting FCC21006 you will need a comb generator,
...but if he will only guarantee his work for one year, then you should consider the following:

• The ISS Engineering **GL2610XT Series II** operates on ALL channels from 2 through WW *without costly options*. Inexpensive options are available for 4.5 audio, T Channel operation and remote RS-232 Control.

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−25
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+25
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Society of Cable Television Engineers

Registration Package for

CABLE-TEC EXPO '88

San Francisco Hilton and Towers
San Francisco, California

June 16-19

DATES: Annual Engineering Conference, June 16, 1988
Cable-Tec Expo, June 17-19, 1988

LOCATION: San Francisco Hilton and Towers, San Francisco, California

HISTORY: Cable-Tec Expo '88 is the sixth annual convention/trade show sponsored by the Society of Cable Television Engineers, Inc., combining a wide variety of technical programs, hands-on training and breakout technical workshops with instructional hardware exhibits. The Annual Engineering Conference will be SCTE's 12th yearly conference dedicated to current engineering issues, FCC compliance and technical management. In addition, the Society has presented more than 60 national technical programs in cities across the United States over the past 18 years, attended by more than 13,000 engineering and technical personnel from the broadband communications industries.

ATTENDANCE: Attendance is open to individuals within the CATV industry as well as anyone involved in broadband communications. Over 1,300 registered attendees are expected from all levels of the cable television and related businesses, including all levels of non-technical personnel.

PROGRAM: The Annual Engineering Conference will be packed with six hours of technical and management papers presented by many of the industry's CEOs and engineering leaders. The annual membership meeting, held during the conference luncheon, will afford attendees the opportunity to meet members of SCTE's Board of Directors. Awards to be presented at the luncheon include "Member of the Year" and the "President's Award."

The 2½-day Cable-Tec Expo follows the Annual Engineering Conference and combines practical workshops with "hands-on" technical training and hardware displays. The program features many schoolroom-style workshops to choose from. No other activities are scheduled during workshop sessions to guarantee maximum attendance and participation.

As with all SCTE activities, the main purpose of Cable-Tec Expo '88 is to provide the maximum amount of training opportunities for the lowest possible cost. The event has been coordinated to fulfill this purpose, as it offers a wide variety of informative, up-to-date technical training programs. Additionally, Expo '88 will give attendees the opportunity to prepare for and participate in the Society's Broadband Communications Technician/Engineer (BCT/E) Certification Program, gaining valuable knowledge and practical skills in the process.

EXHIBITS: The exhibit floor has been designed to provide industry suppliers with the opportunity to present live technical demonstrations of products in a relaxed and non-commercial atmosphere.

Over 85 hardware exhibitors have reserved space on the already sold-out Expo '88 exhibit floor. Exhibits will include all types of products, supplies, services and equipment used in the design, construction, installation, repair, maintenance and operation of cable television systems. The exhibit floor will also feature a Technical Training Center for further equipment demonstrations.

SPECIAL EVENTS: The California Cable Television Association, SCTE's Golden Gate Chapter and area suppliers will sponsor a Welcome Reception on June 16. The Expo's main social event, the Expo Evening, will be held Friday night, June 17. Dress for this exciting and entertaining evening is casual. Scheduled for Sunday, June 19, is the administration of Broadband Communication Technician and Engineer (BCT/E) Certification Program examinations. In addition, tours of Catel and Raychem manufacturing facilities, Mt. Sutro Tower and KBHK-TV studio facilities will be available to Expo attendees.

Preliminary Program
Engineering Conference

- **High Definition Television Technology**
  Looking Between The Lines—A Golden Opportunity for Cable?
- **The Future of the CATV Business**
  Forecasts by Industry CEOs—They See the Future—Are You In It?
- **Fiber Optics—Here and Now**
  How This Technology Can Work for You
- **Frontline: Senior Cable Engineers**
  Fiery Discussions of Hot Technical Topics
- **PLUS: Guest Luncheon Speaker**

Expo Workshops

- **Rebuilds and Upgrades**—How To Analyze Your Existing Plant
- **Signal Leakage and CLI Testing**—Take a Leak Before It Takes You
- **FCC Compliance**—A Timely Discussion with the Federal Communications Commission's Cable Engineering Staff
- **Spectrum Analysis**—Learn from Hewlett Packard and Tektronix Field Engineering Staffs
- **BTSC Stereo**—Is Here To Stay. Learn Equipment Testing Alignment from Broadcast and Cable Engineers
- **Installer Certification**—Program Overview and Review Course for SCTE's New Level of Industry Certification
- **BCT/E Certification Category III Review Course**—Transportation Systems (AML, FML, Fiber Optics, Supertrunking)
- **BCTE/Certification Category V Review Course**—Data Networking and Architecture (System Design Implementation and Transmission Basics)
- **BCT/E Certification Category VI Review Course**—Terminal Devices (Installation Practices, Set-Top Units, Addressable Systems, Testing)

PLUS: Demonstrations of HDTV Systems, Product-Specific Equipment Usage Classes, "Hands-On" Splicing of Fiber-Optic Cables

Schedule of Events

Wednesday, June 15, 1988

5 p.m.-8 p.m.	Annual Engineering Conference Registration

Thursday, June 16, 1988

7:30 a.m.-8:30 a.m.	Conference Registration
8:30 a.m.-4:30 p.m.	Engineering Conference and Annual Membership Meeting
4-6 p.m.	Cable-Tec Expo Registration
6-8 p.m.	Welcome Reception (sponsored by the California Cable Television Association, the SCTE Golden Gate Chapter and area suppliers)

Friday, June 17, 1988

8 a.m.-4 p.m.	Expo Registration
8:30 a.m.-Noon	Hands-On Workshops
Noon- 5 p.m.	Exhibit Hall Open
7-10:30 p.m.	Expo Evening

Saturday, June 18, 1988

8:30 a.m.-Noon	Hands-On Workshops
Noon-5 p.m.	Exhibit Hall Open
4-5 p.m.	Exhibitors' Reception
7-10 p.m.	Jerrold Night

Sunday, June 19, 1988

8:30 a.m.-Noon	BCT/E Certification Program Examinations
9-11 a.m.	Chapter Development Meeting
9 a.m.-5 p.m.	Tours of Catel and Raychem manufacturing facilities, Mt. Sutro Tower and KBHK-TV studio (see registration form)

Tour Information

Catel/Raychem Manufacturing Plant Tour

You'll get both sides of the picture when you take this scenic tour, which will take you to two industry manufacturing plants. Catel is located on San Francisco's East Bay side, while Raychem is situated on the West Bay side. You will go on an in-depth tour of the Catel facility, to see a wide variety of cable television-oriented equipment manufactured, including fiber-optic receivers and laser transmitters. You will also visit the Raychem facility's R&D and Applications Engineering Labs involved with the production of cable connectors and heat shrinkable plastic wrap. Only two groups will be taken on this tour, which will pass by many of the area's points of interest as you travel from one plant to another, so sign up now!

Mt. Sutro Tour

An exciting tour of the transmitter building at the base of the 977-foot Mt. Sutro tower, which houses broadcast equipment for eight TV stations and several radio stations, plus Viacom Cablevision's San Francisco Headend.

KBHK-TV Studio Tour

Take a behind-the-scenes tour of San Francisco's Channel 44 TV station and visit control rooms and studio facilities during this unique opportunity.

IMPORTANT: Attendees **must preregister** for all tours using the accompanying registration form. Space is limited and will be reserved on a first come-first serve basis. **Maximum two (2) people per registered Expo attendee on all tours.**

Cable-Tec Expo 1988 Registration Fees
(Unchanged from 1986)

	Until May 13, 1988		On-Site	
	Member	Non-Member	Member	Non-Member
Engineering Conference and Expo*	$195	$350	$235	$390
Expo only**	$145	$250	$185	$290
Engineering Conference Only	$120	$200	$160	$240
Spouse Registration*	$ 95	$ 95	$ 95	$ 95

ADMISSIONS: Admissions to all events will be through color coded badges received at the registration desk upon arrival.

* Includes tickets to the Membership Luncheon and Expo Evening. Additional luncheon tickets are available at $20 each.

** Includes 1 ticket for the Expo Evening. Additional tickets are available at $40 each.

Lunch service will be available at special prices Friday and Saturday on the exhibit floor for your convenience.

TRANSPORTATION: SCTE has designated United Airlines and Delta Airlines as the Expo's official air carriers. Supersaver and discounted coach air fares have been arranged and Hertz Rent-A-Car is offering special rates to attendees. Transportation from the San Francisco International Airport to the hotel can be economically gained through "Super Shuttle" (located on the upper level near the ticket counters) for approximately $8.

PLEASE NOTE: Although you may be able to locate comparably priced air fares through your local travel agency, SCTE receives credit for all flights booked through Caravelle Travel by calling (800) 222-6664. Using the official 1988 Cable-Tec Expo travel agency will help us by cutting our costs in flying out engineers from the FCC and instructors for Expo workshops.

LODGING: The San Francisco Hilton and Towers has reserved 750 sleeping rooms for the Expo and is offering special attendee room rates:

Single/Double/Twin	Daily Room Rate	% of Total Rooms Available
Standard	$72	50
Superior	$82	30
Deluxe	$92	20

Double rooms can be shared by two for the unbeatable rate of **$36** per night per person. Please make reservations directly through the San Francisco Hilton and Towers. Use the enclosed reservation card for your convenience. Hotel reservations must be made by May 13, 1988.

ENTERTAINMENT: The hotel lobby features brochures covering area dining, nightlife and sightseeing activities. Grey Line Tours has a reservation desk in the lobby for sightseeing and spouse tours—(415) 896-1515. The discounted hotel rates are in effect for Expo attendees wishing to tour the city for three days before or after the conference.

EVENT SPONSOR: Society of Cable Television Engineers, 669 Exton Commons, Exton, PA 19341, (215) 363-6888.

Instructions

1. **DEADLINE:** Cable-Tec Expo '88 Registration Forms must be received by SCTE National Headquarters on or before ***May 13, 1988***. Forms received after that date cannot be processed and will be returned to the sender. If you do not preregister for the Cable-Tec Expo in advance, you must register on-site at the San Francisco Hilton.
   - Use a separate form for each individual (forms may be copies)
   - Appropriate registration and activity fees ***must be enclosed*** for this form to be processed.
   - Hotel reservations must be sent directly to the San Francisco Hilton and Towers and must be received by ***May 13, 1988***.

2. **REGISTRATION CANCELLATIONS:** All cancellations must be received in writing by SCTE National Headquarters on or before ***May 13, 1988***. Substitutions will be accepted until ***June 10, 1988***. A $50 cancellation charge is applicable to all registrations cancelled after May 13, 1988. **No Refunds Will Be Granted After May 31, 1988.**

3. **TELEPHONE REQUESTS** for cancellations and substitutions will not be accepted. All requests for cancellations must be submitted in writing and received before ***May 31, 1988*** and all requests for substitutions must be received before ***June 10, 1988***.

4. Return the Cable-Tec Expo 1988 Registration Form with the appropriate fees to: SCTE, 669 Exton Commons, Exton, PA 19341.

5. Please make flight reservations through Caravelle Travel at 1-800-222-6664 (In Illinois and Canada 1-312-860-8325). Rental car reservations may be made through Hertz at 1-800-654-2240.

6. All correspondence concerning hotel reservations should be made directly with the San Francisco Hilton and Towers at (415) 771-1400.

Membership Application

MAIL TO:
SCTE
669 Exton Commons
Exton, PA 19341

Check one:

________ I hereby apply for membership in the Society of Cable Television Engineers, Inc., and agree to abide by its bylaws. Additional member material will be mailed to me within 45 days. Payment in U.S. funds is enclosed. I understand dues are billed annually.

________ Please send me further information on the Society of Cable Television Engineers, Inc.

SCTE is a 501(c) (6) non-profit professional membership organization. ***Your dues may be tax deductible***. Consult your local IRS office or your tax advisor.

*/** Applications without payment will be returned. Applications from outside U.S./Canada/Mexico, enclose additional $20 (U.S. funds) to cover mailing expenses.

Make check payable to SCTE.

Please print or type information. Data will be used exactly as it is submitted here.

Name: ________________________
First Initial Last

Employer: ____________ Phone: ____________
Company name Area code & number

Company Address: ________________________
Street/PO City State ZIP

Use Home Address? ________________________
Street/PO City State ZIP

Your Signature: ____________ Date: ____________

Complete the information. Enclose full payment or charge to MasterCard/VISA shown below:

Name on Card: ____________ Exp. ____________

MasterCard No.: ____________ IB No. ____________

VISA No. ________________________

Signature for Charge Authority: ________________________

Applying for: ☐ Individual @ $40* ☐ Sustaining @ $250**

Tour Registration

The following tours are available on Sunday, June 19 at no extra cost to Expo attendees. Tour registration is on a first-come first-served basis and **attendees must preregister** for all tours using the form below (maximum two people per registered Expo attendee on all tours).

Reminder: BCT/E Certification Examinations will be offered on Sunday, June 19 from 8:30 a.m. to 12 noon. If you plan to attend this testing session, be sure to avoid scheduling conflicts when preregistering for tours.

Catel/Raychem Manufacturing Plant Tour

No. ________ reservations for 9 a.m. - 1 p.m. tour
No. ________ reservations for 1:30-5:30 p.m. tour

Mt. Sutro Tour

No. ________ reservations for 9:30 - 11 a.m. tour
No. ________ reservations for 11:30 a.m. - 1 p.m. tour
No. ________ reservations for 1:30 - 3 p.m. tour

KBHK-TV Studio Tour

No. ________ reservations for 9 - 10:30 a.m. tour
No. ________ reservations for 11 a.m.- 12:30 p.m. tour
No. ________ reservations for 1 - 2:30 p.m. tour

Cable-Tec Expo Registration

Everyone must register. ID badge ***must*** be worn and visible at all times in workshops and on the Expo floor. To avoid delay, fill in all information requested. Full and complete payment must be sent with this registration form. Use Official Hotel Form for room arrangements.

Registration Fee includes technical workshops, Expo and hospitality/entertainment event. SCTE Individual Active, Senior and Charter Members must provide Member ID Number. New Individual Members applying with registration must attach SCTE Member Application and payment of dues. If you wish to register more than one person, please make copies of this form.

Please print or type.

Your Name: ______________________________ Nickname: ______________
First Initial Last

Company: ______________________________ Title: ______________

Address: ______________________________
Street/PO City State ZIP

Telephone: ______________ SCTE Member No.: ______________

Registration Fees (until May 13, 1988)

	Member	Non-Member
Engineering Conference and Expo	$195	$350
Expo only	$145	$250
Engineering Conference Only	$120	$200
Spouse Registration*	$ 95	$ 95

(Spouse registration includes: Sessions, Exhibit Floor, Membership Luncheon and Expo Evening)

No. ________ Additional Membership Luncheon tickets at @ $20 $ ________

No. ________ Additional Expo Evening tickets at @ $40 $ ________

☐ I plan to take BCT/E Certification Examinations on Sunday, June 19, 1988 from 8:30 a.m. to 12 noon.

Total Amount Enclosed: **$** ________

Pre-Registration Form** must be received ***before May 13, 1988.

Cancellation Policy—** $50 cancellation charge is applicable to ***all registrations cancelled ***after May 13, 1988. No refunds given after May 31, 1988.***

Method of Payment

☐ Check (made payable to SCTE) ☐ MasterCard ☐ VISA

Name on Card: ______________ Exp. Date: ______________

MasterCard No.: ______________ IB No. ______________ VISA No.: ______________

Signature for Charge Authority: ______________________________

NOTE: There are no further discounts available. SCTE Sustaining Membership qualifies only ONE (1) person to register at SCTE Member rate. Additional personnel must be registered at Non-Member fee or submit application for membership with full payment.

SCTE

Please Mail Form To:
SCTE Cable-Tec Expo
669 Exton Commons
Exton, PA 19341
(215) 363-6888

Reader Service Number 1.

Signal analysis meter

The SAM 1000 from Wavetek uses microprocessor control, making it easier to use, according to the company. Phaselock tuning is keyboard controlled by entering frequency or channel number, automatically increasing or decreasing with use of up and down arrow keys. Video and audio carrier levels can be compared by flipping a switch, which automatically tunes up 4.5 MHz from the selected video carrier. The product features tuning from 50 to 550 MHz, measurement of horizontal sync suppression scrambled channels and weatherproof materials.

For additional information, contact Wavetek RF Products, 5808 Churchman Bypass, Indianapolis, Ind. 46203-6109, (317) 788-9351; or circle #131 on the reader service card.

Addressable converter

Pioneer Communications of America introduced its BA-6000 addressable converter with the optional VCR filter. This option combines the output of the converter with the cable input, restoring the tuner functions of the VCR and television and permitting the subscriber to record and watch different channels. It also allows the timer on the VCR to be utilized fully, independent of the four additional timers on the converter.

Other features include volume control, enhanced display, larger remote, integrated IPPV modules, downline-loadable output channel and multi-vendor compatibility.

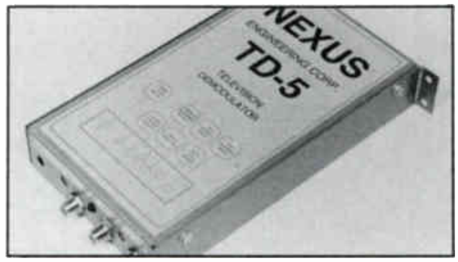
For further information, contact Pioneer, Sherbrooke Office Centre, 600 E. Crescent Ave., Upper Saddle River, N.J. 07458-1827, (201) 327-6400; or circle #133 on the reader service card.

Remote transmitters

Philips ECG announced the addition of 11 new remote control transmitters to its ECG universal replacement line, which now includes 82 types that replace more than 3,100 original manufacturers' part numbers in 48 brands. The remotes are intended for use with TV sets, cable converters and VCRs in both infrared and ultrasonic modes. All models are new and individually packaged.

According to the company, the units are ideal as second or spare remote controls; key function on all ECG types closely parallel those of the one being replaced or supplemented.

For further information, contact Philips ECG, 100 First Ave., Waltham, Mass. 02254, (617) 890-6107; or circle #111 on the reader service card.



Demodulator

Nexus Engineering Corp. introduced its TD-5 agile TV demodulator, which accepts any channel in the VHF, mid-, super- and UHF bands, and generates a composite video and audio subcarrier output. According to the company, this product is ideal for restricted access systems, and processes HRC and IRC frequencies. Audio is maintained at 4.5 MHz when the TD-5 is used to process off-air channels.

For additional details, contact Nexus Engineering Corp., 7000 Lougheed Hwy., Burnaby, British Columbia, Canada V5A 4K4, (604) 420-5322; or circle #120 on the reader service card.

Balun tester

The NDI Link-Tester System from Atronix, for use during installation of twisted pair or coaxial cable, tests and verifies conductivity, bandwidth, connectivity of balun units and provides attenuation readings. The system consists of a trans-

mitter, receiver and accessories to provide positive on-line testing at both ends and features a three-digit LED error display counter on the receiver and an attenuation control.

For more information, contact Atronix, 780 Boston Rd., Billerica, Mass. 01821, (617) 663-5100; or circle #126 on the reader service card.

Asphalt cutter

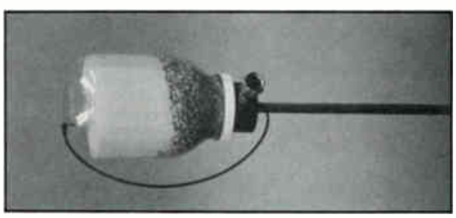
Allied's Model 1200C Roto-Cut is a rotary asphalt cutter used for roadpatching, edging, scoring and utility line construction. It is designed to attach to a variety of tractor loader/backhoe buckets with a screw clamp. The 12-inch wheel provides a 3½-inch deep smooth-sided cut at a rate of 6,000 feet per hour and the twin tapered roller bearings and ¼-pound capacity lubrication reservoir ensure low maintenance requirements, according to the company.

For further information, contact Allied, 5800 Harper Rd., Solon, Ohio 44139, (216) 248-2600; or circle #122 on the reader service card.

Standby power

The PowerVision division of C-COR introduced its PS900, a lightweight single-module standby power supply. According to the company, the product, which is used for broadband LANs, is capable of delivering clean uninterrupted power in the event of a utility power failure, with a transfer time of 16 milliseconds or less. The output waveform is virtually the same in both standby and normal modes.

For additional information, contact C-COR Electronics, 60 Decibel Rd., State College, Pa. 16801, (814) 238-2461; or circle #124 on the reader service card.



Grounding kit

PolyPhaser Corp.'s new PolyRod chemical ground rod has been expanded into a grounding kit module, allowing electrolyte to be dispersed along 25 feet of interconnecting copper tubing between PolyRods. The modules can interconnect up to three other modules to form a tailored ground system for equipment vaults and towers. An external water source may be attached during drought and modules are available for no soil, minimal soil or more than eight feet of soil.

For more information, contact PolyPhaser Corp., 1425 Industrial Way., P.O. Box 1237, Gardnerville, Nev. 89410-1237, (702) 782-2511; or circle #141 on the reader service card.

Waveguide attenuator

Microwave Filter Co.'s Model 6151 variable waveguide attenuator reduces signal levels from broadcast remote pickups and STL links to prevent overload in receivers. The unit attenuates from 0-15 dB (user adjustable) any frequency 6.8 to 7.2 GHz. VSWR is 1.15:1 typical and impedance is 50 ohms.

For additional details, contact Microwave Filter Co., 6743 Kinne St., East Syracuse, N.Y. 13057, (315) 437-3953; or circle #135 on the reader service card.

Linear power supply

Electronic Measurements introduced its Model ATR100C, a 100-watt, quarter-rack, linear power supply offering an output voltage range of 0 to 128 VDC. This product can be used for automatic test equipment, measurement systems, diagnostic instruments, discrete device burn-in systems and is designed for either bench or laboratory use.

The power supply is fully programmable via an external resistance, voltage or current. Other features include low ripple, full regulation in both current and voltage modes, remote sensing and the capability for parallel and series operation.

For more information, contact Electronic Measurements, 405 Essex Rd., Neptune, N.J. 07753, (201) 922-9300; or circle #129 on the reader service card.

FO test set

Available from Siecor, the compact CME 1000 fiber-optic attenuation test set consists of a software-driven mainframe with two universal plug-in ports, which accept and automatically configure any combination of detector and light source modules.

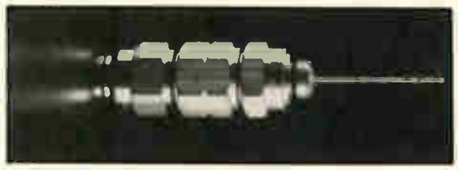
The unit has a measurement range of +3 dBm to −60 dBm, resolution of .01 dB and an accuracy of ±0.1 dB. The software allows direct entry of calibrated wavelengths as well as storage of multiple test references. Features also include synchronous and continuous detection as well as multiple averaging.

For more information, contact Siecor Corp., 489 Siecor Park, Hickory, N.C. 28603-0489, (704) 327-5000; or circle #134 on the reader service card.

FO couplers

Corning's line of Photocor fiber-optic couplers was expanded to include all multimode fiber sizes, including 62.5/125, 85/125 and 100/140 micron applications. Couplers with 1 × 3, 1 × 6 and 1 × 32 port counts are also available for the four standard sizes and can be used as combiners as well as splitters.

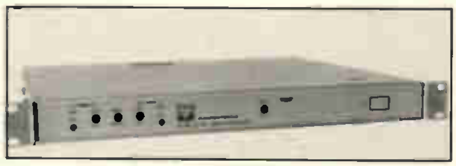
For additional details, contact Corning Glass Works, Telecommunications Products Division, MP-RO-03, Corning, N.Y. 14831, (607) 974-9000; or circle #140 on the reader service card.



Connectors

LRC Electronics redesigned its three-piece connector line. The W-series connectors still have a no-twist center conductor seizing mechanism, but the keyway has been removed to make installation easier. The product also features a 30 dB return loss extended to 1 GHz on pin type entries and splices, a center conductor cutting guide and 2-inch pins on all entry connectors. To date, the ½-inch and ¾-inch designs are in production with additional sizes to follow.

For more details, contact LRC Electronics, 901 South Ave., Box 111, Horseheads, N.Y. 14845, (607) 739-3844; or circle #116 on the reader service card.



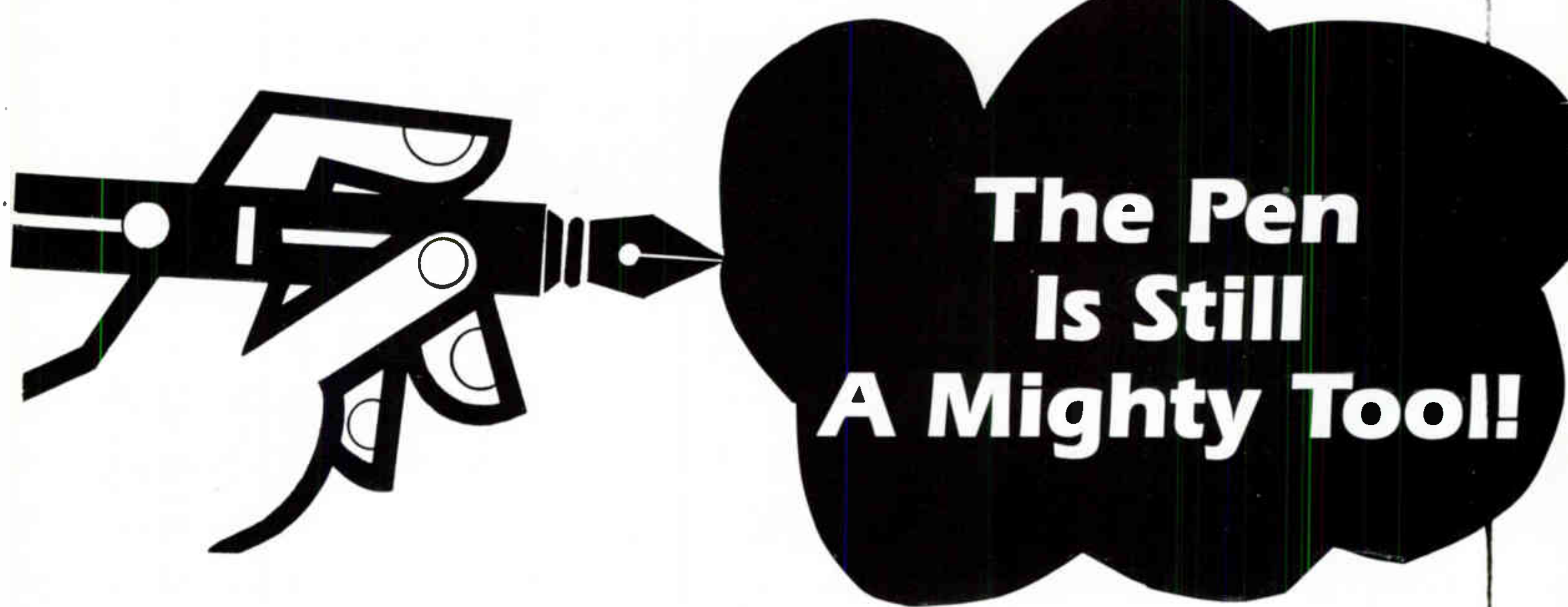
Agile modulator

Available from Blonder-Tongue Laboratories, the FAVM-300-60 frequency agile heterodyne audio and video modulator features a high output level of +60 dB while providing a modulated visual and audio RF carrier output on any TV channel up to 300 MHz. Any standard output channel can be selected by setting an eight-position DIP switch, and overall channelization configuration can be shifted from standard to HRC, IRC, inverted or any other offset.

For more details, contact Blonder-Tongue, 1 Jake Brown Rd., Old Bridge, N.J. 08857, (201) 679-4000; or circle #132 on the reader service card.

Microwave guide

Available from the Farinon Division of Harris Corp. is a booklet entitled "Getting the Jump On Trouble: Innovative Solutions to Microwave Communications Problems." The booklet contains actual case histories analyzing the primary concerns and obstacles encountered by a variety of businesses in developing microwave communications networks and details how these problems were solved. Issues such as environmental constraints, climate conditions and information trafficking are addressed. This



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For further information, contact Harris Corp., Farinon Division, 1691 Bayport Ave., San Carlos, Calif. 94070, (415) 594-3000; or circle #119 on the reader service card.

Sync pulse generator

The Leitch Model SPG-1300N NTSC sync pulse generator has two plug-in modules (genlock and power supply) that are housed in a 1RU mounting frame. Three module options can be included to suit specific requirements (pulse generator, black and tone and test signal). Product features include independent timing for pulses, black and test signals; adjustable blanking widths and burst flag options for 12-bit digital test signals; and color frame-locked tone output.

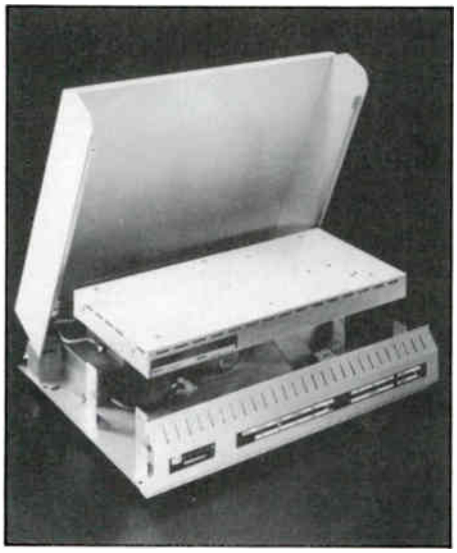
For more details, contact Leitch Video of America, 825K Greenbrier Circle, Chesapeake, Va. 23320, (804) 424-7920; or circle #127 on the reader service card.

Converter

The Venator FSC-1 frequency selective converter from 3M is used with a standard transmission test set to locate and analyze transmission and signaling problems in an FDM system. It may be used to test any type of circuit that exists in analog form in conformance with CCITT standard 10 supergroup arrangement.

Testing capabilities include: sectionalizing trouble in a microwave or cable system; aligning or checking levels in FDM multiplexers or transmultiplexers; monitoring voice and signaling tones at repeater stations not equipped with multiplex channel drops for the selected channel; and checking baseband devices in analog systems.

For more information, contact 3M, P.O. Box 2963, Austin, Texas 78769-2963, (800) 426-8688; or circle #136 on the reader service card.



LAN products

Chipcom Corp. expanded its Ethermodem III series of broadband Ethernet connectivity products for single-cable LANs. The Ethermodem III/18 family of modular 18 MHz IEEE 802.3 10BROAD36 compliant transceivers implements a chassis/module design enabling users to alter frequencies and change bandwidth from 18 MHz to 12 MHz. Users can modify their systems by replacing individual frequency modules and upgrade products from one port to two or eight ports, and from two to eight ports by changing the chassis. The products include a full set of internal diagnostic capabilities.

For further information, contact Chipcom Corp., 195 Bear Hill Rd., Waltham, Mass. 02154, (617) 890-6844; or circle #128 on the reader service card.

Component catalog

Microflect's new 80-page component catalog CC188 has more than 900 items including waveguide support and protection components, tower accessories, tower hardware and small antenna support structures. Illustrated examples show recommended installation configurations. The catalog has been expanded, containing a section for small antenna support structures such as antenna wall mounts, tripods, monopole structures and roof-mounted frames.

For further details, contact Microflect, 3575 25th St. S.E., P.O. Box 12985, Salem, Ore. 97309-0985, (503) 363-9267; or circle #118 on the reader service card.

Trencher/plow

Ditch Witch introduced the Model HT100, a new 100 HP-class track-mounted trencher/vibratory plow designed to accommodate a variety of interchangeable work modules for vibratory plowing, trenching, sawing or backhoe work. The trencher will dig a 24 inch-wide trench, to a depth of 48 inches. Maximum trench depth is 96 inches, at a width of 8 inches. Equipped as a vibratory plow, it can be used to install fiber optics, cable, or flexible pipe to a maximum cover depth of 36 inches.

Each track is independently driven, allowing the HT100 to turn in its own length. These tracks are said to give the HT100 more traction during plowing. The track undercarriage has permanently sealed rollers and idler, requiring no lubrication maintenance. The standard track is 19.7 inches wide, and has a ground pressure of 6½ and 7½ psi. The optional wider track is 23.6 inches wide, which lowers the ground pressure from 5½ to 6½ psi.

For more details, contact Ditch Witch, The Charles Machine Works Inc., P.O. Box 66, Perry, Okla. 73077-0066, (800) 654-6481; or circle #112 on the reader service card.

Sweep generator

The Kalun Model 6082 wide-band sweep generator is designed with RF and digital electronics to provide accurate and effective sweep frequency measurements, according to the company. The sweep signal covers the 600 MHz frequency range in one sweep with 0.5 dB flatness. The marker frequency is displayed as an intensified spot on the frequency response trace, while also being indicated by a digital frequency counter.

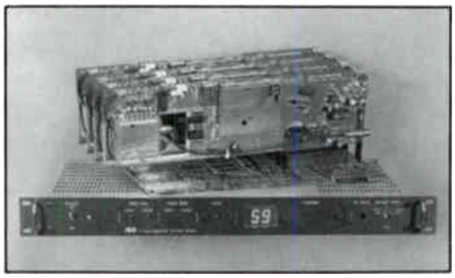
Spectral purity is −30 dBc including all harmonics and non-harmonics; sweep width is continuously variable from 200 kHz to full bandwidth. Output is 75 ohms, 50 dBmV; an output attenuator is continuously variable from 0-10 dB and also has steps of 10 and 20 dB.

For more details, contact Kalun Communications, 11A Glen Watford Dr., Unit 17, Scarborough, Ontario, Canada M1S 2B8, (416) 293-1346; or circle #113 on the reader service card.

VCR interface

Qintar Inc. recently redesigned and improved its line of video switches. The new Models 4006A (amplified) and 4006B (passive) have substantially increased shielding with higher isolation specifications. The units have also been packaged in black cabinets to complement today's high-tech video components.

For more information, contact Qintar, P.O. Box 6579, Westlake Village, Calif. 91359, (800) 252-7889; or circle #110 on the reader service card.



LAN demodulator

ISS Engineering announced the availability of its Model LAN-1001 PC-based video/audio frequency agile demodulator. It is designed to be installed in an expansion slot of an IBM or compatible personal computer and demodulate incoming RF signals as would be encountered over a laser disc (or any other video source)/LAN system. The device is controlled either by the workstation software or host computer instruction.

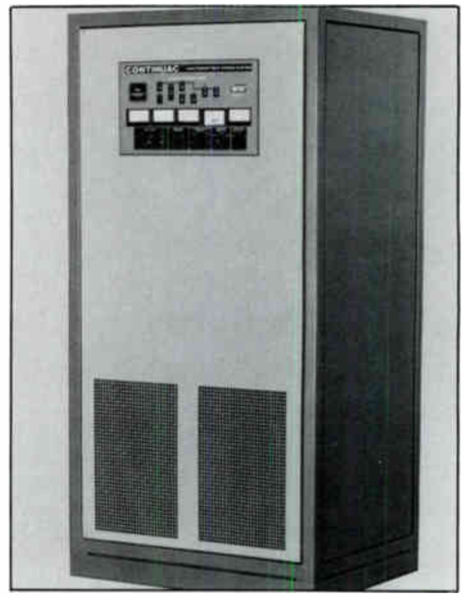
The video can reside above the data on a baseband Ethernet network or on any cable channel on a broadband network. Video information can be modulated on channel by the RS232-controlled video/audio modulator, ISS model GL2610XT Series II, for use at the host computer. This device allows the host computer to select an unused portion of the LAN/video spectrum and provide optical information on channel, either from laser disc or real-time video. All video information is transmitted over the broadband LAN systems and negates the requirement for a parallel video system.

For further information, contact ISS Engineering Inc., 104 Constitution Dr., #4, Menlo Park, Calif. 94025, (415) 853-0833; or circle #109 on the reader service card.

Crimp tools

Cable Management Systems introduced two new crimp tools for use with its RJ line of modular connectors. The Model FIT 26 is capable of stripping and terminating two-, three-, four- and six-position line cords using 26 and 24 AWG solid or stranded wire. The FIT 28 is designed for eight-position line cords. Both tools are metal, with plastic insulation-covered handles and blades for cutting and stripping modular line cord.

For more details, contact Cable Management Systems, 17955 Skypark Circle, Suite F, Irvine, Calif. 92714, (714) 261-2622; or circle #138 on the reader service card.



Power supply

The 80 kVA uninterruptible power supply from LorTec is 50 percent smaller than equivalent units without sacrificing reliability, according to the company. This is accomplished by incorporating fewer, larger inverter modules as well as a rotary switch for the maintenance-override bypass switch.

The unit is compatible with small- and medium-sized mainframes and can handle both three-phase and single-phase loads simultaneously. Features include a solid-state inverter, battery/charter/rectifier, solid-state automatic static switch, meter, alarm and control panel.

For further information, contact LorTec Power Systems, 145 Keep Ct., Elyria, Ohio 44035, (216) 327-5050; or circle #139 on the reader service card.

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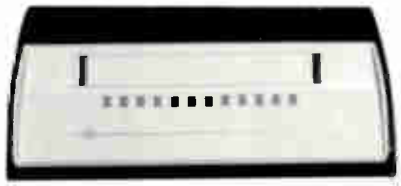

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Cable shielding

Copper Cloth from The Zippertubing Co. is a new material woven from a fine copper wire to form a flexible tight mesh providing EMI shield protection. Combined with an outer Zippertubing jacket, it can be zipped onto round or flat cable. Types CC-80 and CC-100 come with a wire count of 80 × 80 or 100 × 100 per inch and fabric thickness of .011 inch or .0046 inch.

For further details, contact The Zippertubing Co., P.O. Box 61129, Los Angeles, Calif. 90061, (213) 321-3901; or circle #137 on the reader service card.

Voltmeter

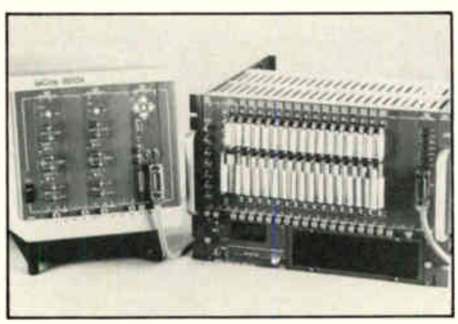
Monroe Electronics announced its Model 263 electrostatic voltmeter for accurate measurement of electrostatic potential without physical contact. The instrument utilizes a hybrid circuit to combine DC electrometer techniques with AC chopper circuitry to produce response rate greater than 50 S (10 to 90 percent) at probe surface spacing less than 0.062 inch.

For more information, contact Monroe Electronics, 100 Housel Ave., Dept. 513, Lyndonville, N.Y. 14098, (716) 765-2254; or circle #121 on the reader service card.

Balun products

ADC Telecommunications' QX/Balun products convert 93-ohm unbalanced RG62 coaxial cable to balanced twisted-pair wire environments. They are available individually or in 16-port wall mount or rack mount balun concentrator panels. According to the company, they perform with high signal isolation and excellent common mode rejection for quieter circuits, fewer bit errors and sharp data signals.

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



Waveform digitizers

LeCroy Corp.'s Century Series is a new line of automated single-channel waveform digitizers. According to the company, the hardware provides higher accuracy measurements, extended memory-length waveform recording, both pre- and post-trigger waveform recording, high resolution transient capture, digital signal processing and analysis and total programmability.

The modular design allows for channel and waveform memory expansion and digitizer modules of higher sample rate, bandwidth or resolution may be added as well.

For further details, contact LeCroy Corp., 700 Chestnut Ridge Rd., Chestnut Ridge, N.Y. 10977-6499, (914) 425-2000; or circle #123 on the reader service card.

FO connector

The Amphenol 953 series ST-compatible multimode fiber-optic connector offers a median insertion loss of 0.14 dB for 50/125 μm fiber with less than 0.15 dB change after 5,000 mating cycles. A new termination procedure and special mechanical fixtures reduce termination time by up to 50 percent. The product is optically and mechanically compatible with ST-type adapters, and is made of glass-reinforced polymeric composite.

For additional details, contact Amphenol Fiber-Optic Products, 1925 Ohio St., Lisle, Ill. 60532, (312) 810-5626; or circle #130 on the reader service card.

Tool catalog

Jensen Tools is offering a full-color catalog featuring new service and maintenance kits and tools and test equipment for electrical and electronic engineers. Included are hand and power tools in inch and metric sizes, work holding devices, lighting and optical aids and more.

For additional information, contact Jensen Tools, 7815 S. 46th St., Phoenix, Ariz. 85044, (602) 968-6241; or circle #125 on the reader service card.

Arnold

Linda Arnold was appointed Southern region sales manager by **Texscan MSI**. She was most recently account executive for commercial insertion products with the Arvis Division of Adams-Russell. Contact: 124 Charles Lindbergh Dr., Salt Lake City, Utah 84116, (801) 359-0077.

The **National Cable Television Association** appointed **Katherine Meier** to the newly created position of deputy vice president for government relations. She is currently minority chief counsel of the Senate Communications Subcommittee. Contact: 1724 Massachusetts Ave., NW, Washington, D.C. 20036, (202) 775-3629.

Charles Blanchard joined **RMT Engineering** as regional director of sales and repairs. Contact: 625 E. Taylor Ave., Sunnyvale, Calif. 94086, (408) 733-4830.

John Johnson was promoted to president of **Anixter Manufacturing**, a division of Anixter Bros. He was previously executive vice president of manufacturing.

Mike Long was appointed vice president of international sales for Anixter Bros. Before this, he served as Mid-Atlantic regional vice president. Contact: 4711 Golf Rd., 1 Concourse Plaza, Skokie, Ill. 60076, (312) 677-2600.

William Fitzgerald joined **C-COR** as manager of management information systems. Most recently, he was senior information systems consultant for Allegheny International in Pittsburgh. Contact: 60 Decibel Rd., State College, Pa. 16801, (814) 238-2461.

Mertzlufft

Ronald Mertzlufft was named Midwest district manager by **ADC Telecommunications**. Previously, he was an account executive with Rockwell International.

ADC also appointed four new account managers. **William Hindenlang** is responsible for its New York district. Formerly, he was Eastern region sales manager for Pulsecom.

John Eberhart is account manager for the Northeast district. He previously served with Alcatel Network Systems as sales engineer.

Robert Hawthorne is account manager for the Southeast district. Prior to this, he was a sales manager for Lear Siegler.

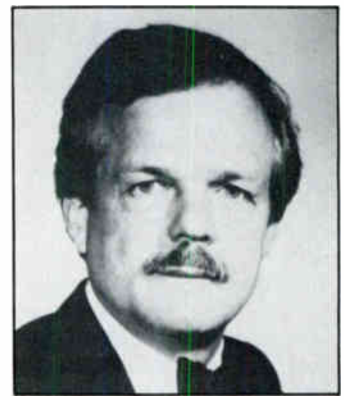
Richard Lawrence was named West account manager for broadcast. Most recently, he was vice president of marketing for Span Line. Contact: 4900 W. 78th St., Minneapolis, Minn. 55435, (612) 835-6800.

Transamerica Energy Associates named **Leroy Gray** national sales and operations manager for its Cable TV Division. He has previous CATV operations management experience with Storer, Cox, Scientific-Atlanta and Warner Amex. Contact: 1301 Hightower Trail, Suite 300, Atlanta, Ga. 30350, (404) 992-7003.

Midwest CATV named **Jim McCauley** vice president for the Northeastern region. Prior to this, he was distribution sales manager for General Instrument's Jerrold Division.

Forrest Frakes joined the Eastern region as a sales representative. He was previously a telecommunications specialist with the Veterans Administration in Washington, D.C.

Bill Cody was appointed telemarketing sales representative for the Southern region. Most recently, he held an inside sales position with Cable TV Supply. Contact: P.O. Box 271, Charleston, W. Va. 25321, (304) 343-8874.



Durey

Hal Krisbergh was elected a vice president of **General Instrument Corp**. He was most recently promoted to president of the Jerrold Division.

Stan Durey was named director of customer support programs for the Jerrold Subscriber Systems Division. Before this, he worked for First Data Resources in various operations management positions. Contact: 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

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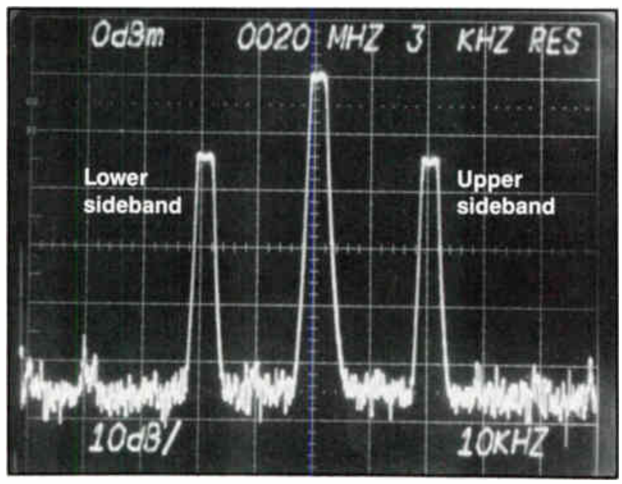
Amplitude modulation on a spectrum analyzer

By Ron Hranac
Jones Intercable Inc.

An amplitude modulated signal, when viewed in the frequency domain on a spectrum analyzer, might appear as shown below. In a conventional double sideband AM signal, the percentage of modulation can be determined by the relationship between the amplitude of the carrier and the amplitude of one of the two sidebands. The table on this page shows that relationship from 1 percent to 100 percent modulation in 1 percent steps. The formulas used to create this table are on the next page, with examples of their use.



A 20 MHz carrier amplitude modulated by a 20 kHz signal. The percent of modulation in this example is about 40 percent.

% mod	Sideband level below carrier (dB)	% mod	Sideband level below carrier (dB)	% mod	Sideband level below carrier (dB)	% mod	Sideband level below carrier (dB)
1	−46.02	26	−17.72	51	−11.87	76	−8.40
2	−40.00	27	−17.39	52	−11.70	77	−8.29
3	−36.48	28	−17.08	53	−11.54	78	−8.18
4	−33.98	29	−16.77	54	−11.37	79	−8.07
5	−32.04	30	−16.48	55	−11.21	80	−7.96
6	−30.46	31	−16.19	56	−11.06	81	−7.85
7	−29.12	32	−15.92	57	−10.90	82	−7.74
8	−27.96	33	−15.65	58	−10.75	83	−7.64
9	−26.94	34	−15.39	59	−10.60	84	−7.54
10	−26.02	35	−15.14	60	−10.46	85	−7.43
11	−25.19	36	−14.89	61	−10.31	86	−7.33
12	−24.44	37	−14.66	62	−10.17	87	−7.23
13	−23.74	38	−14.42	63	−10.03	88	−7.13
14	−23.10	39	−14.20	64	−9.90	89	−7.03
15	−22.50	40	−13.98	65	−9.76	90	−6.94
16	−21.94	41	−13.76	66	−9.63	91	−6.84
17	−21.41	42	−13.56	67	−9.50	92	−6.74
18	−20.92	43	−13.35	68	−9.37	93	−6.65
19	−20.45	44	−13.15	69	−9.24	94	−6.56
20	−20.00	45	−12.96	70	−9.12	95	−6.47
21	−19.58	46	−12.77	71	−9.00	96	−6.38
22	−19.17	47	−12.58	72	−8.87	97	−6.29
23	−18.79	48	−12.40	73	−8.75	98	−6.20
24	−18.42	49	−12.22	74	−8.64	99	−6.11
25	−18.06	50	−12.04	75	−8.52	100	−6.02

Formulas

To convert percentage of modulation to sideband level below the carrier, use the formula

$$-dB = 20\log_{10}\left(\frac{\text{percent modulation}}{200}\right)$$

To convert sideband level below the carrier to percentage of modulation, use the formula

$$\text{Percent modulation} = 200 \times 10^{\left(\frac{-dB}{20}\right)}$$

Examples

Problem: You are measuring an AM signal on your spectrum analyzer and note that the sidebands are 8 dB below the carrier. What is the percentage of modulation?

Solution: Use the formula

$$\begin{aligned}\text{Percent modulation} &= 200 \times 10^{\left(\frac{-dB}{20}\right)}\\ &= 200 \times 10^{\left(\frac{-8}{20}\right)}\\ &= 200 \times 10^{-0.40}\\ &= 200 \times 0.40\\ &= 79.62\%\end{aligned}$$

Problem: You've been asked to set the percentage of modulation at 50 percent on an AM transmitter with your spectrum analyzer. How far below the carrier will the sidebands be when the adjustment is complete?

Solution: Use the formula

$$\begin{aligned}-dB &= 20\log_{10}\left(\frac{\text{percent modulation}}{200}\right)\\ &= 20\log_{10}\left(\frac{50}{200}\right)\\ &= 20\log_{10}(0.25)\\ &= 20(-0.60)\\ &= -12.04\text{ dB}\end{aligned}$$

April

April 13: SCTE Oklahoma Meeting Group technical seminar. Contact Herman Holland, (405) 353-2250.

April 14: SCTE Central California Meeting Group technical seminar, Picadilly Inn, Fresno, Calif. Contact Andrew Valles, (209) 453-7791.

April 15: SCTE Razorback Chapter and **Miss/Lou Chapter** joint technical seminar and BCT/E testing. Contact Garry Bowman, (501) 935-3615; or Rick Jubeck, (601) 992-3377.

April 16: SCTE Midlands Cable Training Association technical seminar on video and audio signals, Omaha, Neb. Contact Herb Dougall, (402) 330-2314.

April 16: SCTE Rocky Mountain Chapter technical seminar on terminal devices. Contact Steve Johnon, (303) 799-1200.

April 18-20: Technology Dynamics Institute course "Optical fiber communications systems," San Diego. Contact (213) 935-4649.

April 19: Scientific-Atlanta seminar "The engineering economics of channel expansion," Philadelphia. Contact Russell Paul, (404) 441-4714; or Perry Tanner, (404) 925-5674.

April 19-21: C-COR Electronics technical seminar, Atlanta. Contact Shelley Parker, (800) 233-2267.

April 19-21: Magnavox CATV training seminar, Santa Fe, N.M. Contact Amy Costello, (800) 448-5171.

April 20: SCTE Delaware Valley Chapter technical seminar on grounding, bonding and electrical safety, Williamson Restaurant, Horsham, Pa. Contact Diana Riley, (717) 764-1436.

April 20: SCTE Palmetto Meeting Group technical seminar. Contact Rick Barnett, (803) 747-1403.

April 20: SCTE Greater Chicago Chapter technical seminar on long haul transmission options. Contact John Grothendick, (312) 438-4200.

April 22-23: Kentucky Cable Television Association membership meeting, Holidome, Bowling Green, Ky. Contact Ranada Wright, (502) 864-5352.

Planning ahead

June 16-19: SCTE Cable-Tec Expo, Hilton Hotel, San Francisco.

July 11-14: New England Show, Tara Hyannis, Cape Cod, Mass.

Sept. 7-9: Eastern Show, Atlanta Merchandise Mart, Atlanta.

Sept. 27-29: Great Lakes Expo, Cobo Hall, Detroit.

Oct. 4-6: Atlantic Show, Convention Center, Atlantic City, N.J.

Oct. 18-20: Mid-America Show, Hyatt Regency, Kansas City, Mo.

Dec. 7-9: Western Show, Convention Center, Anaheim, Calif.

April 25-27: Tennessee Cable Television Association annual convention, Hyatt Regency, Nashville. Contact Dan Walters, (615) 256-7037.

April 25-29: Trellis Communications workshop on designing and installing fiber-optic networks, Trellis Training Center, Salem, N.H. Contact (603) 898-3434.

April 26-28: Commwest visual communications exposition and conference, Vancouver Trade and Convention Centre, Vancouver, B.C., Canada. Contact (416) 536-4621.

April 26-28: Magnavox CATV training seminar, Los Angeles. Contact Amy Costello, (800) 448-5171.

April 27: SCTE Great Lakes Chapter technical seminar on CLI and leak monitoring/reporting. Contact Vic Gates, (313) 422-2814.

April 30-May 3: NCTA Show, Convention Center, Los Angeles. Contact (202) 775-3550.

May

May 10-11: ElectroniCast Corp. conference on fiber optics, Monterey Plaza Hotel, Monterey, Calif. Contact Eloise Beckett, (415) 572-1800.

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May 10-12: Magnavox CATV training seminar, Bellingham, Wash. Contact Amy Costello, (800) 448-5171.
May 11: SCTE Greater Chicago Chapter BCT/E testing. Contact John Grothendick, (312) 438-4200.
May 17-19: Magnavox CATV training seminar, Great Falls, Mont. Contact Amy Costello, (800) 448-5171.
May 23-27: Trellis Communications workshop on designing and installing fiber-optic networks, Trellis Training Center, Salem, N.H. Contact (603) 898-3434.
May 24-26: C-COR Electronics technical seminar, Harrisburg, Pa. Contact Shelley Parker, (800) 233-2267.
May 25-27: Magnavox CATV training seminar, St. Paul, Minn. Contact Amy Costello, (800) 448-5171.
May 30-June 1: Canadian Cable Television Association annual convention and expo, World Trade and Convention Center, Halifax, Nova Scotia, Canada. Contact (613) 232-2631.

June

June 1-3: Magnavox CATV training seminar, Casper, Wyo. Contact Amy Costello, (800) 448-5171.
June 7-9: Magnavox CATV training seminar, San Francisco. Contact Amy Costello, (800) 448-5171.
June 8: SCTE Rocky Mountain Chapter technical seminar on signal processing. Contact Steve Johnson, (303) 799-1200.
June 9: SCTE Greater Chicago Chapter technical seminar on construction and cable handling. Contact William Gutknecht, (312) 690-3500.
June 13-15: Hughes Microwave technical training seminar on broadband AML equipment, Torrance, Calif. Contact (213) 517-6244.
June 13-15: New York State Cable Commission on Cable Television's Northeast Cable Television technical seminar on fiber optics, Roaring Brook Ranch, Lake George, N.Y. Contact Bob Levy, (518) 474-1324.
June 13-16: Trellis Communications workshop on designing and installing fiber-optic networks, Trellis Training Center, Salem, N.H. Contact (603) 898-3434.
June 16-19: SCTE Cable-Tec Expo, Hilton Hotel, San Francisco. Contact Howard Whitman, (215) 363-6888.

AD INDEX

HDTV report from Japan

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

While I promised last month to expand on the FCC committees and report on their progress, I will postpone that topic so I can discuss even more timely information.

A delegation from the National Cable Television Association visited Japan the week of March 7. The purpose of the trip was to increase Japanese understanding of the role of cable in U.S. television and to learn of Japanese progress and plans for advanced television (ATV) systems in Japan and the United States. High-definition television (HDTV) was emphasized. The following are my interpretations of the trip.

At each meeting, Jim Mooney, president of NCTA, introduced the cable participants and stated the cable message. Emphasis was placed on describing the role of cable television in the United States and listing cable's priorities for HDTV. Cable penetration, expected penetration at HDTV introduction, hours of cable viewing time and the propensity of cable subscribers to buy video technology products were mentioned.

Cable's HDTV priorities were presented. Foremost, cable video quality must be competitive and robust signals are required if they are to survive the multiple processing steps present in modern cable practice. Spectrum is valuable, not free; compatibility with existing NTSC is desirable because it would conserve spectrum. However, compatible proposals must not cause cable to have uncompetitive video quality. Cable must be able to deliver whatever signals broadcasters transmit and do so at the same or better quality level. Encryption and addressability are musts.

The NCTA affirmative vote in the Advanced Television Systems Committee (ATSC) on the NHK production standard was contrasted with others' negative position. (NHK is the Japanese public broadcasting corporation.) Questioning from the Japanese side indicated they are finally appreciating the role of cable in the United States.

Important developments

Mitsubishi demonstrated a baseband HDTV VCR prototype with VHS mechanics: metal tape, a one-hour playing time and 20 MHz of baseband bandwidth. The pictures were wide screen and spectacular.

Huge resources have been invested in Japan for HDTV, Multiple Sub-Nyquist Sampling Encoding (MUSE), direct broadcast satellite (DBS) and consumer electronics. MUSE is a bandwidth compression technique that reduces the required baseband bandwidth from about 30 MHz to 8.1 MHz, allowing it to fit in the spectrum allowed for a satellite transponder. The goal is to launch a MUSE DBS service in Japan in 1990; HDTV products won't be available in the United States until 1991 or 1992.

Extended definition television (EDTV) provides picture improvements that require changes in broadcast signals but remain compatible with existing NTSC receivers. First-generation plans for Japan have been scaled back. Improved gamma correction for better gray scale and preemphasis for noise reduction have been added, while the ratio of picture height to width—the aspect ratio—remains the same. Second-generation plans are on hold waiting to see what happens in the United States; since Japan exports video products to America, U.S. developments are likely to determine EDTV for Japan as well. There are no third-generation EDTV plans at present.

NHK will demonstrate its MUSE transmission system at both the National Association of Broadcasters convention in Las Vegas, Nev., April 9-12 and the NCTA convention in Los Angeles April 30-May 3. Anyone interested in HDTV should make a serious attempt to see at least one of these exhibitions.

NHK has a 20-amplifier cable test facility to study MUSE behavior on cable and it clearly prefers original MUSE over other members of the "MUSE family," which it first introduced in its filing with the Federal Communications Commission. Only computer simulations of the MUSE family have been undertaken; neither detailed specification nor hardware exists.

Mitsubishi is emphasizing large-screen direct view (picture tube) and projection TV receivers. The company makes the world's largest production picture tube with a diagonal measure of 35 inches. Demand is exceeding supply, with high brightness projection receivers of 40- and 50-inches selling briskly.

Digital technology applied to Sony professional tape machines is paving the way for consumer, cable and telco applications of digital video approaches. Dramatic noise and distortion immunity were demonstrated.

Improved definition television (IDTV) involves no changes in transmission standards and is compatible with existing televisions. IDTV receivers go on sale this year in Japan; Mitsubishi demonstrated a prototype of the Japanese IDTV 35-inch receiver it will sell this year. A conventional TV receiver was fed from the same signal, but the IDTV receiver had double the scan lines and three-dimensional comb filtering to separate the color signal from the brightness, so still pictures and those with little motion were dramatically better on IDTV. Normal scenes with lots of motion also were noticeably better. There were some minor motion artifacts on diagonal edges or during motion, particularly diagonal motion, but these were not particularly objectionable and probably wouldn't be noticed by the average observer.

It is clear that most cable systems will need increased bandwidth and better signal-to-noise and signal-to-distortion ratios. What is not clear at this point is the amount of improvement required.

Cable implications

The flood of confusing information on ATV makes it difficult to avoid the two extremes of panic and unpreparedness. A tendency to panic at the challenges presented by the startling video makes it too easy to forget about cable's fundamental advantages over other delivery media. There is plenty of time for cable to become well-prepared to use ATV to its advantage if it works diligently. The greatest danger is that cable may become distracted and fail to follow through on the ATV challenge, ending up unprepared.

Mitsubishi's VCR clearly indicates that video quality competition will come from tape and disc rentals and sales. The cable industry must keep this in mind when it is pressed to accept quality compromises in the interests of bandwidth or cost containment. Mitsubishi's success forces us to consider large-screen impact on HDTV. While the differences between NTSC, IDTV, EDTV and HDTV are hard to see on a small screen, they become dramatic on large screens.

Sony's digital tape machine points to the potential of digital video signals into the home that are nearly noise and distortion free. We must build our digital expertise.

Prudence requires the cable industry to understand the potential for MUSE over cable, which is one of the strongest contenders for a standard because of all the resources invested in it. IDTV and EDTV may exacerbate differences between cable and other video. Cable artifact visibility may be increased.

Taking action

Take every opportunity you can to see HDTV, EDTV or IDTV in order to calibrate your eyes. Plan to attend the NCTA convention. This year, visit the Electronic Industries Association's Consumer Electronics Show in Chicago June 4-7 to see what that industry is selling to our subscribers for connection to cable. Stay over a couple more days for the Institute of Electrical and Electronic Engineers' International Conference on Consumer Electronics and see what consumer electronics engineers are cooking up.

Visit a store that sells laser discs and study the picture on a large-screen TV. While this is far from HDTV, the noise-, beat- and ghost-free nature of the picture helps indicate the potential of the existing TV system.

Observe a quality Super VHS demonstration tape on a large-screen monitor fed with the proper "S-connector" to see the impact an absence of color artifacts can have. To improve the demonstration, simultaneously feed an identical monitor with the Channel 3 output of the tape machine.

Improve your digital knowledge so you can judge the progress, threat and opportunity of digital approaches for yourself.