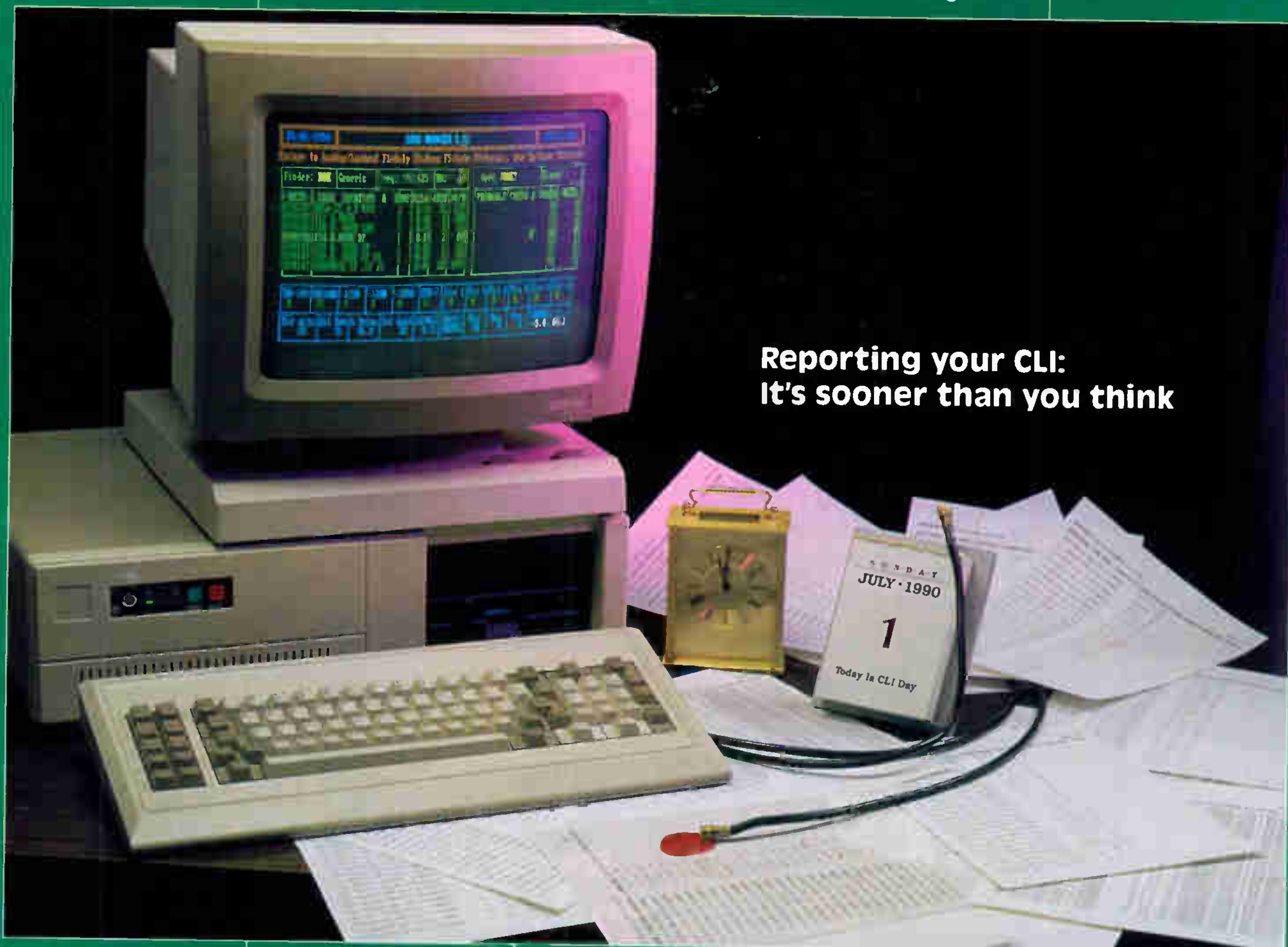
COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers



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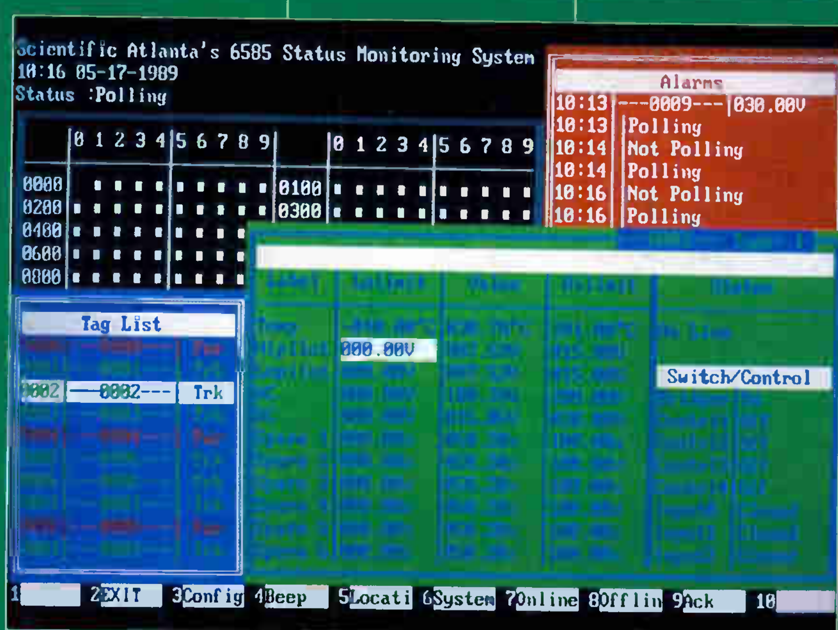

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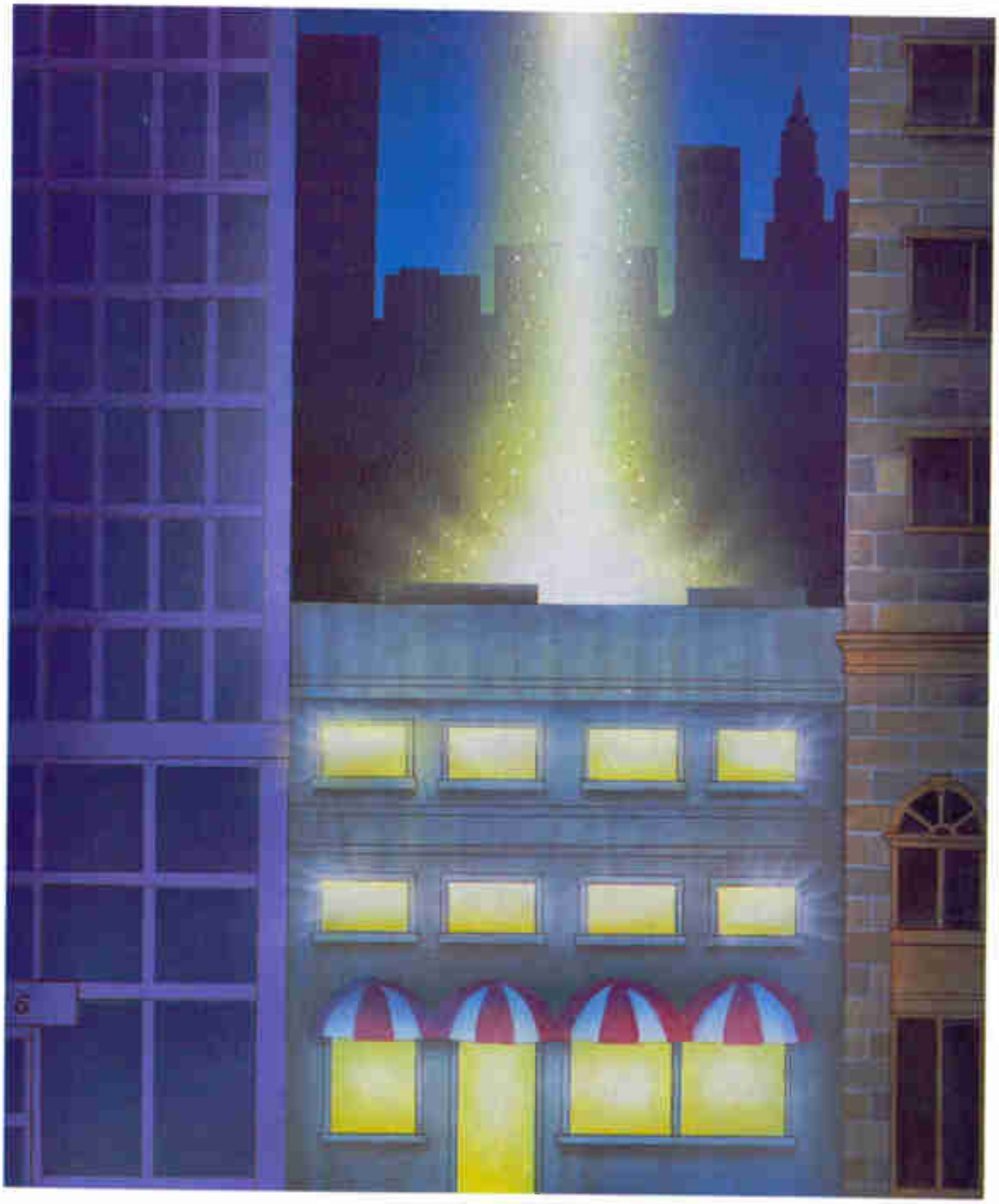

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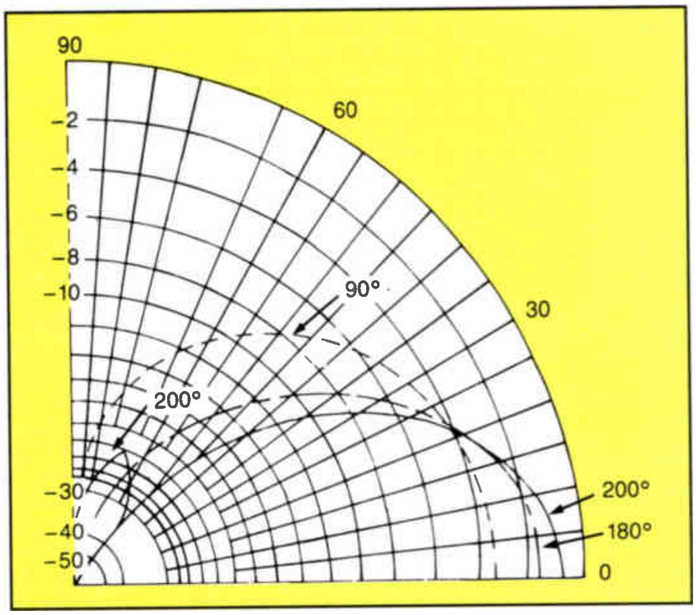
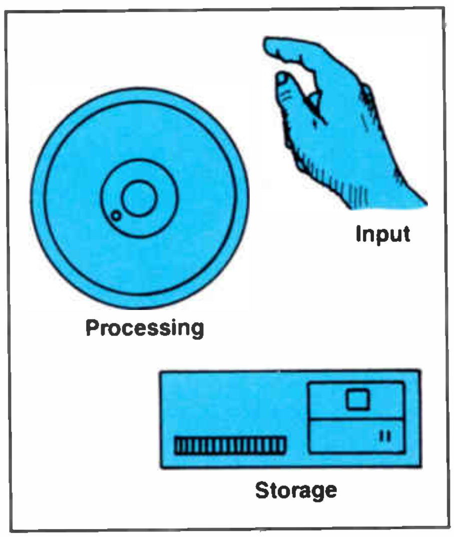
CONTENTS

Departments

Cover
CLI photo by Bob Sullivan; software, printouts courtesy Roy Ehman of Jones Intercable. Status monitoring screen from Scientific-Atlanta.

Rikki Lee





Features

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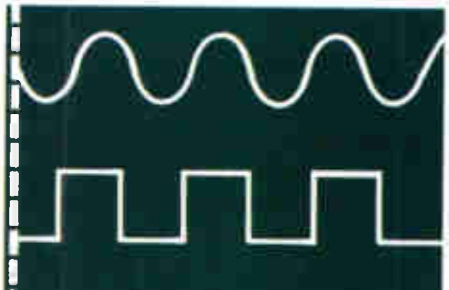
Overmodulation protection assures clean, clear audio output (top). It prevents clipping and flattening of audio (bottom).

Logarithmic parallel LED metering shows you sound separation at a glance.

Both 41.25 MHz and 4.5 MHz output are provided.

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Reader Service Number 4.

EDITOR'S LETTER

The National (and international) Show

You might say that this year's Cable '89 in Dallas had a distinct "country" flavor. With the actual (and proposed) expansion by several major MSOs into CATV markets in the United Kingdom, Europe, Japan and elsewhere, representatives from many of these markets dropped in at the National Show.

On the exhibit floor, the amount of international activity at times seemed to be permanently altering the future of U.S. CATV technology, operations and programming. The first-time National Show exhibitor Cabletime, a U.K. manufacturer of hardware and software for switched-star systems in Europe, drew crowds of curious convention-goers. In its booth the company demonstrated home ordering, impulse pay-per-view, remote metering and integration of telephony.

The Far East also was represented: A delegation from the Cable Television Association of the Republic of China met with exhibitors and sought programming agreements for operators in Taiwan. (For more details on this story, read "News" on page 9.)

Meanwhile, back at the ranch...

Finally, on the evening of Tuesday, May 23, 150 attendees from 12 different countries converged on Southfork Ranch for a barbecue buffet hosted by Gilbert Engineering, Magnavox CATV Systems and Times Fiber. But whatever the native tongue of the participants, all seemed to carry with them the same message: international growth of CATV through cooperation and understanding.

Another event at the National Show was an excellent rodeo hosted by Anixter Cable TV. In an awe-inspiring feat, *CT*'s Vice President of Editorial (and veteran rodeo champ) Toni Barnett mounted her bull in an attempt to harness the forces of unbridled power—her moment of glory.

HDTV: Pictures on exhibit

Despite the ongoing contemplation of high definition TV standards by the Federal Communications Commission, this technology proved to be alive and well at the 1989 National Show. Two technical sessions ("HDTV transmission implications" and "HDTV testing") covered the theoretical aspects of the topic. Meanwhile, several vendors supplied information and/or provided demonstrations of their own versions of advanced TV on the exhibit floor or in demonstration rooms at the Convention Center. Several of these were:

- Scientific-Atlanta exhibited its new satellite-delivered HDB-MAC, an extension of the B-MAC system introduced in 1985. According to S-A, the format incorporates a "spectrum-folding" technique to achieve 950 horizontal lines of resolution with a 525-line progressive scan and a vertical resolution of 480 lines per picture height. S-A announced that its first customer for the new system would be Telesat Canada based in Ottawa.
- Tele-Communications Inc., Capitol Cities/ABC, Group W Broadcasting, Tribune Broadcasting and NBC announced that they would participate in a series of joint tests of the Faroudja Labs' SuperNTSC system for regularly scheduled broadcast and cable programming. The equipment was placed in Heritage Cablevision's Dallas system; the signal was transmitted over a 12-mile fiber/coax link and into the Convention Center.
- The actual videotape from the first satellite transmission test of the Advanced Compatible Television I (ACTV I) signal was featured at the David Sarnoff Research Center booth. Scientists at the center transmitted the ACTV I signal 44,000 miles round trip to and from a 40 watt Ku-band transponder May 9.
- Jerrold announced its program to pursue research into advanced TV, evaluating coax, fiber and satellite delivery. With a test facility to be operational by year's end, the Jerrold Applied Media Lab plans subjective and consumer preference testing. The company has already purchased test and demonstration equipment.
- Finally, Zenith demonstrated its Spectrum Compatible HDTV System via computer-simulated pictures on a large screen projection TV. According to Zenith, the system offers twice the horizontal and vertical resolutions of NTSC. It is designed to use an extra, unallocatable 6 MHz channel in the VHF/UHF spectrum as an HDTV augmentation channel.

Fun and games

The SCTE Rocky Mountain Chapter, CT Publications, the Colorado Cable TV Association and the National Cable Television Institute are hosting the first annual Cable Games at this month's CCTA convention, July 19-21 at Marriott's Mark Resort in Vail, Colo. Judge Ted Hartson of Post-Newsweek Cable will preside over the competition, with technicians and engineers from area MSOs and cable systems competing for medals (and a traveling trophy to the company with the highest aggregate score). Entrants will be judged on their skill and accuracy in performing four tasks: drop cable splicing, .500/.750 cable splicing, passive testing of active equipment and using a time domain reflectometer.

Speaking of shows, I'm writing this letter in Orlando, Fla., on the eve of SCTE's Cable-Tec Expo. Who knows what technical events and surprises this show will bring. But just in case you weren't able to make it, fear not; next month's *CT* will provide our wrap-up of the expo in words and pictures. Don't miss it!

Rikki T Lee

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Summit Media acquires CT Publications Corp.

GOLDEN, Colo.—Summit Media International, publisher of *Media Business, Media Business Review* and *Newspapers & Technology*, recently acquired CT Publications Corp. (CTPC) of Englewood, Colo. CTPC publishes *Communications Technology, Installer/Technician* and *Cable Strategies*.

This acquisition will reunite Summit Media President Paul Maxwell and CTPC President/Publisher Paul Levine. Under the agreement, Levine will become president and chief operating officer of Summit Media's newly formed cable TV division and will oversee day-to-day operations of that group.

Rikki Lee

Members of the Taiwan delegation pose with Bob Toner (front row, right) at the NCTA Show.

Chinese delegation invades NCTA Show

DALLAS—Seeking programming agreements for CATV operators in Taiwan, a Chinese delegation (including top leadership of the Cable Television Association of the Republic of China) met with exhibitors here at the National Show in May. Although franchises haven't yet been awarded, a 100-mile test system carrying 24 channels initially will be constructed, with a projected startup date of July 1, 1990.

The new system, to be built in Taipei, will provide a test of technologies including microwave, fiber optics and 500 MHz gear. About 100 MATV systems currently are operating in Taiwan, which has four off-air broadcast stations. Taiwan, an island of 20 million people and 7 million homes, now supports a three- to six-channel MATV service with average per month revenues of about $6 to $7 and installation charges between $50 and $100.

Anixter sells 100th Laser Link

DALLAS—At a press conference during the National Show, Anixter Cable TV announced that Westmarc Communications' Cape Cod Cablevision recently purchased the 100th Laser Link fiber-optic system. Cape Cod will employ five AM fiber nodes using the second generation LLR series Laser Link receivers. As well, 51 miles of AT&T LXE six-fiber cable will be installed in the system to link five towns in the area. To connect two headends, Anixter will provide its Video Link FM electronics manufactured by Synchronous Communications.

In addition, Anixter and Synchronous announced the signing of a two-year marketing agreement. Under the terms of the agreement, Anixter will be the exclusive marketing partner for all Synchronous products sold to the CATV industry in the United States, Canada, the United Kingdom and Europe.

Other announcements at the press conference included an agreement with Denver-based Rifkin & Associates, whereby the MSO's Suwanee, Ga., system will use over 20 miles of fiber-optic cable to carry FM signals from the main headend to four hub sites. Also announced was Anixter's agreement to supply 83 miles of fiber cable as well as electronics to Suburban Cablevision in East Orange, N.J.

In other news from the show, Anixter announced the completion of Laser Link installations for two Tele-Communications Inc. systems. The Corvallis, Ore., system will use the Laser Link to reduce the cascade on an 11.5-mile supertrunk. According to Dave Willis, TCI's director of engineering, "Not only was there an immediate and significant improvement in the quality of delivered pictures, but the equipment performance levels far exceeded our expectations." Another installation was recently completed in TCI's Millbrae, Calif., system, where operating specifications were said to have exceeded those reported in Corvallis.

RMT employee wired for sting operation

REDONDO BEACH, Calif.—It was not a normal Wednesday for Chuck Blanchard, regional sales director at RMT Engineering's Southern California office. He received a call from the company's home office in Sunnyvale, Calif., that someone in Blanchard's area wanted to sell test equipment. There was a good possibility that this equipment had been stolen.

Blanchard made arrangements to meet with the dealer the next day. After discussing prices, the dealer told Blanchard that there was other equipment available and only cash was acceptable. The dealer went to his car and returned with a field strength meter, which he agreed to sell for $500. Blanchard made a mental note of the serial number and arranged for the transaction to be completed the following day.

RMT's computer produced a record of having repaired the meter two years ago; the meter belonged to Century Cable of Redondo Beach. A phone call to the system revealed that this particular meter had indeed been stolen in 1987 (at least the thief had waited for it to be repaired). At this point the local authorities were contacted.

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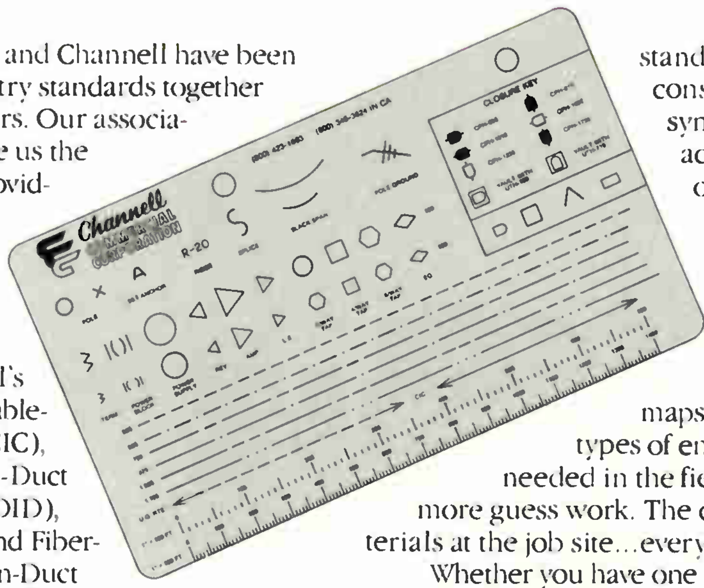

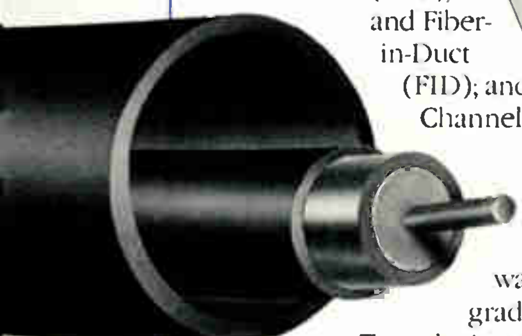

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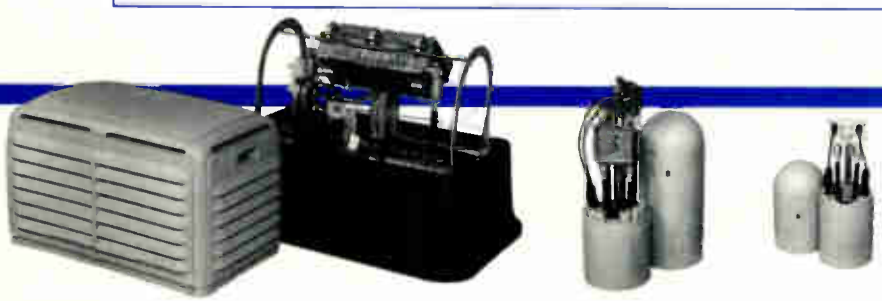


Channell COMMERCIAL CORPORATION

According to the police, the only way to catch the thief and retrieve the meter was to wire someone with a hidden microphone, meet the dealer and get him to admit the meter had been stolen. Since Blanchard had made the initial contact, he was the logical choice.

The next day, he met with the Undercover Division of the Redondo Beach Police Department. At the station, he was briefed on the sting operation and was fitted with a hidden microphone and a light armor vest. Soon, Blanchard and the detectives met near the arranged location, the Miami Spice restaurant. By the time Blanchard entered, the Los Angeles Sheriff's surveillance team was in the parking lot and the undercover team in the restaurant, all in place.

As expected, the suspect was there. Blanchard talked with him about the meter and other items for sale. After getting the suspect to admit to the theft, the booth was surrounded by detectives and the perpetrator was handcuffed. In the trunk of his Mercedes he had stashed several converters, meters and a commercial grade camera. So the police arrested the thief, Century Cable received the stolen meter and Blanchard saved the day.

National Cable Museum names Riker director

UNIVERSITY PARK, Pa.—William Riker, executive vice president of the Society of Cable Television Engineers, was recently appointed to the board of directors of the National Cable Television Center and Museum (NCTCM). He was also named to the NCTCM Education Committee.

The NCTCM, located on the campus of Penn State University, was established in 1986 to provide educational and training opportunities about CATV and its services to the public; establish a comprehensive national archive of the history and development of CATV and to take oral histories of its founders and of leaders from the private sector and government; maintain a repository for the documents, programming and artifacts to preserve them for research and scholarly activity; and monitor the development of cable and allied broadband communications services as they relate to subscriber services and to actively pursue their future development for the public good. Since the official opening Oct. 4, 1988, the NCTCM facilities have been used by the students for educational courses, lectures and seminars on CATV technology.

ALS, Adcom sign pact with Rogers

TORONTO—In what is being called the largest fiber-optic transport system sale in CATV history, Rogers Cablesystems of Canada recently signed an agreement with American Lightwave Systems (ALS) of Wallingford, Conn., and Canada-based Adcom Electronics Inc. Under the terms of the agreement, Rogers will purchase an ALS fiber-optic network through Adcom for the MSO's Toronto metropolitan area system.

ALS will provide all the electronics of the system plus status monitoring and control software; Adcom will supply system integration of hardware including optics and switching systems and additional control software. The total purchase price is approximately $5 million, with delivery of the network and control software planned for the last quarter of 1989.

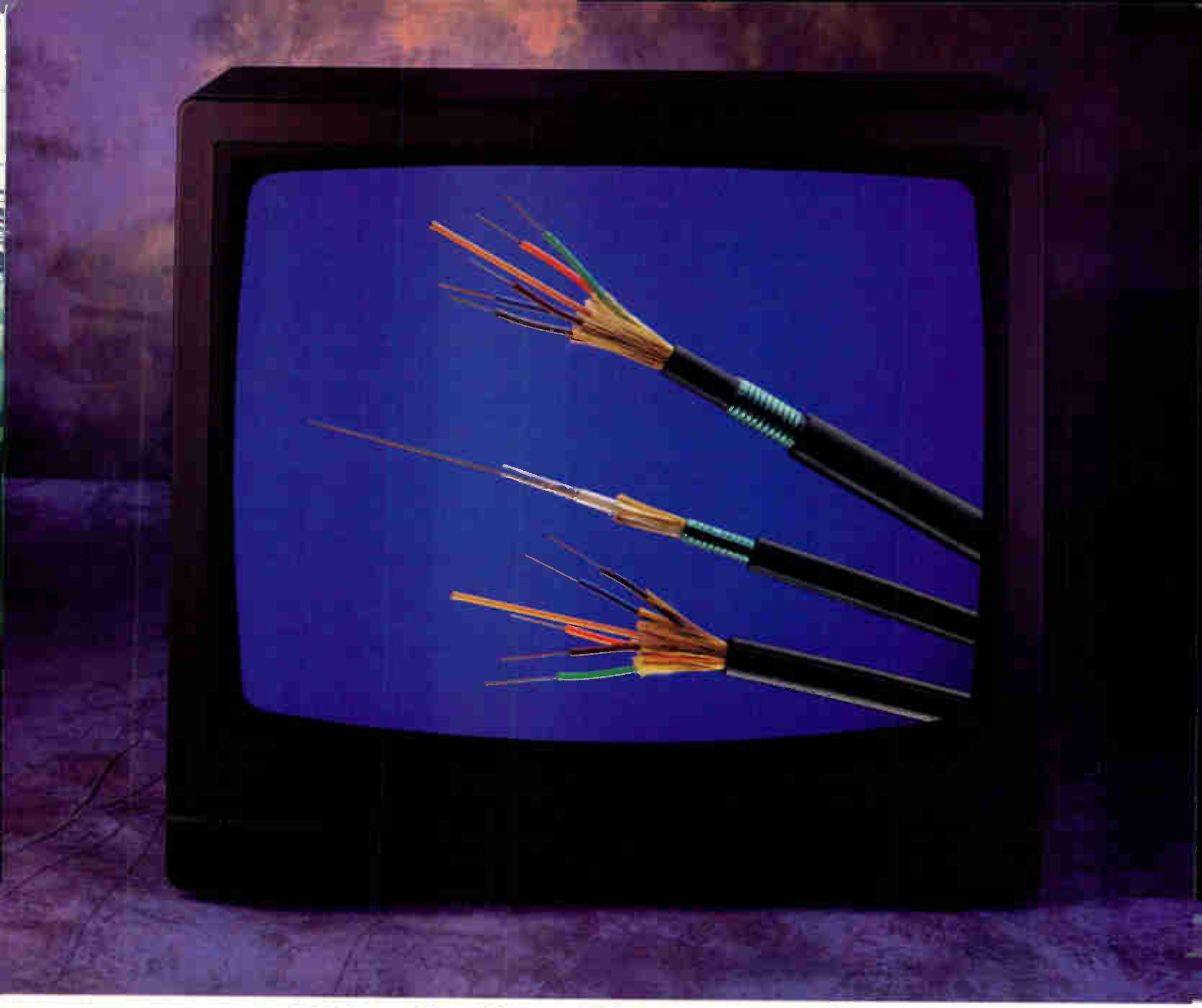
Industry loses pioneer Parsons

FAIRBANKS, Alaska—One of the original pioneers of CATV, Ed Parsons, died here May 23 at age 82. In November 1948, Parsons set up his antenna atop a local hotel in Astoria, Ore., and strung twin-lead cable to his home. This allowed him to receive off-air transmissions from KING-TV in Seattle. Shortly thereafter, he distributed the signal to other homes in his neighborhood.

After building several other CATV systems in the northwest United States, Parsons moved to Alaska. While becoming involved in constructing aeronautical navigation and communications sites, he also built a CATV system in Point Barrow, Alaska—the northernmost city of the 50 states.

National Show notes

- Zenith Cable Products is planning to expand its role as a supplier of addressable decoders to the international market. Zenith has



already begun shipping its RF converters to France and announced agreements with companies in Venezuela, Colombia, Barbados, Indonesia, Netherlands Antilles, Finland and Sweden. Also, Zenith reported that it shipped its first multiport decoders last month; its first customers included TeleCable Corp. of Norfolk, Va.

- The Fiber Connection Inc. is planning to hold two training classes on fiber optics throughout the country for the CATV industry. The first class consists of splicing (mechanical and fusion) and construction, while the second class will include design, engineering, construction and electronics. Several manufacturers of fiber equipment are becoming involved in the classes.
- ISS Engineering announced a reorganization of its distribution. The authorized distributorships for the CATV market have been reduced to eight national distributors. They are: Passive Devices Inc., Fort Lauderdale, Fla.; Jerry Conn Associates Inc., Chambersburg, Pa.; Robinson Communications, Birmingham, Ala.; Cablenet Supply, Eden Prairie, Minn.; Spectrum, Bedford, Texas; Mega Hertz, Denver; Western CATV, Torrance, Calif.; and Com-Tek, Hayward, Calif.
- Capital Cities/ABC, NBC, Group W Broadcasting and Tribune Broadcasting announced they would participate with Tele-Communications Inc. in a 10 to 12 city test of the Faroudja Super-NTSC advanced TV system.
- Standard Communications Corp. named Toner Cable Equipment as CATV industry distributor for Standard's SATCOM Division products. According to the agreement, Toner will distribute Standard's complete product line.
- Catel Telecommunications and Reliance Comm/Tec Corp. announced an agreement to develop fiber-to-the-home products. The resultant product offering is anticipated to provide a near term, economic justification for fiber-based voice, data and video services in the local loop while positioning its users for future broadband capability. The two companies are currently negotiating with several regional Bell Operating Companies, major independents and MSOs to establish field trials to take place by year's end.
- Pioneer announced that the recent order from Warner's Brooklyn Queens Cable systems for Pioneer addressable converters brought the total of these products used by BQ Cable to over 275,000 units.
- Midwest CATV recently opened a new warehouse in Phoenix to serve 11 Western states. In addition, Midwest became the only authorized stocking distributor of Jerrold fiber-optic products. Also, it is now carrying the Milenium line of multitaps and passive devices manufactured by Antronix.
- Scientific-Atlanta recently completed shipment of 82 Model 6380A stereo encoders to Adelphia Communications' systems in New York, Virginia, Pennsylvania and Ohio. S-A began shipments of its Models 8590 and 8595 addressable volume control converters to Cox Cable Jefferson Parish, La. It also will supply Model 8595 addressable set-tops to Comcast Cable Communications for six sites in New Jersey, Mississippi and Arkansas. In addition, S-A will supply 18 AM fiber-optic transmitters and bridging amplifiers for Jones Intercable's rebuild in Turnersville, N.J. Finally, TKR Inc. will employ S-A feedforward and AT amplifiers in the MSO's rebuild of the Rockland, N.Y., system.
- The Cable-Satellite Public Affairs Network converted its entire operation to Panasonic's MII videotape format, which, C-SPAN says, makes it the first U.S. network to use the new format exclusively. The 1/2-inch MII format enables a cassette to hold up to 90 minutes of recording time, compared to other available portable systems that limit cassettes to only 20 minutes of tape.
- BradPTS was selected as one of three converter and CATV service organizations to provide nationwide repair and remanufacturing on converters, headend and other equipment for all Jones Intercable systems.
- ComSonics is now offering flyovers, an alternative to ground-based CLI (cumulative leakage index) measurement. Recognized by the Federal Communications Commission's Part 76.611, this option utilizes airborne test equipment to perform an aerial inspection of the entire cable plant. This service also generates a statistical summary of the test data as well as indicating excessive leakage areas.
- David Pangrac, director of engineering and technology for American Television and Communications Corp., received the 1989 Vanguard Award for Science and Technology. Pangrac was honored for his development of the ATC fiber backbone concept for AM broadband transmission.

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HDTV—An interim proposal

By Isaac S. Blonder
President, Blonder Broadcasting Corp.

American TV is popularly proclaimed as being born at the 1939 World's Fair. Maybe so, but I was a visitor to the fair along with a fellow physics student; nothing like that crossed our eyeballs. Later on, in the spring of 1941, I was employed at the General Electric radio factory in Bridgeport, Conn., where gossip opined that the laboratory was secretly copying an RCA TV receiver for production next year. Of course the war canceled civilian electronics and television didn't really come out of the diapers until 1946.

It does seem that every new facet such as UHF, color or stereo sound when added to the TV jewel suffers from obstreperous obstacles no less serious than a war. High definition TV's greatest handicap may be the surfeit of inventors. The heyday of an NTSC committee format where everyone labored toward a common goal and employed the best ideas regardless of the patent implications is over; the Federal Communications Commission will be forced to flail the ideas and toss out the chaff as best as it can without a consensus from industry.

50 years old?

Television is now 50 years old (43 by my reckoning). The NTSC format is one of the major engineering miracles deserving of the highest honors our country could have awarded. Perhaps it is not too late for our "kinder and gentler" president to declare an annual holiday and stage impressive ceremonies that would highlight the good life we citizens enjoy as a result of the deliberations of the NTSC participants!

To arrive at an interim solution for HDTV we need to consider the cost to the consumer as the first priority and universal improved TV as the ultimate goal. NTSC is a proven, rugged, low-cost scheme useful in every delivery format. Any variant of NTSC that is not totally compatible would require the expenditure of billions of dollars to replace an existing TV infrastructure that is totally satisfactory to everyone except the prophets who can see the future but not its birth.

Terrestrial broadcasting will remain the lowest cost television for the low income citizen, of course without the richness in programming available from a pay service such as cable. But our society needs to love even the poor among us. Black and white TV will survive as the lowest cost viewing device; 20 percent of the receivers sold today are without color. Compatible HDTV should be the order of the day.

However, if spectrum space can be found and the inventors deliver HDTV in 6 MHz, then we could be free of the fetters of NTSC and perhaps a generation later NTSC could be abandoned if the low-cost version is no more expensive than today's black and white special. Mobile TV has its place; one often desires and even is dependent upon the ability to receive television away from a fixed site.

The interim proposal

Without fear or favor for the declared proponents of HDTV, here is my interim proposal: Within the constraints of 6 MHz, the lowest cost enhanced technology that eliminates most of the artifacts now plaguing NTSC should be offered as an alternate standard to be employed on a voluntary basis by the broadcaster (or cable, etc.). Also, 12 MHz should be assigned to all UHF TV with the additional 6 MHz to be internally used for HDTV or leased to other broadcasters for any useful purpose. The highest quality HDTV proposal using up to 12 MHz should be approved by the FCC only after giving all comers time to perfect their system, even if it takes five years.

Ultimately, this new HDTV scheme will be made obsolete by some yet unborn technology, probably by a fully digitized format viewed through a 3-D pair of lightweight glasses self-powered and remotely fed. Meanwhile old faithful NTSC will still be hypnotizing its audience and for less bucks for the bang!

CLI: It's not just for engineers anymore

By Ted Hartson
Vice President and Chief Engineer, Post-Newsweek Cable

Any industry utilizing technology requires technicians or engineers to keep things working. Beyond simply constructing and repairing technical things, the person who does all this also should be a translator and express technical issues to non-technical people in a non-technical way. This person conversely takes generalized goals and direction from management and translates them into tasks for "teckies." All too often technical personnel adroit in technical capability fail miserably in the role of translator. Most managers are not especially technical and hence rely on the constructive recommendations of their technical staff to outline the scope of a technical task.

In matters related to compliance with regulation, the manager may not be fully versed in the technical nuance of the issue. The engineer may lack the sense of importance associated with the regulatory issue. A special relationship must exist if technical regulatory issues are to be dealt with to the satisfaction and detail required by all parties.

It is simply unfair for management to expect technical personnel to undertake and manage a system's signal leakage compliance program without the involvement and support of management.

Effective management of a signal leakage program takes:

- a plan that can be easily understood and periodically reviewed,
- time to monitor for leaks and an orderly process for their repair,
- money for adequate leakage detection equipment and necessary repairs and
- encouragement and praise.

Trained for centuries

Every manager I ever knew was good at the first, most were good at the last, but a few would rather eat a bug than spend time or (worse yet) money. Some managers have been trained for centuries to avoid engineers looking for money. A comprehensive leakage monitoring program must have the support and cooperation of everybody in the company if it is going to work. The manager must provide a clear-cut message as to what is expected. Saying "go fix the leaks" is a copout. Time necessary to patrol, isolate and repair leaks must be provided on a regular basis. Leakage monitoring is as much a part of a modern cable system as installs, reconnects and non-pay disconnects.

No manager would hand out disconnects and say, "Do these if you have nothing else to do." Yet how many of us say, "Look for leakage while you're out doing your regular work"? Casual leakage patrolling will not identify enough leaks fast enough to get an undermaintained system into compliance. If your leakage program has been weak, a concerted effort will be necessary to clear the backlog of problems presently going undetected.

"It is important to remember that the most severe leakage in a system usually occurs in aluminum plant."

Another big mistake: "If you hear a leak, stop and fix it." You will be amazed how hard of hearing an otherwise healthy installer can be at 4:45 p.m. on Friday. Make it easy to report a leak; radio dispatch is the best. Then integrate this job into the regular work schedule. It is not realistic to expect people to diligently search out that which increases their workload.

As a rule of thumb, a system should find and fix about one leak for every two miles per month. If your system is well below this volume of activity, you either have a very tight system or an ineffective maintenance program. Any system can be sufficiently leak-free to pass the CLI requirements. The older the system, the higher the degree of maintenance that must be afforded the plant to hold acceptable values of CLI. The final resolution to nearly every leakage issue is to tighten; most leaks are caused by something loose.

If you are accelerating your leakage activity, it is important to remember that the most severe leakage in a system usually occurs in aluminum plant. That's where higher level signals are carried in the feeder and to some extent the trunk. When a break occurs or something gets loose, fields much larger than those associated with drops occur. This doesn't mean to ignore the drops. But it's a good idea to get the "big guys" first since they create the greatest exposure to the FCC, and the "big guys" are in the aluminum. Then go back and work on the drops.

An extremely effective leakage control device is available in every hardware store; it's a 7/16-inch wrench. Any person who doesn't wrench-tighten drop fittings is making unnecessary work for everybody.

Touring the system

Every manager can benefit from a tour of the system. The view from the right seat of truck with a "whoop-whoop" coming out of the leakage detector is far different than behind a desk looking at your P & L.

In the final analysis, both are equally important. We still have a year to get compliance under control. In Nevil Shute's classic *On the Beach*, the last scene is a banner proclaiming, "There's still time, brother."

There is, but not much.

Antenna considerations for controlling leakage

By Ted J. Dudziak
Director of Engineering, EIP Microwave

The required methodology for making ground-based field strength measurements in determining the cumulative leakage index (CLI) is well-described in Section 76.605 of the Federal Communications Commission rules. It states: "The resonant half wave dipole antenna shall be placed three meters from and positioned directly below the system components and at three meters from the ground." While this measurement technique will ensure a consistent standard in terms of the law it does present certain logistical problems if the cable operator is to perform the measurement process on a routine basis. Any measurement alternative should have traceable performance to the legal standard.

An antenna will provide a terminal voltage when placed in an electric field according to the following relationship:

$$dB\mu V = dB\mu V/m - K \quad (1)$$

$$K = 20\log(f) - G_{dB} - 31.54 \text{ dB} \quad (2)$$

where:
K = antenna factor in dB
f = frequency in MHz
G_{dB} = gain of the antenna over an isotropic

Any antenna should be able to be used for field strength measurements

Figure 1: Horizontal antenna patterns

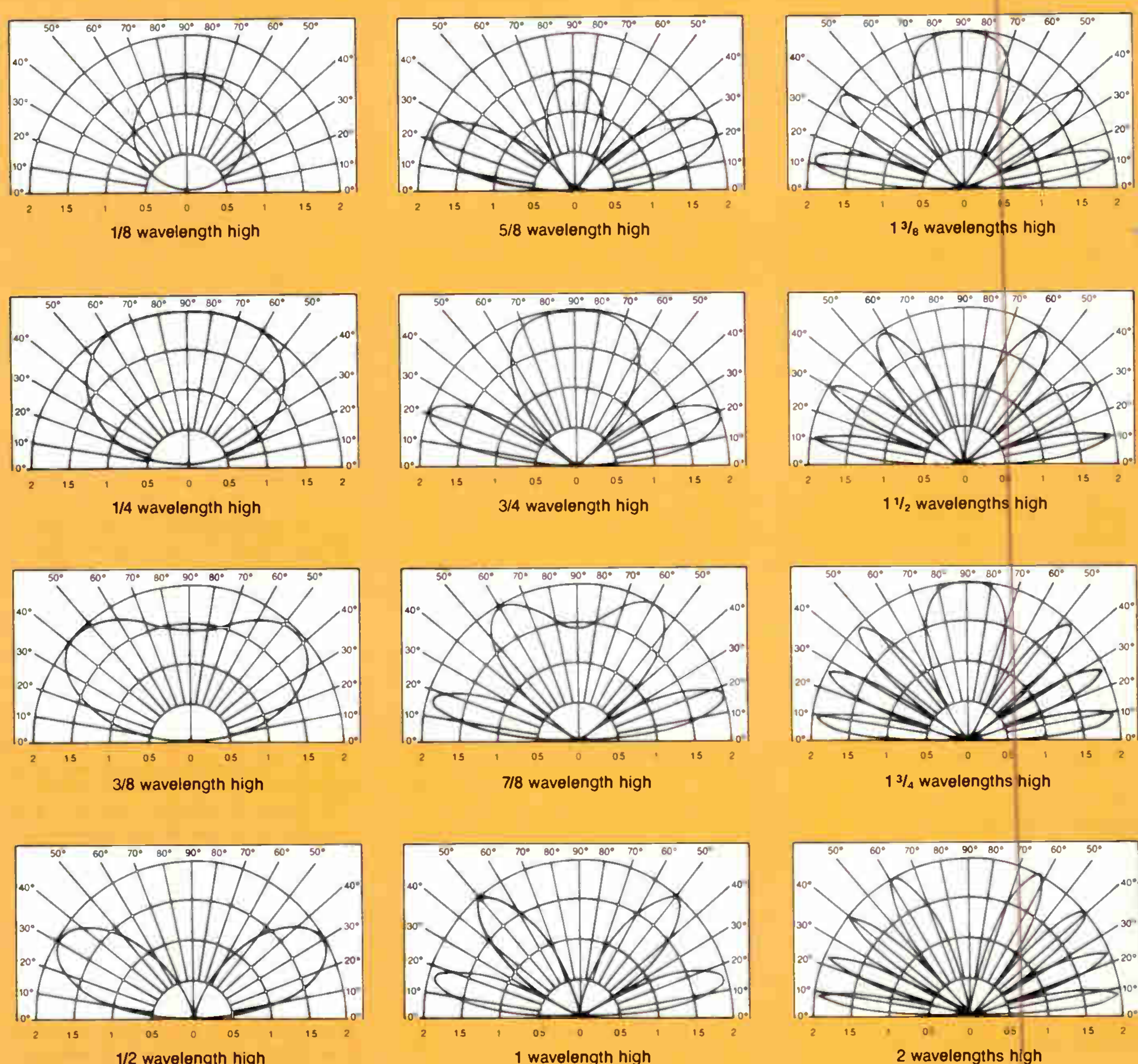

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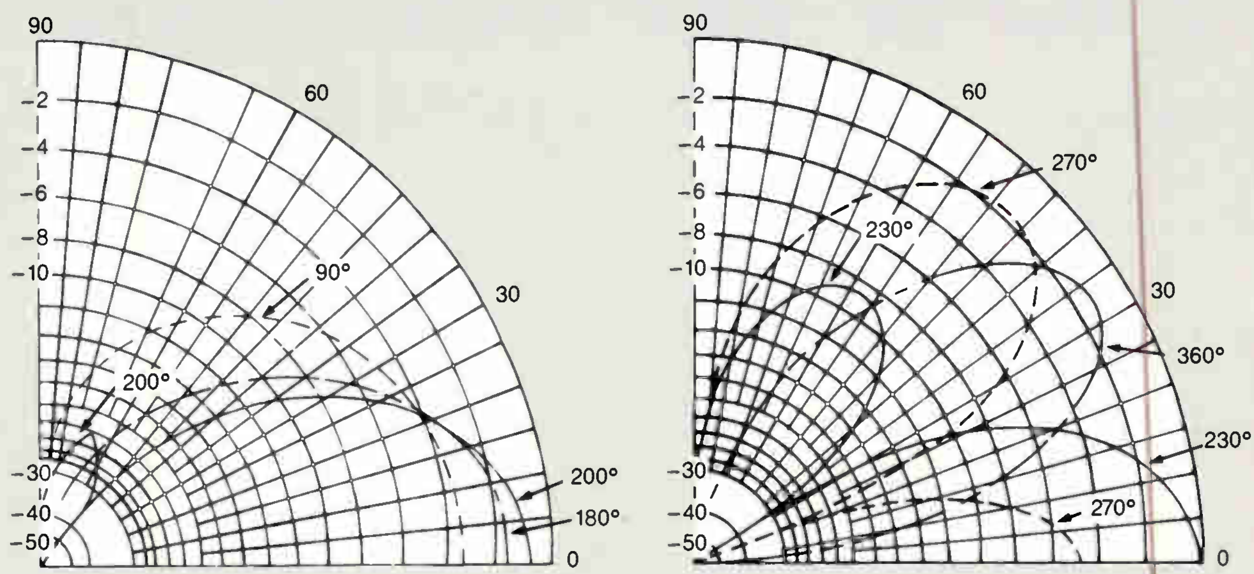
Figure 2: Vertical antenna patterns



if its antenna factor can be established. The antenna factors can relate the measured terminal voltage to that obtained with a dipole. The user can then be assured that the field strength measurements made with the alternative antenna are representative of those obtained using a dipole. More suitable measurement techniques will encourage routine quantitative characterization of leaks resulting in better control of leakage.

Currently there are two measurement alternatives accepted for the CLI process. First is the use of the inverse distance law that relates field strength to the distance from the RF source. By using this relationship, measurements can be made from a more practical distance and the measured results extrapolated to the actual distance. The assumption is more sensitive to parasitic effects such as reflections from conductive elements (power and phone lines) as well as any other reflective elements (such as buildings).

The second alternative is the placement of the measurement dipole on a vehicle roof at a height of one meter. An antenna height of less than several wavelengths above ground or a reflective element acting as ground causes a distortion of the antenna pattern and the resulting gain at various radiation angles. Knowledge of how the pattern is affected will ensure that the proper interpretation is made of the field strength readings.

Alternative antennas

The purpose of this article is to present information about alternative antennas that may be used for leakage measurements. Antennas can be classified by their polarization: horizontal, vertical or circular. We will discuss antennas that have vertical and horizontal polarization. Additionally, direction finding (DF) and near-field antennas will be discussed.

Half wave dipole: This is a well-characterized radiating element that exhibits a gain of 2.14 dB over an isotropic antenna. It is the practical standard used for most antenna work; most other antennas are related to it. However, it cannot be used indiscriminately. The radiation pattern and overall gain are easily affected by parasitic reflective elements. The strategic placement of parasitic elements and the resultant effect on the overall antenna pattern is of course the basis of the Yagi-Uda design. Using Equation 2 the antenna factor for a half wave dipole is given as $K = 20\log(f \times 0.021)$.

Figure 1 illustrates the pattern distortions that can occur for various antenna heights. What results is that the gain of the dipole varies at different angles of radiation. A certain antenna height has advantages over other heights when measuring emissions. Leakage measurements in an easement made from the street will have a low angle of radiation. Made on a strand directly above the CLI vehicle, they will have a high angle. These pattern distortions should be taken into account if CLI measurements are to be directly correlated to those made with a dipole outlined in Part 76.605.

One way to minimize pattern distortion is to select a measurement frequency compatible with the desired antenna height. There are two measurement scenarios: The first is with the dipole three feet above the roof of a vehicle and the second is outlined in Part 76.605.

Table 1 has the antenna heights in wavelength for each of these scenarios at different frequencies. Note the pattern variation between heights at 118, 225 and 400 MHz (3/8, 3/4 and 1¼ wavelengths). The pattern at 118 MHz gives a good overall coverage except at low radiation angles, which will be experienced when the leak is in the easement; these leaks will be covered better with higher antenna heights. In a similar manner, leaks directly above a vehicle will be covered well with an antenna height that has a predominant response at high angles of radiation.

A popular vehicle configuration is to mount a dipole a very short distance (eight inches) above the roof. Although somewhat difficult to characterize, the resultant antenna pattern will be similar to that of the eighth wave pattern for the frequencies in Table 1. As the dipole is raised above the ground, reflections become less predominant and the free-space radiation pattern emerges. The nulls will be less distinct since there is rarely perfect reflection from the ground surface. The patterns for low antenna height will be typical for vehicle configurations, while the patterns for high antenna height will be typical for walkarounds.

Yagi-Uda: The Yagi-Uda (or Yagi) antenna has two characteristics that can assist in leakage measurement and detection. The antenna gain can be used to overcome problems that a dipole will have with increasing frequency and to extend the measurement range. An improved front-to-back ratio and reduced gain on the sides of the antenna will minimize the effects of interference from reflections and other leak sources.

A Yagi's multielement configuration and resulting size dictate that a high frequency of operation be used. However, at 225 MHz the total boom length of a four-element Yagi is less than three feet. A four-element Yagi will exhibit 8 to 9 dB of gain over a dipole, 20 dB of front-to-back ratio and good side lobe performance. A 4 percent bandwidth can be expected at the frequency of interest.

One might consider modifying a commercial off-air Ch. 13 antenna for operation in the upper aeronautical band. The antenna can then be

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Table 1: Antenna heights related to frequency of measurement

f	L	10/L	3/L	0.666/L
72 MHz	13.0 feet	0.76	0.231	0.051
108 MHz	8.6 feet	1.20	0.349	0.078
118 MHz	7.9 feet	1.30	0.378	0.084
137 MHz	6.8 feet	1.50	0.439	0.098
225 MHz	4.2 feet	2.40	0.721	0.159
400 MHz	2.3 feet	4.30	1.280	0.290

Table 2: Four-element Yagi dimensions

Dimension	Wavelength
Driven element to reflector	0.20
Driven element to first director	0.20
First director to second director	0.25
Reflector length	0.51
Driven element length	0.47
First director length	0.45
Second director length	0.44

trimmed for the operating frequency of interest. A return loss bridge and a bench sweep can be used to retune the antenna. Overall guidelines are listed in Table 2 for a four-element Yagi.

Vertical antennas

The use of vertical antennas for use in all leakage activities will always be in doubt. The predominant polarization of a leak has been argued for some time. According to the law, the use of a vertical antenna is not acceptable. However, it has been shown that most leaks will exhibit both polarizations when measurements are made at a distance. In terms of controlling leakage a vertical antenna can be used to make a field strength measurement. Some determination of the leak severity can then be made. However, decisions should be made on the pessimistic side.

The use of a vertical antenna should be done with the same caution as for horizontal antennas. Parasitic reflectors on a vehicle will cause a distortion of the antenna pattern, which could result in nulls in the response. These reflectors can come from other antennas or metal objects such as booms and ladders. The objects should either be moved or the overall pattern of the vehicle characterized. Figure 2 shows the antenna patterns for vertical antennas of different lengths. The lengths are given in electrical degrees.

The 1/4 wave vertical is a popular choice. It exhibits 3 dB gain over a dipole and is easily configured on a vehicle. It does, however, exhibit a null at high angles of radiation, as shown in Figure 2. This antenna can be configured for multiple frequencies to give coverage in all three aeronautical bands.

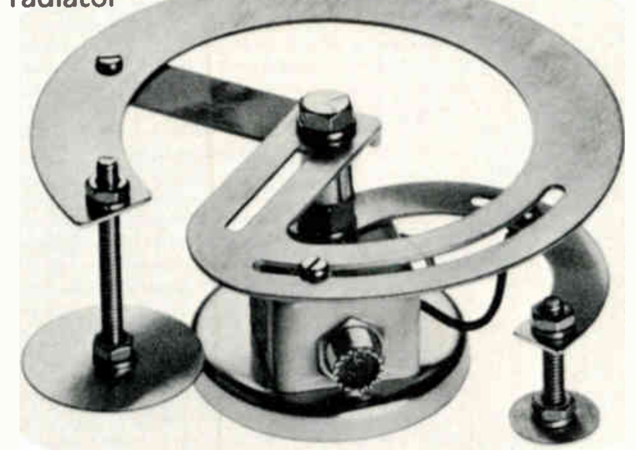
The 5/8 wave vertical antenna exhibits 3 dB of gain over a 1/4 wave but has a significant lobe at high angles of radiation. This can be a benefit since leaks directly overhead will be covered better. A matching network is built into the antenna base because the 5/8 wave is not electronically resonant at the desired operating frequency. The matching network brings the antenna into resonance at 3/4 wavelength. The antenna also will resonate at frequencies in which the physical element is 1/4 and 1/2 wavelength. The result is that other off-air signals will be received and may show up as intermodulation components in the receiver.

The multiple response of a 5/8 wave antenna also can be used to an advantage. Monitoring frequencies can be picked so that several frequencies are scanned. This can give more coverage with one antenna.

Directional discontinuity ring radiator (DDRR) is an interesting variation of a vertical antenna. Shown in Figure 3, it has an overall antenna height of 2½ inches and a diameter of 8 inches for a unit tuned to the aeronautical band (121.25 MHz). The DDRR is intended for use on a vehicle. A radome is available to protect it from the weather. This antenna has a similar radiation pattern to a 1/4 wave whip. It exhibits unity gain; however, its high Q gives it narrow bandwidth, which makes it ideal for areas with high intermodulation from off-air signals. For a 2-to-1 standing wave ratio, the DDRR has a 3 MHz bandwidth vs. the 10 MHz bandwidth of a 1/4 wave vertical.

The DDRR has the advantage that it requires very little ground plane area to achieve its characteristics. This suggests that this antenna could be mounted on the front of a vehicle; this may be a consideration if roof space is a premium.

Figure 3: Directional discontinuity ring radiator



Rubber duckies and others

A popular antenna for use in portable detection is the "rubber duckie." The types used on communications transceivers are 1/4 wave helically wound antennas that have a narrower bandwidth than conventional 1/4 wave verticals. Scanner-type "rubber duckies" also may be helically wound, but generally have a somewhat broadband characteristic. Neither design has well-characterized gain; however, the wider bandwidth scanner antennas are more suitable for portable detection and location of leaks than are communications transceiver "rubber duckies."

Direction finding (DF) antennas: Several types are available; the references contain many examples of DF antennas and their application. One of the simplest vehicle-based DF techniques is to use two Yagis at a frequency in the high aeronautical band. The gain of the antenna will make up for any anticipated free-space losses and the directional characteristics will allow isolation of the leak. The initial direction of the leak can be determined with each Yagi oriented toward each side of the vehicle. Switching between each antenna will tell the technician where to start the search.

A more sophisticated approach is to use multiple vertical antennas and Doppler techniques. Several antennas can be switched electronically and the direction of the incoming signal can be determined from the relative phase of the signal at each antenna. The relative bearing can be read out on an indicator device giving the initial direction of the search. These devices seem to be very sensitive due to multipath and require a lot of patience to use. False indications while the vehicle is in motion as well as at rest are very common.

These systems usually use an audio tone as the antenna commutating signal. The recovered audio is then used to determine the bearing of the signal. The audio tone is usually placed at the lower corner frequency of the audio response at most receivers. Its placement causes some problems if the receiver does not have adequate response at the commutating frequency. Future possibilities include real-time processing of the recovered Doppler signal to determine the validity of the reading. Another possibility is to place the commutating tone within the audio passband of the receiver to ensure a reliable bearing indication.

Near-field loops: Once a leak is detected it must be located, isolated and repaired. Isolating a leak is usually the most difficult part of the task. Near-field probes can assist in this process by using the magnetic field

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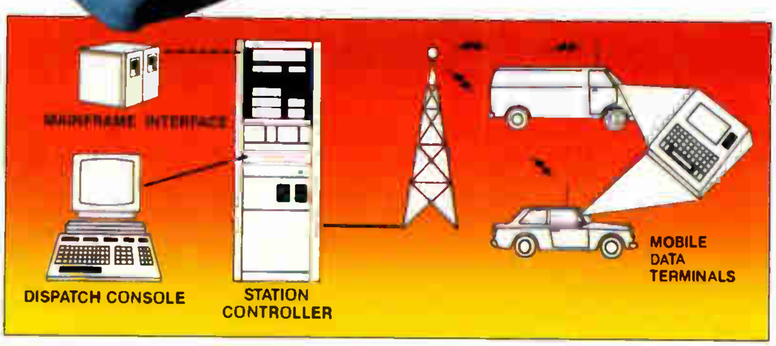

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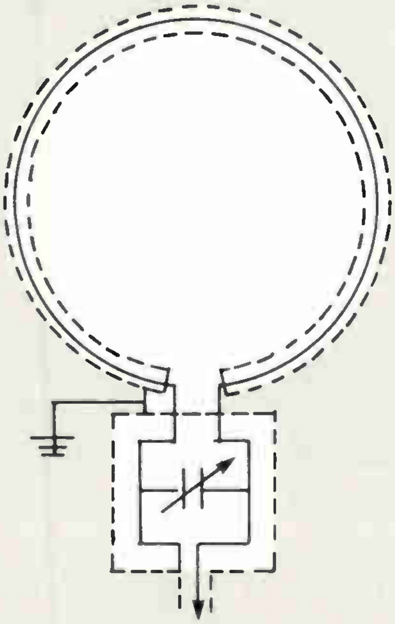
Figure 4: Near-field loop



of the leak instead of the electric field. The magnetic field has a more pronounced attenuation effect with distance and does not seem to exhibit the same extreme standing wave effects that electric fields demonstrate.

The classic near-field loop is shown in Figure 4. It is easily constructed, commercially available and is usually tuned to one frequency. There is no specific calibration requirement except that it be tuned for maximum response. Once connected to a sensitive RF voltmeter it is moved along the strand until a maximum response is achieved.

Another type of near-field probe is a very short vertical antenna. These are usually used with portable detection equipment to locate a leak when the receiver is very near to the source. They take the form of a short, single element attached to the input of the receiver. The effect is to desensitize the receiver and allow variations in field strength to be noted.

Understanding antenna behavior

The best reference for a practical and theoretical understanding of antenna behavior is the American Radio Relay League's *Antenna Book*. This reference is revised on a regular basis so that some of the material might not be repeated every issue. However, much of the basic material has not changed since the early 1950s and is repeated unchanged. Much of what has changed is related to current work in the amateur arena. It is this author's view that the 1970 and 1988 issues represent good overall references for any technical personnel who has to deal with antennas.

Acknowledgement: Several of the illustrations in this article are used with permission of the ARRL.

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CATV and amateur radio: Toward peaceful coexistence

By Jonathan L. Kramer, KD6MR
Vice President of Technology, Communications Support Corp.

The title of this article exemplifies a primary desire of the majority of plant managers and technicians in our business. Why, then, does the issue of cable TV interference (CATVI) to amateur radio operations due to signal leakage continue to be a major concern for many operators? The parallel question is, "Are we destined to continue to stir the ire of hams?"

It is not the goal of this article to tell you how to eliminate CATVI. Rather the goal is, through understanding the underlying issues, to help you face the inevitable challenge head-on in a positive and productive manner.

History tells the tale

The history of our stormy relationship with amateur radio goes back to the early 1970s. As our industry graduated to provide our subscribers with more than the 12 off-air channel assignments, we ventured into the use of the mid-band to provide additional channel carriage capacity. This band of frequencies lies between 108 and 174 MHz.

As the pressure for additional channels grew and equipment manufacturers increased the operational gain and bandwidth (while decreasing the distortion products), we saw our industry expand into the super- and hyper-bands. But every time we expanded our channel carriage bandwidth, we encroached into someone else's primary domain.

The Federal Communications Commission views cable TV systems as non-broadcast facilities utilizing "closed" transmission links. In plain language, this means that we are required to deliver our signals without their leaking out of our closed, coaxial transmission systems. Our carriage of cable channels in the on-channel mid-band, super-band and other bands is on a secondary basis. That is, we can use these frequencies as long as we don't cause harmful interference to the primary (over-the-air) users assigned by the FCC.

Who are the FCC-assigned primary users of the CATV sub-, mid-, super- and hyper-bands? Aircraft, amateurs, fixed and mobile private two-way (like delivery trucks, taxicabs and railroads), and public safety (e.g., government, police, fire, forestry) two-way, to name just a few. The FCC has granted them primary authority for over-the-air use of frequencies that we use on a secondary basis. When we as secondary users leak our signals into the over-the-air world, we can violate our FCC authorization to be the secondary user. And this is how the real trouble begins.

The ham radio connection

It didn't take long for the relationship between the cable and amateur communities to deteriorate as hams began to hear the buzz of our sync centered on 145.25 MHz (Ch. 18 or E, depending on your channel designation scheme) in the lower portion of their 2-meter band. Additionally, some cable systems using Ch. 23/K (223.25 MHz) introduced a new and most unwelcome noise into the center of the amateur 220 MHz assignment.

Many ham VHF receivers in daily use have an operational sensitivity rated at or better than 0.5 μV. When you consider that some cable system leaks below 20 μV/m are not treated as priority issues by some operators, you can begin to understand how the rift between our systems and amateurs grew.

The American Radio Relay League (ARRL), based in Newington, Conn., represents over 100,000 amateur radio operators in the United States. Founded in 1914 as the principal legislative (read: "political") representative of the amateur community, the ARRL has taken a leadership role before the FCC in representing what the ARRL considers to be the significant detrimental impact of CATV leakage on amateur operations.

By January 1982, our relations with the amateur radio community had deteriorated to the point where the ARRL filed a Request for Proposed Rulemaking with the FCC asking that the cable industry be directed to cease using amateur frequencies. At about the same time, the ARRL established a "CATVI Desk" at its headquarters office as a central clearinghouse for amateur-generated cable leakage complaints. System- and corporate-level engineering representatives were invited to register themselves to assist in resolving complaints.

Throughout the late 1980s the relationship between amateur radio community and cable operators improved. This was due largely to the efforts of many diligent cable operators and plant managers who began to patrol their systems in earnest for leaks. Others made overtures to local amateur radio groups asking for assistance in locating leaks and correcting problems on a same-day or next-day basis. The ARRL and the National Cable Television Association have established a formal method of passing on CATVI complaints from hams to local cable operators.

Many operators are encouraging the hams on their technical staffs to get involved in local amateur radio clubs and meetings. American Television and Communications Corp. and Jones Intercable are good examples here. One of ATC's corporate engineers and a ham radio operator, Steve Johnson, spoke on CATVI issues at the 1988 ARRL Southwest Convention. His trip was sponsored by ATC. Jones Intercable's Roy Ehman, Bob Luff and Ron Hranac, also hams, have conducted several seminars on leakage, teaching many industry employees (including me) about the impact of and cures for CATVI.

How to fix that leak

You've probably noticed that I have not yet addressed the issue of correcting CATVI; I don't intend to. Many authoritative articles on the subject have been published, and I'm assuming that the reader knows how to identify leaks and make corrections. (Remember, your first cumulative leakage index filing is just around the corner.) Instead, I'd like to share some down-to-earth approaches to dealing with CATVI on a "people basis."

The best approach to solving a CATVI problem is to prevent it before it starts. By "problem," I don't mean the leak itself; I'm talking about the angry ham or subscriber who is demanding that you plug up the system *now*!

I knew of a system where the CSRs would discourage sales of specific premium channels in certain areas because of ingress tearing up the pictures. Not surprisingly, the local ham community was quite angry with the operator. The community had a VHF paging transmitter located within 100 feet of the trunk and several ham radio 2-meter repeaters were just as close. A quick trip to the system warehouse showed the just-hired technical manager that the techs were still using trunk and feeder connectors without integral sleeves. He ordered new connectors with sleeves, developed a preventive maintenance program to install them and let the techs loose.

The immediate results were that the system could sell pay services to a larger group of the subscriber base, which the general manager and sales manager loved. The technical manager actually got calls from hams asking what he had done to eliminate "that darned buzzsaw," which he loved. The number of calls for ingress went down to nearly zero, which the techs loved. (Oh yes: I was that technical manager.)

Have you identified the members of your technical department who are hams? Many systems attract hams as technical employees because of the parallel in hobby and employment. These "amateur ambassadors" (pun intended), if properly trained, speak both languages: ham and cable. They can empathize with the distressed hams—unable to hear their favorite local repeater over your sync buzz—and usually learn about many more leaks in the local area. This in turn can directly and positively impact your CLI by allowing you to find "hot spots" in advance of your routine drive-out or flyover.

How about asking your general manager to underwrite the cost of the newsletter of the local ham radio club (in trade, of course, for a reasonable sponsorship announcement)? I've used this particular tool with great success. It is a true "win-win" approach that, on a yearly basis, usually costs less than a couple of spot ads in the local paper.

Hams, as technically trained communicators, have a natural interest in the operation of your system and headend. Why not offer to show off your operation and, at the same time, tell them about what you are doing to track down and eliminate CATVI? By all means, show them your leakage receivers and explain how you patrol for leakage.

Let your franchisors (usually at city hall) know that you take complaints from hams seriously. At renewal/modification time, you may find yourself facing a group of angry hams offering the city fathers sample franchise language attempting to limit your use of ham frequencies.

But remember, none of these recommendations will be worth your consideration if you have not yet made your own commitment to addressing leakage in general and specifically CATVI. You will likely have a very narrow window of opportunity to resolve CATVI problems before a call goes to your local FCC field engineering office. (By the way, it is not unusual to find out that the FCC engineer assigned to investigate that nasty CATVI complaint logged against your system is also a ham operator.)

A people issue

CATVI is a people issue with a dark, long, underlying history. When you compare the current, relatively calm waters of CATVI with the past stormy seas, you might be lulled into believing that the problem is behind us. In fact, the problems we caused ourselves in the past could resurface with little warning. It just takes a little bad judgment (or neglect) to rekindle the CATVI fires. If we are to continue to use shared frequency assignments as secondary users, we must continue to put forth maximum effort to prevent leakage. Like most ongoing technical issues in our business, our commitment to resolve CATVI is directly reflected in how well we do our jobs overall. ∎

Ham operators in CATV industry

The following is a list (in alphabetical order) of amateur radio operators employed in the CATV industry. The 150 who responded to the request in the April 1989 issue of "CT" provided their name, call sign, company, location and modes used. This list was compiled by Steve Johnson of American Television and Communications Corp.

Acevedo, Nelson
KP4FEN
CATV Noroeste
San Antonio, Puerto Rico
SSB, FM, CW

Adel Sr., John
W5RR
Precision Electronics
Richardson, Texas
SSB

Allen, Fred
KAØYAE
United Artists
New Hope, Minn.
FM, SSB, NEWSLETTER ?

Almeyda Jr., William
NP4EX
CATV Noroeste
Aguadilla, Puerto Rico
CW, SSB, FM

Amos, Alan
KN1O
Jerrold
Stow, Mass.

Andrews, David
N1ESK
Storer
New Haven, Conn.
2FM, 10FM

Atkins, Gary
WØCGR
CSU Technical Services
Ft. Collins, Colo.
HF/CW

Bailey, Wendell
KC3BU
NCTA
Washington, D.C.

Barnes, Richard
W4IXN
Scientific-Atlanta
Atlanta, Ga.

Barnhart, Bill
AA5HH
Cadco
Garland, Texas
SSB

Bartlett, Dave
NØCQC
United Artists
Englewood, Colo.

Beeman, Paul
KA2MUM
Viacom
Smithtown, N.Y.

Bentley, Bill
KB5HOX
Times Mirror
Midland, Texas
HF, VHF, UHF, SSB, CW

Beuret, Kit
KH6JDE
ATC
Honolulu, Hawaii

Bourne, Dave
WB8TMP
Pioneer Communications
Columbus, Ohio
HF20-10, SSB, Packet

→

Bowles, Tom
W7VA
King Videocable
Seattle, Wash.

Bray, James
WØFBC
ATC
Kansas City, Mo.
HF/CW, SSB

Brillhart, Scott
N5JJZ
United Artists
Tulsa, Okla.

Burton, Jack
WB2CJS
Cablevision
Woodbury, N.Y.
2FM, 440FM

Carey, Bill
KC4BPK
ATC
Fayetteville, N.C.

Ciciora, Walt
WB9FPW
ATC
Stamford, Conn.

Clayton, Francis
AH6X
Kauai Cable
Kekaha, Hawaii
SSB, FM

Cohen, Jeff
N1ACQ
Harron Cable
Bourne, Mass.
2M, CW40-80

Colegrove, Tom
WA6QBQ
Lectro Products
Canyon Country, Calif.
220FM

Coombs, Gary
N4OJW
Scientific-Atlanta
Atlanta, Ga.

Cordero, Francisco
KP4CJ
CATV Noroeste
Aguadilla, Puerto Rico
SSB, CW, FM

Crown, Ron
KH6JI
Kauai Cable
Kalaheo, Hawaii
HF-SSB, 2FM, 450FM

Dawkins, Al
KØFRP
Consultant
Aurora, Colo.

Dickenson, Bob
W2CCE
Dovetail Systems
Bethlehem, Pa.

Ditlow, Doran
WA8EOW
United Artists
Grand Rapids, Mich.
2FM, 6SSB/CW, 80-10SSB/CW

Ehman, Roy
VE6EV
Jones Intercable
Englewood, Colo.

Eide, Joe
KB9R
ATC
Eau Claire, Wis.
CW, P, RTTY, AMTOR

Evanyk, Walt
W8KSW
Precision Electronics
Richardson, Texas
SSB, AM, FM, CW, FSTV, Packet

Ferguson, Jan
W4REN
ATC
Melbourne, Fla.

Ferguson, Michael
KQ2K
Cable Technology Associates
Syracuse, N.Y.
CW, SSB, FM

Figal, John
WBØCUC
United Artists
Denver, Colo.

Fitch Jr., William
KA2AFG
NewChannels
Troy, N.Y.
80-10, 6, 2

Flessner, Andy
KA9ARM
Insight
La Grange, Texas
2FM, Packet

Gall, Don
NØCPN
ATC
Kansas City, Mo.

Greene, Doug
NQ9I
Jones
Englewood, Colo.
2FM, ATV, Packet, HF

Grunewald, Peter
KA2ZHA
Cablevision
Hudson, Mass.
CW

Gunter, Kenneth
W5ZJ
Columbia
San Angelo, Texas
CW/SSB-40-20

Gur, Eugene
W4TFM
Central Virginia
Winchester, Va.
SSB, CW

Hampton, Jim
WA3YXX
Starview
Claymont, Del.
2M, 10M, UHF, ATV

Hansen, Tom
N8DGD
United Artists
Grand Rapids, Mich.
2FM, SSB, CW

Harrington, Joel
N7KOJ
KBLCOM
Portland, Ore.
440, 2M, Packet

Hartson, Ted
WA8ULG
Post-Newsweek
Phoenix, Ariz.

Hatch, Earl
AB4AO
ATC
Melbourne, Fla.

Haworth, Jim
WA4QPP
ATC
Maitland, Fla.
2FM

Hayashi, Ichiharu
JA3ILI
DX Antenna
Kobe City, Japan
20-10SSB/CW/RTTY, P, Amtor, AMSAT

Heim, Bob
K8HLH
Erie County Cablevision
Sandusky, Ohio
SSB, FM, CW, NEWSLETTER ?

→

Hemmings, Brian
KA3CTP
ATC
St. Louis, Mo.
2M, 440

Henley, Lynn
KB4JXY
American Cable
Columbus, Ga.

Herrman, Tony
KDØZE
ATC
Kansas City, Mo.
HF/CW, SSB

Hill, Tommy
KD4EN
Comcast
Meridian, Miss.
HF, VHF, Packet

Hodges, Marsha
KAØUIN
ATC
Kansas City, Mo.
2M

Holmes, Fredrick
N1GIQ
Northeast Cablevision
Ayer, Mass.
SSB, CW, FM, RTTY, Packet, ATV

Honnold, Fred
W6YKM
King Videocable
Jackson, Calif.

Hranac, Ron
NØIVN
Jones Intercable
Englewood, Colo.
ATV, Packet, 2M, 6M, HF

Johnson, Glenn
WB7UXS
ATC
Emporia, Kan.
HF, 2M

Johnson, Kenneth
WA7YHN
Cablevision
Moscow, Idaho
HF/SSB, 2FM

Johnson, Rey
K8JCB
United Artists
Denver, Colo.
2FM

Johnson, Steve
NØAYE
ATC
Englewood, Colo.
2FM, 10SSB, Packet

Jones, Herb
KA4NIF
ATC
Melbourne, Fla.

Karr, Randy
KC4IOT
Channel Master
Clayton, N.C.
HF, 2M

Kasekamp, Marlon
KK3L
TCI
Cumberland, Md.
HF/SSB, VHF/UHF/FM, 10FM

Kaser, Gary
AB8Y
Adelphia Cable
Richland, Mich.
160-10/SSB/CW, 2FM

Kean, Peter
K2AXI
Mystic Star
Rock Tavern, N.Y.
CW, SSB, FSK

Kelsey, Charles
WB2EDV
Village of Mayville
Mayville, N.Y.
UHF/VHF/FM

Knies, Mike
WB8MMR
ATC
Columbus, Ohio
HF, UHF, VHF

Kosek, Bill
WA2KXY
ATC
Albany, N.Y.
SSB, AM, FM, CW

Kramer, Jonathan
KD6MR
Consultant
Laguna, Calif.
2FM, Packet

Kujat, Matthew
WB3FNZ
CATV Service
Freeland, Pa.
SSB, CW, FM, 2M, 432, 6M

Langevin, Larry
K1GXU
Greater Media
Chicopee, Mass.

Lewis, Jon
KH6MS
ATC
Honolulu, Hawaii

Lies, Gene
NN5A
Jones Intercable
Albuquerque, N.M.
2FM

Luff, Bob
W3GAC
Jones Intercable
Englewood, Colo.
2FM, AMSAT

MacLeod, Doug
N8ASM
Comcast
St. Clair Shores, Mich.
2FM

Maziarz, Joe
K8BIU
NASA Lewis
Cleveland, Ohio
FM, Packet

McDonald, Stan
WA4IZI
Scientific-Atlanta
Atlanta, Ga.

Michael, Tracy
AA9Z
TCI
Hartford City, Ind.
CW, SSB, FM, P, RTTY

Michaels, Joe
KAØGIB
ATC
Emporia, Kan.
HF, 2M, Packet

Moore, Doug
KAØTQJ
ATC
Kansas City, Mo.
HF/CW, SSB

Moore, Marcus
N4RYD
Scientific-Atlanta
Atlanta, Ga.

Mountain, Ned
WC4X
Wegener Communications
Duluth, Ga.

Musser, Dennis
KA5GTM
Cox Cable
Oklahoma City, Okla
2M, 10M, SSB, Packet

Myers, Ron
KH6JQP
Comband
Virginia Beach, Va.

Nydegger, Charles
WA9HCU
Cardinal
Crawfordsville, Ind.
75SSB, 2M, 6M, FSTV

Orwen, John
KBØXE
Metrovision
Lincoln, Neb.

Ottinger, Michael
NX9O
TCI
Lebanon, Ind.
FM, AM, SSB, HF, VHF, UHF, P, RTTY

Pangrac, Dave
WAØRNP
ATC
Stamford, Conn.
2FM,HF/SSB

Paul, Cliff
W2JEA
Consultant
Port St. Lucie, Fla.

Peterson, Michael
KAØYAD
United Artists
New Hope, Minn.
FM, SSB, NEWSLETTER ?

Phelps, Alan
KA4DXM
Jones Intercable
St. Leonard, Md.

Preston, Charles
N4SXM
North Georgia Communications
Norcross, Ga.

Prince, Bradley
N3GMT
Adelphia
Plymouth Meeting, Pa.
2M

Pringle Jr., Leon
W5NA

Pine Belt
Hattiesburg, Miss.

Radzik, Jack
N2RK
LRC
Horseheads, N.Y.
75SSB

Reed Jr., Oscar
W3FFQ
Reed Associates
Silver Springs, Md.
160-10,2M

Reihs, Warren
WB6QKA
ISS
Thousand Oaks, Calif.
2FM

Reynard, Rand
NØDYQ
ATC
Kansas City, Mo.
2FM,Packet,CAP

Rosenberg, Eric
WA6YBT
C-SPAN
Washington, D.C.
VHF/Packet, AMSAT

Runkle, Fred
K4KAZ
Scientific-Atlanta
Atlanta, Ga.

Rupert, Scott
N3DDZ
TCI
Apollo, Pa.
FM, SSB, 2M, 440

Sabraw, Martin
N8IWQ
Starion
Ada, Mich.
CW, SSB, FM, AFSK, ATV

S-A Ham Radio Club
WA4LOJ
Scientific-Atlanta
Atlanta, Ga.

Sambol, Don
K7CS
ATC
Englewood, Colo.
HF/CW

Scott, Noel
KAØTWQ
ATC
Kansas City, Mo.
HF/SSB/CW, 2FM/SSB, Packet

Sell, Bob
WB4OEZ
ATC
Melbourne, Fla.

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Siebring, Gary
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Siebring Electronics Co.
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United Artists
Galesburg, Ill.

Stelle, Raleigh
NYØY
ATC
Austin, Texas
HF/CW

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N7LSD
TCI
Seattle, Wash.

Sutton, Dave
WA9J
United Artists
Galesburg, Ill.

Swanson, Pete
KA2IAY
Eagle
Liverpool, N.Y.
10, 15, 20, 80, 2FM, Packet

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K9JT
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Thompson, Mike
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ATC
Kansas City, Mo.

Tonge, Tim
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ATC
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Winchester, Va.

Tschirner, Alan
KAØTQH
ATC
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KØCPT
Hewlett-Packard
Englewood, Colo.

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N5BZL
Texscan
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Spokane, Wash.
VHF, Packet

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WB6JNP
Hughes Microwave
Torrance, Calif.
2FM, Packet

Wanderer, Bob
KT2D
United Artists
Pompton Lakes, N.J.
CW/SSB/160-10, 2FM, 440FM

Wasleske, Bruce
WB9YVT
Jones Intercable
Mosinee, Wis.

Wightman, Gary
WA8MCD
Cablevision
Kalamazoo, Mich.
2FM

Wilke, Allen
KEØEN
ATC
Kansas City, Mo.
HF/CW, SSB

Wilkenson, Mike
N5IQP
Precision Electronics
Richardson, Texas
SSB, Packet, FM

Wiltshire, Dan
KB8BKF
Pioneer Communications
Columbus, Ohio
SSB, CW, NOVICE BANDS

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KA9CAS
ATC
Terre Haute, Ind.
2M, 10M, Packet, HF NET?

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Atlanta, Ga.

Wonn, Jim
W3GCZ
C-COR
State College, Pa.

Wyatt, Tim
KAØTYE
ATC
Kansas City, Mo.

Young, Scott
N4HLA
ATC
Memphis, Tenn.

Younker, Dennis
NE6I
Jones Intercable
Santee, Calif.

Zeidler Sr., David
WB6TBT
LucasFilm
San Rafael, Calif.
2FM, HF/SSB

Zhorne, Brent
WB9FHI
United Artists
Galesburg, Ill.
HF/SSB, RTTY, Packet, 2FM, 440FM

Please send any additions or corrections to:
Steve Johnson, NØAYE
c/o ATC
160 Inverness Drive West
Englewood, Colo. 80112

How to cost-justify your signal leakage software

By Harry E. Long
President, Long Systems Inc.

Over 40 years ago a new invention was changing our society forever; this new electronic wonder was television. In addition to the broadcast side of the industry, it spawned another billion dollar baby—cable TV—that supports most of you reading this.

And now our children are undergoing a similar revolution. This time the perpetrator is the microcomputer. With the number of computer magazines available, you would think microcomputers have been with us for decades. However, the first popular micros were introduced in the mid-1970s. Although there are still some CATV systems resisting evolution, most have one or more microcomputers.

So, now that we have all this power at our fingertips, the question becomes how we can best harness it. As it relates to signal leakage, you may be considering a specific software package to help manage the situation and perhaps are running up against some opposition over this expenditure. Let us now prove how we can use this new technology to help manage signal leakage.

First, the cumulative leakage index (CLI) arithmetic and logging requirements are not that difficult. For a simple example of 10 theoretical leaks, we could easily calculate CLI using just a pad and pencil. Part 76 of the FCC rules require only the date detected, date repaired, location and probable cause be logged for each leak. Nothing so far that we cannot handle without a computer.

At what point does this task become complex? The rules assume simply that every leak you find you will fix. Therefore you have no need to log the strength of the leak. How many of us have the manpower to fix every leak we find and do so within the current quarter? This creates the necessity for the leakage manager to be able to track which leaks have been repaired, which ones have not and which ones are leaking at the strongest intensity (and need urgent repair).

What can software do for us?

Repair work orders and other reports: Accepting reality, it would be helpful if the software could print repair work orders (RWOs) to give to the technicians. And a listing of leaks by size, largest to smallest, allows us to swiftly select leaks that need RWOs. Throw in a few other reports for good measure.

If you are doing any task (sometimes no matter how insignificant), management will always want to analyze it. Make sure your software will provide some sort of analysis reports such as how often each type of leak occurred. Of course, this also will cause you to track more information. (But you may not get your purchase requisition approved if you do not create more work for yourself.)

Converting units of measure: Since logic and the FCC dictate that we must eliminate the larger leaks first, we must be able to determine the relative intensity of them. There are many commercially available signal level meters that can provide a reading. However, until recently most meters did not read in microvolts per meter (μV/m), as the rules provide. Now, you must go through a conversion process to convert to the FCC standard unit of measure; your computer software should do this for you. Once again, you can probably perform this step with a calculator, but have you ever experienced the agony of doing anything hundreds of times or more by hand (for cost-justification purposes we call this "labor intensive")?

Converting distances: Part 76 requires that the technician be three meters (10 feet) away from the source of the leak during the once a year structured ground-based patrol used for calculating CLI. Reality sets in again when there is a backyard easement and you are sitting in a truck 75 feet away from the cable. Since there is no practical way to always be the regulated distance from the leak source, your software should be able to apply standard attenuation factors and accurately convert to as if you were 10 feet. This also could be done with a calculator but be sure you delegate the chore to someone else.

Let us discuss the once-a-year calculating of CLI. If you have repaired every leak as you found them, your CLI equals zero (passing). No problem, except the FCC wants you to cover your entire system within a two- to three-week timeframe. Not to appear unsympathetic, the FCC permits you to only drive out 75 percent of your system (as long as you include the leakiest portion of your plant). However, this does not leave enough time to detect and repair; hence, you will end up calculating CLI.

Here is the procedure for calculating CLI: Square each leak (make sure you convert your reading to μV/m and as if you were standing at 10 feet). Add all the squares together. If you did not test 100 percent of your plant, multiply the previous result by the total plant miles divided by the miles tested. Then take 10 times the log (base 10) of your number. If the grand result of this calculation yields a number of 64 or lower, you pass. If not, you must go out and repair leaks until you do pass. (There is no such thing as turning in a failing CLI to the FCC unless you were looking to switch jobs anyway.)

The FCC simplifies CLI by not including leaks under 50 μV/m. There is a good reason why: The log part of the CLI calculation would require a plethora of leaks under 50 to have any effect on the resulting index. This obviously eases your task tremendously. But do not confuse the fact that leaks under 50 μV/m are not included in CLI with the fact that you must still log and repair leaks over 20 μV/m. Also, remember that just because you have repaired a leak does not mean that it is not included in CLI. If the repaired leak level is 50 μV/m or greater, you must still include it in the CLI calculation.

An experiment

But is this software really a necessary purchase? Ask those responsible to approve the purchase requisition if they would be willing to participate in an experiment. Go out in the field and log a sample 500 leaks. Then, returning to their office, hand them a pencil, pad and calculator and they will help calculate the CLI. (Do not forget to have a pen with you for them to sign the purchase requisition.)

Not everyone will be convinced as yet. So your last tactic is to pull out a piece of paper extolling how failure to meet the FCC requirements could result in a daily fine plus possible immediate cessation of your pay channels and how you are exonerated from all responsibility.

The sad truth is that you never needed a software program to begin with. What the FCC is doing is little more than a regulated preventive maintenance program for your system. Unfortunately your budget for that was cut years ago. If not, you would not have a leaky system now nor would you be regulated. But wait a minute—back to reality. Get that software approved! ■

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Reader Service Number 32.

Training for leakage detection

By Douglas Ceballos
Regional Safety and Training, Paragon Minnesota

It's almost 1990—do you know where your leakage technicians are? Are they part of your plant maintenance crew, service technicians or installation team? Or are they specific people you have hired to fill this particular need?

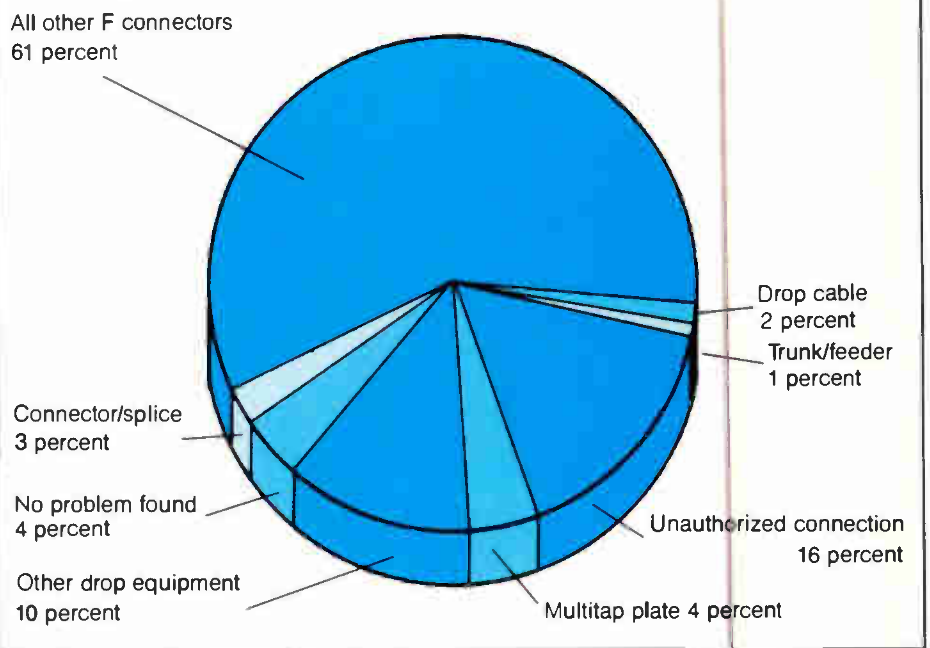
Whichever course you take, you need a program designed to train these individuals in the fine art of signal leakage. For example, would you show your personnel quick measurements with a particular device and send them into the field? That's like pointing out the steering wheel, brake and accelerator and telling someone who has never driven a car to take your Lamborghini through downtown traffic at rush hour.

Now is the time to train. If you already have a program in place, congratulations! You are in the small percentage prepared to meet the fast approaching date of July 1, 1990. But if you have decided to put training on the back burner, be careful you don't get burned.

Elements of training

Location: Do you have a training site away from the "hustle and bustle" of the office or are you being constantly interrupted by people and phone calls? Consider holding this training away from the office. You also will need a setup point where you can calibrate your equipment.

Leakage repair analysis



Materials: Just don't teach how to measure leaks and send your people out. On the contrary, some of the information you will need to pass along includes:

1) background on cumulative leakage index (CLI)
2) the critical spectrum (aeronautical navigation and communication frequencies)
3) units of measurement and conversion
4) source of leakage; i.e., plant and subscriber drop
5) monitoring, measuring and reporting leakage
6) equipment operation and calibration
7) maintaining system integrity—work habits, construction practices and preventive maintenance procedures

Hands-on experience: This can be done in two phases: 1) Having an outside location, set up a calibration point with a reference leak. Familiarity with different types of leakage equipment used is important to the success of a CLI program. 2) If personnel are new, have them ride out with a repair/audit crew to see first-hand the problems and different situations to look for.

Reporting: There are as many different forms to use as there are engineers and technicians working on CLI. The best to use is the one most closely developed for your own needs. (The July 1988 issue of *CT* gives examples of report forms and procedures.)

Equipment usage: Usage of different equipment will arise, with each product having its own advantages and disadvantages. Trainers should first use all equipment over a period of time to fully understand the peculiarities of each. The variables in equipment, frequency, leakage levels, distance to leaks, propagation of leakage and personnel competence all have great influence in how well leaks are detected.

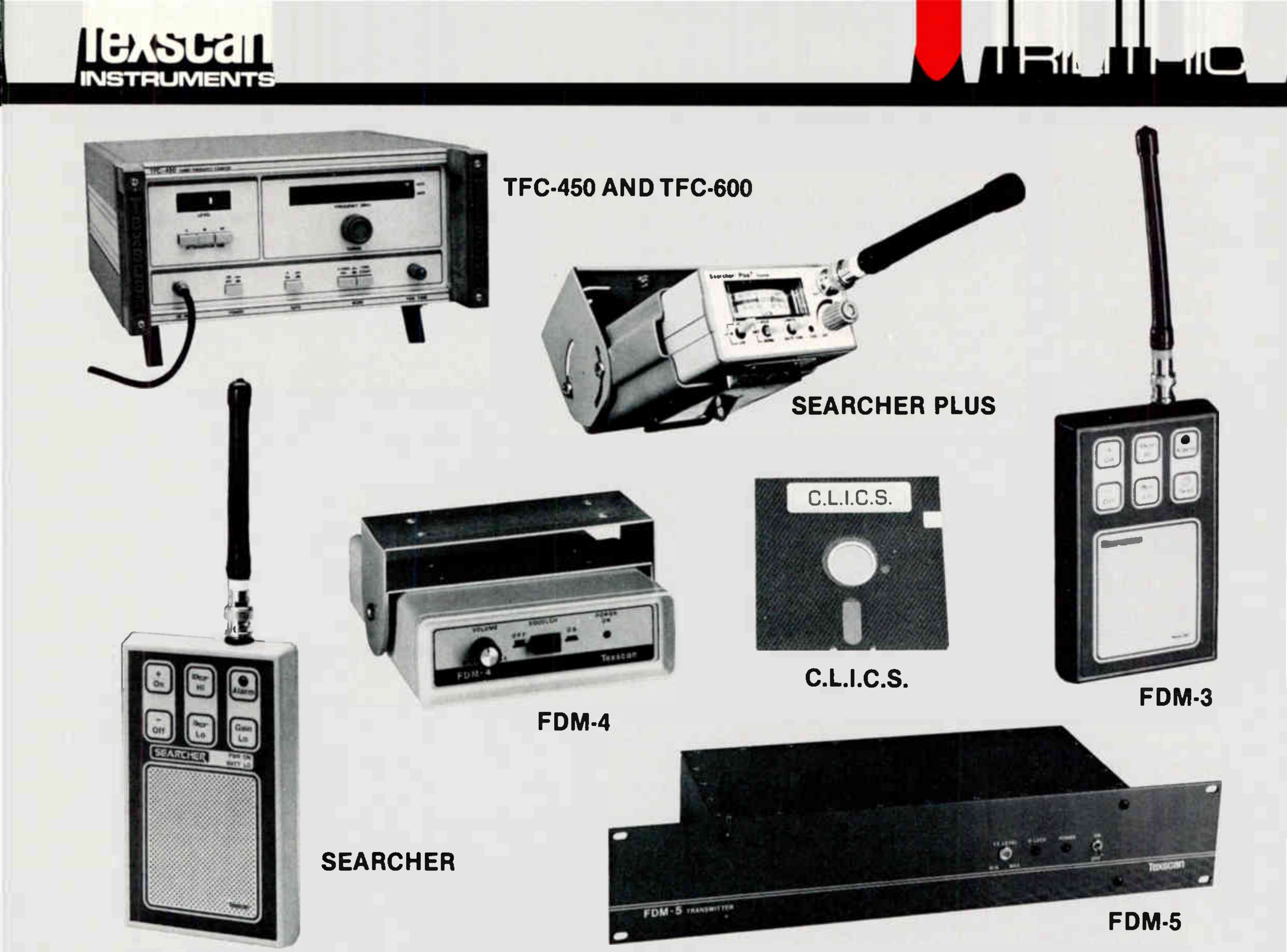
"Familiarity with different types of leakage equipment used is important to the success of a CLI program."

Some receivers are better than others. For example, I have seen some FM radios be more effective in locating leaks than some vehicle-mounted detectors. In many instances, systems will have more than one type of receiver; thus, personnel should be cross-trained with each of the detectors to ensure a continuity in reporting and compliance.

Analysis: Information analysis can be helpful to a number of people. To technicians, analysis will help them to see where most of the leaks are coming from, what to look for in detection and repair and where to concentrate their efforts. If used in conjunction with leakage level analysis and possibly a flyover snapshot, repair could be concentrated on the higher level leaks.

Any input from the field should be welcomed to help fine-tune the leakage program and change the training approach if needed. Analysis causes also can help determine if a particular component is giving problems (see accompanying figure).

Training information can be obtained from many different sources, such as trade journals, meeting groups seminars of the Society of Cable Television Engineers and regional and national shows. Do not overlook companies that provide CLI-related services. Some MSO engineers are willing to help those who might not have many resources available to them.



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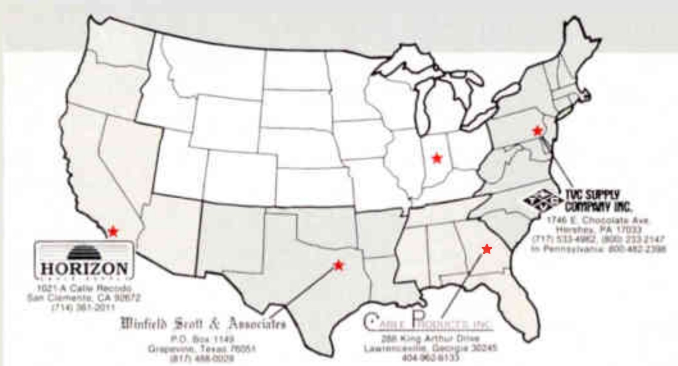

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Reader Service Number 34.

Four down and one to go

By J. Donald Runzo
Applications Engineer, ComSonics Inc

During the past few months I have spoken at various SCTE groups and system signal leakage seminars and have provided on-site training at various cable systems coast to coast. This has put me in contact with all levels of system personnel; it has convinced me that signal leakage and CLI (cumulative leakage index) are the current topics of interest. Meeting groups have been filled to capacity with personnel showing interest in the what, why and how of leakage: "What do we have to do?" "What will it cost?" "How much time is involved to comply with the new FCC standards?"

One thing common to all CATV systems is leakage. Systems may appear to be relatively leak-free one day and beyond tolerable limits the next. Among the factors that make up the leakage problem are poor quality drop cable or connectors, improper installation procedures, poor construction practices, animal "chewage" and signal theft, to name a few.

Environmental temperature changes cause expansion and contraction of the aluminum hardline cable, eventually making it crack at the stress points. These breaks can produce the most severe levels of leakage since signals of greater amplitude are transported throughout the system by way of these cables. Hardline should be addressed first in leakage maintenance due to the ability of radiated signals to reradiate themselves onto nearby conductors. This phenomenon can produce phantom leaks, causing confusion in the identification of the primary leakage source.

The new CLI regulations adopted in 1985 state that the entire plant must be driven out every three months, with all excess signal leakage recorded and corrected. Deregulation of the Federal Communications Commission Part 76 technical standards for cable systems did not eliminate the requirement for maintenance of leakage in excess of 20 μV/m at 10 feet (54 to 216 MHz). To fulfill this requirement any portion of the physical plant that exceeds this limit must be logged, repaired and kept on file at the system office for two years.

Most major MSOs have already implemented leakage programs. Their system personnel have been trained in the operation of leakage detection devices and to be alert for plant leakage. Some operators have attempted partial CLI measurements with varying degrees of success. Others have taken a dim view of this requirement, saying, "We'll get to it sooner or later." In fact, difficult as it is to believe, some systems have never heard of CLI. July 1, 1990, is rapidly approaching and systems that have been lax in leakage maintenance practices cannot afford to wait any longer. These new regulations are directed to all applicable cable systems and must be taken seriously.

Bob Sullivan

Continuous monitoring

Being able to control leakage to a manageable degree requires continuous monitoring of the entire plant. Systems that never have been involved with any type of leakage program have a tremendous task ahead of them. Signal leakage will not heal itself; it takes manpower utilizing appropriate leakage monitoring equipment, an understanding of how leakage reacts in a CATV environment, proper construction and installation practices, and appropriate recordkeeping to bring leakage under control. Even systems that have active leakage programs in place will require an understanding of good engineering practices to achieve the required CLI threshold.

Why has the FCC required that all systems employing the use of the aeronautical bands (108 to 137 MHz and 225 to 440 MHz) submit a passing CLI? In conversations with the FCC I have learned that to date the commission has no formal data on the condition of system leakage. So how can we, with valuable channel allocations at stake, expect the FCC to withstand continuous attacks from the Federal Aviation Administration, ham operators, etc., with whom we share a common frequency spectrum?

The FAA's contention is that excessive leakage has the potential of interfering with navigation and voice communications used in commercial and military aircraft. The CLI program was set in place to obtain substantial leakage information throughout the CATV industry. So cable systems must demonstrate to the FCC and the FAA that leakage is under control. If we fail in our attempts to reduce excessive leakage, we stand to forfeit all commercial and government aeronautical frequencies.

At a recent SCTE meeting, I met a gentleman who for the last 15 years was involved in investigative documentation of aircraft accidents. All aircraft mishaps from single-engine private airplanes to 747 jumbo jets are subject to investigation. The information he relayed to the group concerned the litigation factor that results from negligence. If it can be demonstrated that a system's plant leakage is directly or indirectly responsible for the malfunction of navigational or voice communications equipment, resulting in an accident of an aircraft, the legal implications will be devastating. Hundreds of millions of dollars in settlement costs can effectively dismantle even the largest MSOs. If an incident of this magnitude should occur the FAA would demand that the FCC force the CATV industry to cease operations in all aeronautical frequency bands. As an industry, can we afford to take such a chance?

"Management can no longer sit back and feel that this CLI business will somehow go away."

In order for us to continue using the frequency spectrum to which we have been accustomed, the CLI requirement has to be addressed by each individual system. Technical requirements are generally handled by engineering personnel but with the advent of CLI, management also must get involved. It has to take the initiative and formulate plans along with the engineering staff to provide equipment, personnel and training to ensure that the system meets or exceeds the preconditions set forth by the FCC. Management can no longer sit back and feel that this CLI business will somehow go away. The FCC has stated that no extensions will be granted.

Several cable connector manufacturers as well as various individual cable systems have released studies that confirm the relationship between signal leakage and service calls. From the management standpoint, this correlation translates directly to maintenance revenues and customer service. If leakage can be discovered and corrected before a subscriber complaint is initiated, the costs involved in a truck roll can be saved.

Four years ago

The CLI program was inaugurated four years ago with the intention that the CATV industry be given sufficient time to enact programs and formulate courses of action to fulfill leakage requirements. Time is quickly running out. Is there sufficient time to act on a maintenance policy that will enable a system to be in compliance? Yes, time is still available but systems that hesitate any longer may be lost. It seems likely that one or more systems will be made examples of if they fail to submit a passing CLI. Loss of channel allocations along with monetary fines will generate chaos in system revenues. Our industry has to be in compliance or ready to suffer the consequences. Four years down and one to go; it's certainly time to get ready.

Equipment and procedures for airborne leakage testing

By Chris Duros
General Manager, CableTrac Inc

The cumulative leakage index (CLI) and flyover tests described in Part 76.611 of the Federal Communications Commission rules serve as both a point-in-time check of the system's cumulative leakage levels and as a means of gauging the effectiveness of its ongoing leakage control program. The primary goal for the test is to determine whether or not an aircraft flying in the overlying airspace 1,500 feet above the cable system would be subject to leakage field intensities in excess of 10 μV/m. This has been shown to be the threshold level above which there may exist a potential for interference with airborne communication or navigation systems. Also, 10 μV/m is the level that the ground-based CLI calculations predict would exist at the limit values of 64 for the $10\log I_{\infty}$ or −7 for $10\log I_{3000}$.

The minimum airborne test equipment package breaks down into three parts: an aircraft with a suitable antenna, a sensitive receiver/detector and some form of storage for logging the collected data. In exploring these items we find the FCC rules leave many of the parameters to the discretion of the engineer.

With regard to the measurement antenna, one important consideration is its gain pattern. The mounting location on the craft should be such that the antenna has an unobstructed view to either side as well as directly beneath the aircraft. The 3 dB points should be a minimum of ±45° left and right of a plumb line extending down through the center of the aircraft. This configuration assures the antenna will be capable of measuring leakage coming from sources between flight tracks as well as those over which the aircraft passes. A procedure is spelled out in the rules that serves the purpose of "washing out" the gain uncertainties that may exist with a particular antenna installation. In this procedure, in-flight calibration is performed for the complete installation, which yields a benchmark indication corresponding to a 10 μV/m field intensity. Thus, it's not necessary that the exact gain of the installed antenna be known, only that it have adequate sensitivity in the directions of interest.

Some important considerations for the receiver/detector are as follows:

1) It must be capable of tuning a non-standard air frequency so the test carrier can meet the 12.5 or 25 kHz offset requirement.
2) It must be capable of providing an output relative to input power and do so with input signals of less than 1 μV.
3) It must have selectivity characteristics adequate to minimize the effects of broadband noise and allow the receiver to function in the presence of strong adjacent signals.

Data logging and storage may be as simple as a strip chart recorder or as sophisticated as storing digitized data in an onboard computer. Although not a requirement, it is desirable to generate and log progressively updated position information throughout the flight. By storing both the signal leakage data and the companion flight track data, the usefulness of the procedure can be greatly enhanced, since now a record has been preserved on the exact location of observation over the cable system.

Test procedures

After you have assembled the necessary equipment package, it can be installed in the plane. A test flight can calibrate its performance using the previously mentioned 10 μV/m reference signal source.

Before a test of the actual plant can commence, there are a few more details to take care of. First, it is desirable to place a separate carrier with unique modulation on the systems for the period of the test rather than attempt to use one of the existing carriers. This is done to aid

"The idea is to scan the entire service area with sufficiently fine resolution to allow determination of leakage field intensities over every portion of that system."

in identification and ensure the leakage observed is radiating from the plant under test and not from an adjacent cable system or some other spurious source. It also saves having to correct the readings for the effects of video modulation. The carrier frequency selected should meet the following criteria:

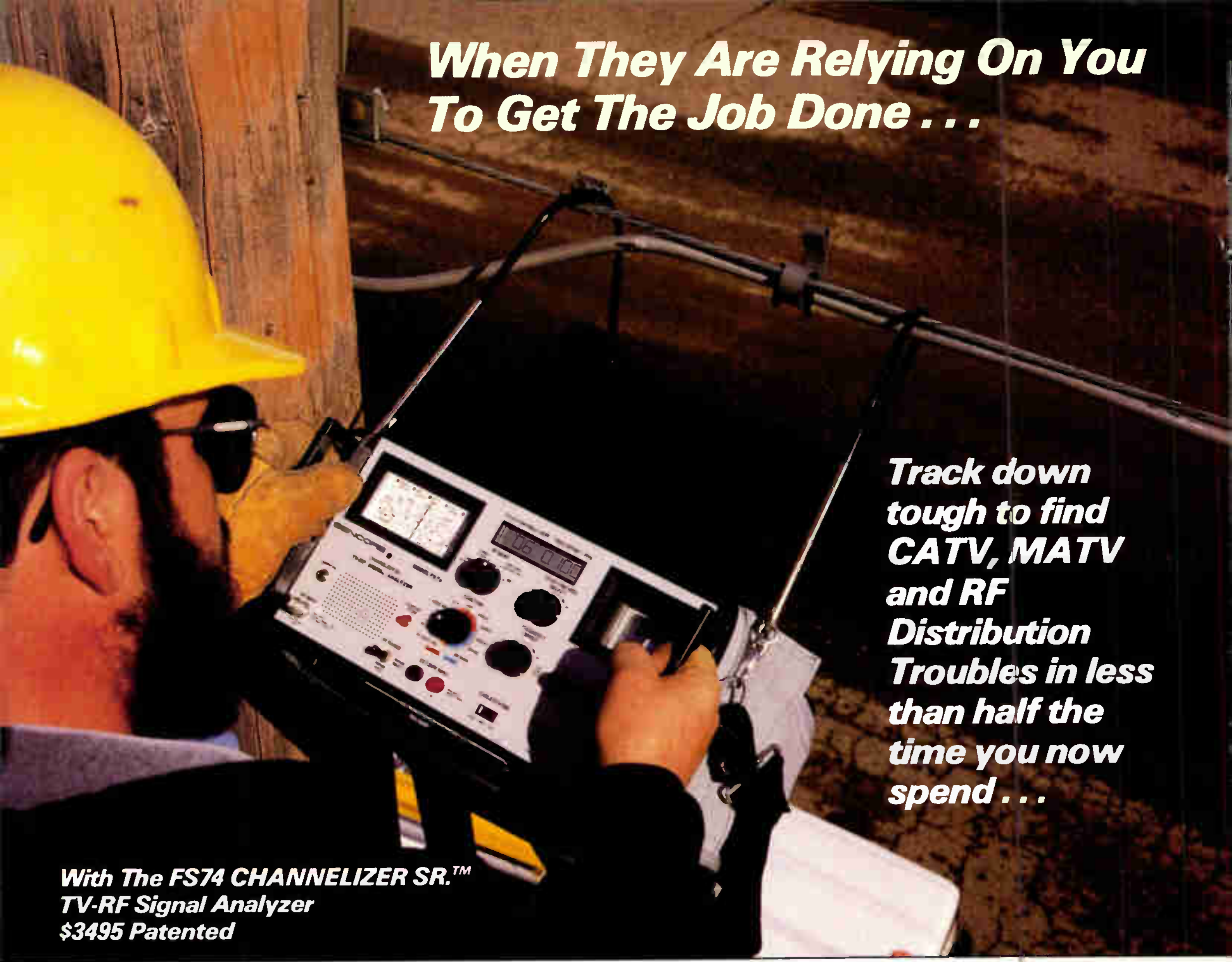
1) It must fall in the VHF aeronautical band between 108-137 MHz.
2) It must avoid "in-use" Federal Aviation Administration navigational and communication channels and harmonics of other high power transmitters in the vicinity.
3) It must be available (or made available) on all portions of the cable system to be tested.

Once a frequency is chosen, the next consideration is how and where to insert it into the cable system. Its amplitude must be set at a level equal to the highest carrier level for aeronautical channels on the system. Injection is usually done at a sweep or other available input at the headend. However, there will be instances where the test carrier may have to be inserted elsewhere and the plant tested in sections. Systems that utilize AML microwave or FM supertrunk feeds to hub locations or outlying communities will require special consideration. Injection at an AML transmit site may be feasible provided the link is capable of passing the additional carrier and (of course) that it is licensed to do so. Where FM transportation or another scheme that similarly modifies the carriers is in use, it must be recognized the FM portion of the plant is not going to be included in the test unless special accommodations are made.

After you have figured out how and where to best get the test signal on the system, it's nearly time to head for the airport. But before launching skyward, a little preflight planning is in order. First, a map must be prepared that details the geographic area served by the cable system and the topography involved. Attention should be paid to airspace that may require coordination or special procedures for its use. With regard to airspace access, a letter or phone call in advance of your flight to the local FAA explaining what you want to do and why is usually a good idea. For the most part FAA controllers have been very accommodating, provided that requests are reasonable. With proper coordination, flights usually can be conducted most anywhere, including over and around active airports. Controllers may interrupt the testing momentarily, requesting you exit the area and then allowing return and resumption after a traffic conflict has been resolved.

When laying out the courses to be flown, keep in mind the flyover test is a means of measuring the *cumulative* effects; that is, the contribution all leaks in the system make at all locations over that system. There is no need to overfly individual runs of coax in the plant (other than those isolated runs extending outside the contiguous service area). Rather, the idea is to scan the entire service area with sufficiently fine resolution to allow determination of leakage field intensities over every portion of that system. This can usually be best accomplished by flying a series of parallel tracks over the service area, uniformly offset from one another and close enough together so as to minimize any slant-range effect on the accuracy of the measurement of leaks from sources located in-between tracks.

The actual aerial testing usually begins with a run through the calibration field to establish the 10 μV/m benchmark for the frequency in use. The calibration array is then de-energized and the same carrier placed on the cable system. The measurement runs are commenced and flown according to the planned route, which usually starts on one edge of the service area. The parallel course legs are followed, working across to the far boundary of the service area. They can be navigated by ground reference, but electronic guidance such as that provided by Loran is



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3200 Sencore Drive Sioux Falls, South Dakota 57107 desirable. In practice, pilotage is often based on input from a combination of sources. Unless other factors dictate, the chosen directions for these tracks should be such that their length is maximized, thereby minimizing the number of turnarounds required. This is important particularly when using higher speed aircraft, where often as much time is spent on course reversals and positioning for the next run as is spent on the actual measurements. Throughout the flight the pilot will have to remain cognizant of the topography and closely monitor altitude so as to maintain the required 1,500-foot height above the average ground level for the immediate vicinity while avoiding obstructions.

Flying the tracks requires a fair amount of precision, so it is important to keep pilot workload and distractions to a minimum. Unless operation of the data gathering equipment is substantially automated, it may be wise to take an observer or helper along on the flight. It is always beneficial to have an extra pair of eyes in the cockpit helping watch for traffic and so on. Some means of two-way communication with the office is in order especially for large plants requiring a lengthy test flight. This is another area where your observer can be of assistance. It is very disheartening to complete the flight, only to find out later that a system outage occurred halfway through your test and invalidated the results. Whether or not two-way radio contact was available during the flight it is important that upon completion the system records be checked to ensure the plant was up and running as expected.

The optimum weather conditions are usually found on a day with light winds, smooth air and, of course, adequate cloud height to allow for VFR (visual flight rules) at 1,500 feet.

Data reduction and report formatting

After you complete the flight according to plan, the first priority is to preserve the raw data by making a backup/archival copy. The methods employed for reducing and processing the data will depend in part on the types of information collected and what you're trying to accomplish with the results. If the calibration curve for the detector used in the aircraft is known, the raw data can be converted to microvolt or decibel values relative to the 10 μV/m benchmark. If digitally recorded, the data can be sorted and a statistical presentation of the results generated.

When a record of the flight path is available, it can be merged with the field strength data, making different formats possible and greatly increasing the utility of the report. With accurate progressive position information, individual field strength measurements can be tied to specified geographic locations. The tabular and plotted presentations are examples of how this information can be presented. Additionally, the plotted results can be scaled to overlay a variety of base maps such as U.S. Geological Survey topographic maps, city street maps or other maps already in use at the system.

What can be gained from analysis of this plotted information is significant. While the flyover does not purport to locate individual leaks down to a specific pole in the plant, for systems in reasonably good condition it does do a good job of depicting leakage "hot spots." The important advantage to be gained is that based on this information, repair crews can often be directed to within a few blocks of the actual source location(s). A large percentage of the service area can be removed from immediate concern with respect to potential aeronautical interference and, more importantly, maintenance can be immediately directed to an area that is of concern.

Granted, this information about the location and severity of leakage problem areas should already be known to the operator as feedback from a properly conducted quarterly monitoring program. But to date, unfortunately, it is often something hoped to be gained while conducting a CLI or flyover. Often this ignorance results in failure of the annual test. Also, recognizing that even in the best of systems new leaks do continue to occur, the information contained on leakage plots can aid in their timely discovery. So the flyover test is a source of similar secondary information as that gained from a ground-based CLI test.

Plotted flyover results are also useful to those decision makers removed from the individual systems as an aid in making objective comparisons of signal leakage problems from one system to another. With CLI results, unless the underlying data is available for examination, there is little information available, for example, from one system's CLI of 68 vs. another of 66.

Yet another application for the flyover results has to do with new system acquisition. The aerial survey provides an efficient means of quickly assessing the plant leakage integrity before the sale. This is certainly something to be factored in when negotiating a purchase price. The FCC has been clear that the responsibility for leakage goes with the system. Requests for a grace period to allow time for rework of a newly purchased system will have a hard time finding a sympathetic ear.

Benefits of flyovers

When considering which type of proof to use for annual certification, keep in mind the primary goal for the test: to determine the interference potential of the system's leakage with operations in the overlying airspace. To that end, airspace measurement has the distinct advantage of providing a direct measure of the actual leakage. The ground-based CLI test can only give a prediction of the extent to which this condition exists. In fact, of the two forms of CLI, the more popular I_{∞} calculation (which ignores geographic distribution of the leaks throughout the service area) may have an undue prejudice against the system passing. Also, inaccuracy of individual field measurements also will adversely impact a CLI test, as may be the case when these measurements are attempted from curb side and "corrected" for the non-standard separation from the cable.

Additionally, the flyover test also has the advantage of speed. The ability to test in hours what would take weeks or months from the ground allows us to truly achieve our point-in-time check of the leakage control program. This speed advantage directly translates into dollars saved for the system. Trying to canvas systems with technicians carrying field strength meters and dipole antennas can create a serious drain on the company's available manpower and equipment resources. It often results in disruption of normal service activities or overtime expenses for weekend call-ins. Initially many people incorrectly assumed flyover testing to be too expensive to be practical; but now, in fact, for most systems just the reverse is true.

This article was presented as a paper at the 1988 Western Show.

Care of the design department

By William P. Bragg
President, CATV Designs Alive

The first designers of the modern era of CATV were talented draftspeople who could accurately and efficiently produce system map prints reflecting the current system that had been built and were able to add new plant to the prints as necessary. As system requirements progressed past 12 channels these individuals were called upon to consider factors such as attenuation, carrier-to-noise, cross-modulation, tap "windows" and return splits for data transmission.

With the increase in channel capacity it has now progressed to the point where the designer also must consider composite triple beat and composite second order for the system extensions that are occurring, anticipate where future extensions will occur in order to eliminate costly redesigns of existing plant and consider the use of new technologies, such as feedforward, power doubling, fiber-optic and pay-per-view requirements.

The art of designing has progressed to where it is a separate discipline and a vital link between the technical and construction personnel, accounting and purchasing departments and the ultimate user—the subscriber. An excellent designer can affect a system's bottom line in more ways than ever before. Yet management sometimes overlooks this position and fails to fully utilize the engineering available to improve the system's financial health.

Designers can know more about the equipment than the technicians, usually because the designer has access to the manufacturer's technical information and the time to thoroughly study it. The designer is also in a position to see the system as a whole instead of as one location at a time. This gives the designer a better sense of what should and could be done at any one location to be cost-effective. The designer should be able to effectively communicate with other departments as a liaison and as a source of information to purchasing, accounting, management, installation, technical and construction departments. A good designer can make things progress efficiently and effectively.

Basic factors for good design

There are basic factors to all good designs. The most basic is the equipment that the designer will be able to use to determine how the plant will be built. This equipment is generally considered to be cable and passive and active devices.

All cable reacts to CATV signals the same way. The most important aspect for the designer to consider is the frequencies that are to be utilized. This includes the highest channel currently used by the system, the lowest channel and whether return signals are to be utilized initially or in the future because the return requirements will affect the forward design. The relationship between the highest and lowest channels will determine the tap windows and the signal that will reach the converter. Return signals used for addressability and other applications also will demand a correct balance between these two frequencies.

Passive devices such as taps and directional couplers determine the signal that will be provided to the subscriber. The way that they affect the signal is a direct design consideration. They all diminish the signal somewhat differently at different frequencies and this must be considered in the design. All equipment manufacturers can provide the values and losses for their products. The lowest downstream frequency will determine the highest value tap that will be used and return capabilities will determine the highest DC that can be used in the design. Incorrect data will greatly affect the operation of the plant when built.

Active equipment includes the amplifiers, which contain electronics that introduce distortions to the signal and establish limitations on total trunk cascade length and line extender cascades, both of which affect the design. The different trunk equipment manufacturers all build their trunk stations with variations on the same idea. These differences, like how much the feedermakers affect the output signal strength and how the return signal is dealt with, will help determine the overall design. Even the differences between aerial and underground plant force considerations in the design, like the extent of the use of AGC (automatic gain control) in the

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"The sphere of influence of a good designer is measured in units or footage per month."

active equipment and extra cable footage for riser poles.

Another often overlooked area of concern in construction is hardware requirements. If this isn't considered in the initial financial requirements then the costs will be understated. Simple things like nuts and bolts, strand clamps of various sorts and lashing wire can add to the expense quickly and ruin an otherwise excellent financial projection. These items should be included in the designer's bill of materials (BOM), generally as a per-foot expense based on past usage.

A designer should be able to effectively use the equipment available to provide the signals necessary for the subscriber. There should be a balance of active and passive equipment that is cost-efficient and allows for future requirements without wasting equipment and money. Most of this usage is based on the designer's experience and style of design. Some designers are more effective than others. Effectiveness will directly contribute to the costs involved and to the return on the investment. Penetration will be a reflection of the value perceived by the subscriber, which is a direct result of the quality of the signals.

Few systems have realized that the designer can be such a benefit to the overall scheme of running a successful and profitable system. A competent designer could be considered to be a first-line engineer, working with the construction and technical departments and coordinating their efforts with other utilities, governmental entities and the environment (a freeway and a river look the same to a designer). This effort will free the other engineer/managers to be able to deal with other projects for management and otherwise be free to devote their time to system operation.

The sphere of influence of a good designer is measured in units or footage per month. This can be utilized by management to effectively cover system mileage as necessary. A large system may be all that a designer can maintain effectively; that is, be able to devote time and energy to the work required. This same individual should be able to handle a cluster of smaller systems, especially because the nature of smaller systems is that they grow slowly. The designer also should be familiar with the governmental entities that affect various parts of the systems, like the local county road department. The county department may wish system relocation for one reason or another; the designer is the logical person to contact for coordination.

Another benefit of having a designer for clusters of systems is during times of upgrades and rebuilds. The designer has the knowledge of the existing system equipment and its location. Hence, the designer will be invaluable in assisting in projections of changes and the construction requirements and should be able to provide clear-cut options for management.

The designer or the engineering department is generally required to keep records of the system's plant. This information can be useful in a number of ways. For example, the accounting department may need the number and use of power supplies in order to determine if the power company's bill is correct or requires further study. With access to correct construction reports, the designer can inform the sales department where the new customers will be available. Cost analysis of the existing plant, forecasting of future building that will occur and the use of new technologies and their costs can be determined from the system records. All of these are necessary for budgeting and accounting processes.

The BOM of the design is used by the purchasing and the accounting departments, one to purchase equipment and the other to document the costs involved in the construction and for taxation purposes. All BOMs include cable, passives and actives. But an excellent BOM will reflect labor costs and the infrequent burden that can arise in order to fully document the costs involved. With these figures it is a fairly simple and straightforward process for management to utilize various computer functions (such as spreadsheets) to determine the system's financial situation. From this, decisions can be made.

A good designer can even determine what equipment should be used by studying the differences in equipment usage in a test design of a particular area. By redesigning an area with

(Continued on page 101)

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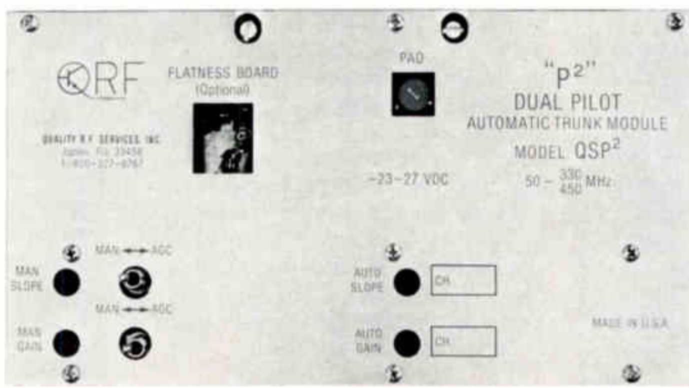

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Passband MHz	50-300	50-300	50-330	50-330	50-400	50-400	50-450	50-450
Flatness ± dB	0.2	0.2	0.2	0.2	0.25	0.25	0.25	0.25
Min. Full Gain dB	29 or 30	29 or 30	29 or 30	29 or 30	30	30	30	30
Gain Control Range dB	8	8	6	8	8	8	8	8
Slope Control Range dB	-1 to -7	-1 to -7	-1 to -7	-1 to -7	-2 to -8	-2 to -8	-2 to -8	-2 to -8
Control Pilots ASC: Turned to Ch.	"O"	"O"	"W"	"W"	"W"	"W"	"W"	"W"
Oper. Range dB	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable
AGC: Turned to Ch.	4	4	4	4	—	—	—	—
Oper. Range dB	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable
Return Loss dB	16	16	16	16	16	16	16	16
Noise Figure dB	6	6	6	6	6	6	6.5	6.5
Typical Oper. Level dBmV	34/30	34/30	34/30	34/30	35/30	35/30	35/30	35/30
Distortion at C/CTB	-93dB	-88dB	-92dB	-87dB	-91dB	-86dB	-89dB	-84dB
Typical Oper. XMod	-94dB	-89dB	-93dB	-88dB	-91dB	-86dB	-89dB	-84dB
levels 2nd order	-85dB	-82dB	-85dB	-82dB	-85dB	-82dB	-85dB	-82dB
DC Requirement mA at -23 VDC Note 1	630-730	420-500	630-730	420-500	650-750	430-500	650-750	430-500

Note 1: DC requirements are stated as typical to maximum.
Note 2: Specifications should be referenced to the modules, not the connector chassis.

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Interactive video: Touch your selection

To learn more about training using interactive video, select your topic and follow the appropriate color: 1) Learning the basics, 2) Writing the script and 3) Implementing interactive video.

Learning the basics

By Joel Milinsky
Special Projects Director, Electronic Media Group
A.R. Brasch Marketing

Interactive video (IV) has been around for 15 years, meeting the training needs of the military as well as manufacturing. Most recently, it's been used for dispensing information to the general public and point-of-purchase as the new paradigm of product promotion. Our company has produced a number of interactive training and trade show applications for the automobile industry. The programs we produce are then sold to dealers to enhance their skills in either sales or maintenance and repair.

Four elements

IV has four elements to consider when choosing a system to run interactive programs. These are: input, output, storage and processing.

Input: The method of telling the hardware system what selection(s) you've made. Selections might be to show a video segment, answer a question or signal any other kind of transaction programmed into the machine. Input tools can be a keyboard, touch screen (a special grid surface installed over the monitor's face that detects where your finger grounds a tiny current in the grid), light pen, mouse, voice recognition or even movement detection devices focused on the operator's eyes.

Output: Simply monitoring your program. All systems require a monitor to view video program segments. This screen also will have to render computerized graphics that overlay the "live" video picture, allowing more than one source of visual information to be displayed. There are many screen sizes and resolution levels.

And don't forget audio information sources. These can be recorded like a soundtrack for a live or real-time video motion segment. Or, to save precious space on all-too-scarce videodisc sides, audio can be highly compressed.

Storage: Optical disc storage devices in some form are commonly used, mostly playable on 12-inch videodisc players. These units allow 54,000 single frames per side, which amounts to 30 minutes of live action with two audio tracks. Technology is changing in this area: Work continues on integrating the 5-inch compact audio disc format to store compressed video in formats called CDI or DVI.

New players can handle an hour of live ac-

Writing the script

By Rick Schick
Scriptwriter, A.R. Brasch

A friend of mine who had never written an interactive videodisc called me for advice. "What's the difference between interactive and conventional videos? Is there a special formula for interactive?"

"No," I said, thinking of the expository content that fills most interactive discs. "You just write the video and audio columns like you would any other video. Except you generally have pre-tests, post-tests and quizzes interspersed with the expository stuff."

In the discs I was thinking about, an instructor or narrator presents the contents of a lesson, like an illustrated textbook. Students have to answer a certain percentage of questions correctly in order to progress from one part of the lesson to another. If they can't demonstrate they've learned enough from one segment to move onto the next, they must repeat it until they do.

Before I'd finished my glib answer, I at least had the presence of mind to add: "Differences are really all in the planning, though. Take the interactive videodisc on cable TV troubleshooting I'm working on now. The producer (Joel Milinsky) had everything flowcharted for me before I started writing. So it was easy to see the structure of the program and to write a script to cover each box in the flowchart."

Separate modules

Milinsky had the disc structure laid out in separate modules. Each was represented by a box on the flowchart. The modules were connected to one another along the possible paths a learner could follow to get from the beginning of the lesson to the end. The paths between modules weren't always a straight line. Sometimes parallel paths beckoned, the "correct" choice depending upon an earlier choice or circumstance. Pursuing separate paths on a flowchart is called "branching."

"Costs usually preclude purely visual exams, relegating too many interactive discs to mere test administration."

Implementing interactive video

By Robert McCleary
Vice President of Customer Service
American Television and Communications Corp

The question often arises, "Why use interactive video for training purposes?" In our industry, the geographic sprawl of the typical MSO gives it locations all over the country. However, individual systems generally do not have enough people to require or justify a full-time trainer on the premises. This forces the system to send a supervisor to a training facility and learn how to be a trainer.

When the turnover is high, the supervisor must spend an inordinate number of working days training each new-hire individually. So the supervisor might wait until a class can be filled. This means that some personnel are on the job without the benefit of training. And when a class finally becomes possible to train even a few technical personnel together, it can be difficult for the system to handle service calls or new installs during training. Hence, training is often postponed.

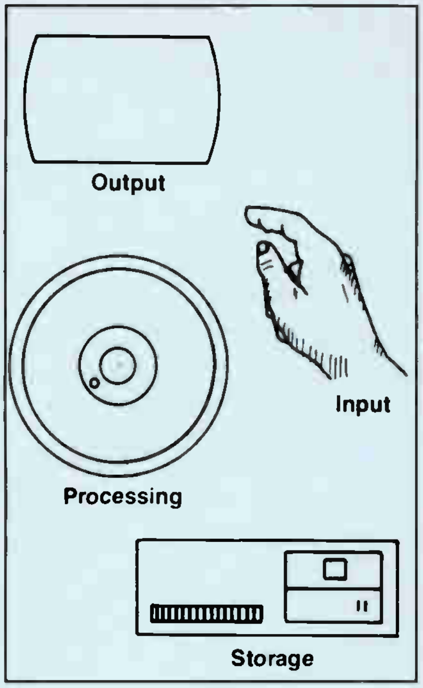
Interactive benefits

Interactive video (IV) is one-on-one trainerless training, with the entire teaching component wrapped up in the video presentation. Also, IV is totally in sync with the students' own speed of learning so they can proceed at their own pace. In a classroom setting, the teacher has to adjust the rate at which information is presented to meet the needs of the students. One student might be quick, another slow. You might bore one student to death or leave another "in the dust."

Interactive training is operational immediately; there is no need to wait for the availability of a classroom, an instructor, a group of students or anything else. All that's required is the new employee and the interactive equipment. In addition, IV can provide repeat training and reinforcement of certain skills; the student need only access the specific module.

Other benefits can be added to existing interactive systems by designing the course software. For example, programs are available to allow the student to exit and re-enter the module at any time. Keeping the training module short (about 30 minutes or less) fits the work schedule availability of many technical personnel at the system level. Also, the capability can be built into the software to store and retrieve a student's test scores for each module.

But there is a limitation to interactive training; namely, to train people to work in a team.



"For training program sharing to occur, hardware and software have to be compatible."

tion video with four sound tracks. As much as 40 seconds of audio can be squeezed into one second (or 30 frames of video information) for digitally recorded voice or sound to underscore a computer-generated graphic. The watchword is: You can store more information in less and less disc space.

Processing: A computer is used to coordinate the actions and responds with the other three components. Even though the computer can and does store information like disc storage devices, it is not necessary to optically master and replicate your information. Updating software can be done by distributing floppy discs. But the computer is the main component that makes the whole system work. Allowing the tracking of the students' performance in training, collection of marketing research data, transacting with other computers to conclude a purchase, creating graphics and storage of text to overlay the video screen with digital audio reading the text are all tasks performed by the computer.

Recently, we were asked by American Television and Communications Corp. to develop interactive video training for technical skills. The course is "How To Troubleshoot Cable TV Systems." When it's finished, there will be any number of specialized topics in that area. Our first disc side is about working with "no

The first module represented a pre-test to assess how much students already knew—and simultaneously tip them off as to what they'll be expected to learn. Five branches followed, one for each of the five reception problems they would have to troubleshoot in the real world. Along each of the five troubleshooting branches were modules for lesson exposition, in which the on-screen instructor demonstrated how to identify and correct problems, as well as modules for quizzes to assess learning.

Yet another part of the disc was the simulation module. This is the fourth stage that students pass through after 1) the initial assessment, 2) choosing a problem and seeing a demonstration of diagnosis and solution and 3) a short quiz covering the contents of the instructor's presentation.

Ideally, even the interactive video quizzes would be purely visual. Instead, they are usually character-generated test questions superimposed on still frames taken from the actual lessons, read aloud by a digitally recorded voice. In purely visual quizzes, the screen would be divided into panels, each showing one or more correct and incorrect situations. In the lesson on antenna wiring connections, the voice might ask, "Which is a properly connected matching transformer?" Students would answer by identifying the terminal wiring configuration(s) by merely touching the correct picture instead of having to answer a verbal question such as: A properly connected matching transformer attaches to the ___________ on the customer's set.

a) 75 ohm input
b) 300 ohm UHF input
c) 300 ohm VHF input
d) video output

Unfortunately, costs usually preclude purely visual exams, relegating too many interactive discs to mere test administration.

Simulation module

However, Milinsky had a better idea. Following each of the five lesson branches, with their assessment, information, quiz and final test modules, the flowchart showed a fifth module—simulation. It allowed students to actually practice what they learned until they're comfortable with the correct troubleshooting routines.

Students select simulation modules by choosing one of the five sets of problem symptoms. Once "inside" the individual simulation screen, they next decide which of the three parts of the troubleshooting process they want to practice: approaching the customer's TV set, diagnosing and treating the problem cause, or leaving the site.

In simulation mode, students are faced with a random jumble of behavior choices. These are illustrated by brief clips replayed from the actual lessons (in which the instructor "walked" them through the correct steps for diagnosing and fixing a problem) and labeled accordingly. Each of these scenes represents

During one day's taping at the ATC National Training Center, the on-camera instructor poses a question to his students.

Using the one-on-one technique of IV does not allow the possibilities of teaching synergistic behaviors called for in a team environment. But for most technical skills that people need to know to do their job, IV is an excellent method of training.

IV training has a demonstrated track record. Over the past few years, Ford Motor Co. has been training its service technicians with this method. In testing its efficiency as a training device, Ford indicated that IV improved the abilities of their technicians over 80 percent.

Also, a study from the University of Missouri at Columbia measured the outcome of training in three different formats—a class led by an instructor, a class led by an instructor with IV assisting and IV alone. The two techniques with IV were more effective than the one with an instructor only. The difference between IV with and without an instructor was almost too small to measure.

Hands-on training

Instead of typing an answer, the student demonstrates a skill by physically touching the screen, pointing with a light pen or manipulating a mouse. So it is considered a hands-on approach. Also, IV uses the time-honored approach to good training: An instructor appears on the screen, describes what the student will learn and then demonstrates a skill (e.g., calibrating a meter). The student is shown each of the steps involved in com-

The cameraman tapes a sequence for ATC's interactive program.

signal, no picture" and "low signal, noisy picture."

The CATV industry is different from the automobile business. In CATV, there is not a small handful of companies producing a unique product. Instead there are dozens offering the same type of service to a vast public. Technical training needs are virtually the same across cable systems. This allows training programs produced by one MSO to be shared by many others or the coproduction of training programs as the areas of skills training become evident to all.

For training program sharing to occur, hardware and software have to be compatible. It would be better to face this need now, when hardware decision-making is fluid in the development of this training network, rather than later when there's only Babel. Not a lot of different interactive training hardware systems are in place in the cable industry.

Blue skies

Any newly applied technology leads to blue-sky thinking: "The sky's the limit on what we can do." However, by clearly defining needs now, long-term cost-effectiveness from better trained staff can be realized from an industry able to share resources. A coordinated response to training needs can bring the CATV industry's use of interactive video down to earth.

---

one of the critical steps or behaviors required to get from problem identification to solution. Students must reorder the random critical behaviors into a logical progression by sorting out the scene labels, thereby demonstrating the correct use of test meters and diagnostic techniques.

It would be better—and more expensive—to dispense with these labels altogether. However, it's hard to imagine a visual menu for dozens of scenes, each with only minute variations among them. To show a complete still picture from each simultaneously on a 13-inch monitor wouldn't provide enough resolution for the viewer to distinguish, say, the terminals to which the cable was connected on the back of the TV set or converter.

A compromise—in which a list of the critical behaviors appears on the monitor, allowing students to call up a still picture or video segment scene when a behavior is selected—involved expensive video editing.

In the version I worked on, students are coached by the digital voice that tells them when they've done something wrong. But the method is heuristic: Students must learn for themselves (by trial and error) the correct order of behaviors in order to get through the simulation successfully. They demonstrate this by going through the behaviors in the correct order and choosing the correct test meter readings.

Graphics of the test meters show needle positions that depend on what measurement the students choose to make. They must recognize the correct ones and reject the incorrect. Also, they have to touch specific map locations on the screen to identify the correct test points in the cable system itself.

Writing simulations is no cinch but it doesn't have to be a hair-tearing experience. Success depends on planning. Clients and producers alike mustn't underestimate the need to identify every single critical behavior required to successfully complete a simulation. They also need to identify what problems look like and how and where correct steps diverse from a troubleshooting procedure where everything works well.

"The capability can be built into the software to store and retrieve a student's test scores for each module."

pleting the skill and must select the right action.

If done correctly, the next lesson begins. However, if the student has not mastered the skill (by selecting the wrong choices or taking too much time to select), there is an automatic "recycling" to the part where the instructor explains and demonstrates the skill. This looping back to instruction is a critical difference between interactive video and classroom training. Also with IV, feedback and reinforcement are instantaneous.

There are currently over 200 generic IV programs on the market (management, computer operations, etc.) but few are applicable to the CATV industry. In addition, several MSOs already have taken an interest in developing IV for CATV training purposes. For example, Jones Intercable has several modules available for sale, and an operating group within Jones is creating CATV-specific programs.

Also, ATC is working with A.R. Brasch to create a series for technicians on troubleshooting; it also will be available to other MSOs for their training programs. However, one company's software may require a particular hardware choice; in this case, adapting the software for different equipment may be necessary.

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CATV system mapping using CADD

By Michael F. Bauer
President, American Digital Cartography

And Tony Steinmetz
System Designer, Star Cablevision Group

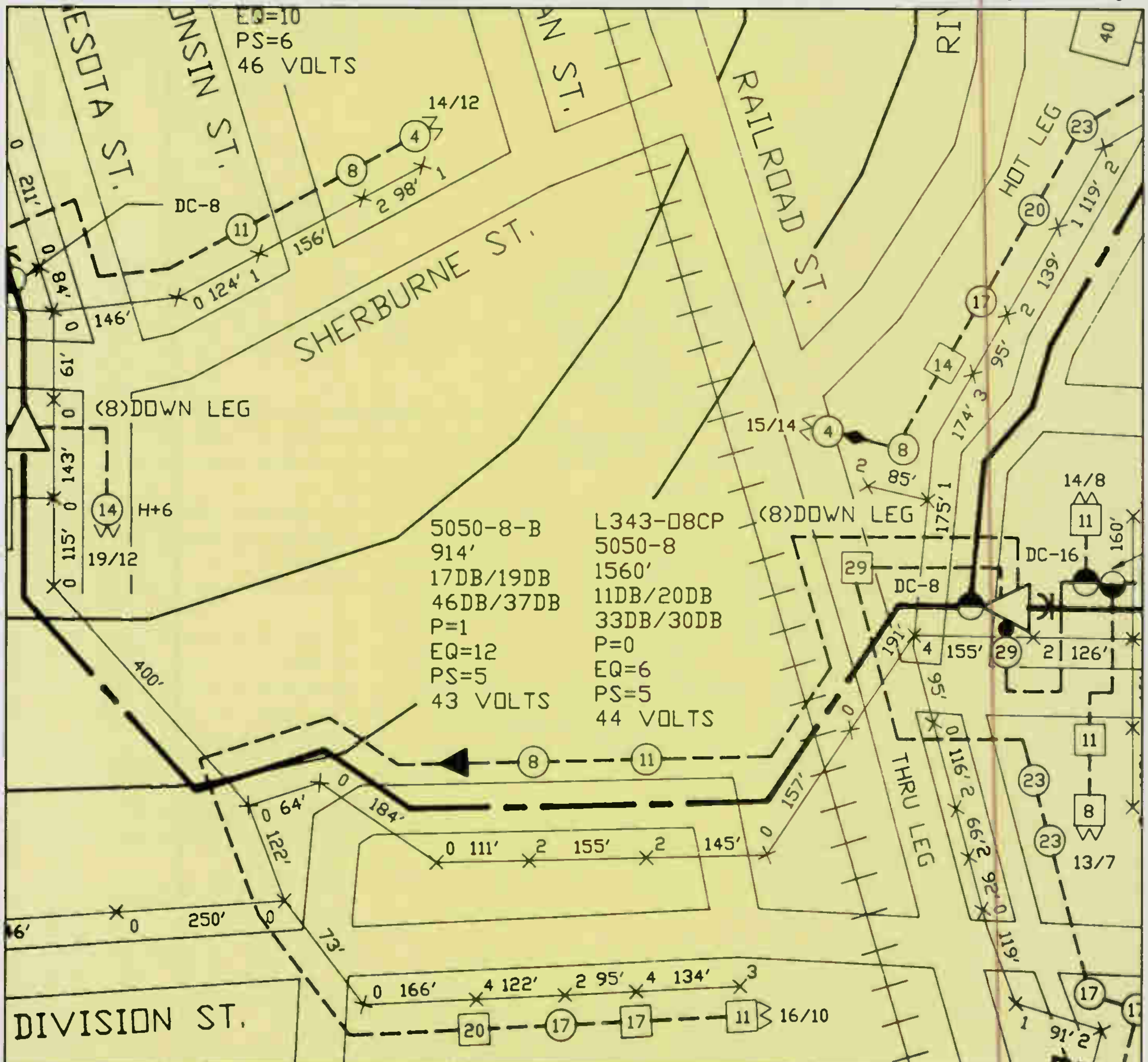
Drawing and maintaining accurate system maps is an important consideration for anyone with the responsibility of operating a CATV system. Traditionally, maps of plant and facilities are kept on paper, drawn with traditional drafting techniques. This method is workable but has several inherent problems. Paper maps can be tedious to draw, hard to store and difficult to modify. They can quickly become obsolete, leaving the system operator with no documentation. Even if maintained perfectly, they might not lend themselves to easy distribution, especially in the different formats and levels of detail required by people who must have access to them.

The advent of computer-aided design and drafting (CADD) has offered many operators an alternative to their older mechanical drawing procedures. Until recently, CADD systems were extremely expensive, often costing hundreds of thousands of dollars. However, recent advances in computer technology now puts CADD within the reach of almost every CATV operator. With a modern CADD system, the designer can use the computer screen as a drafting table.

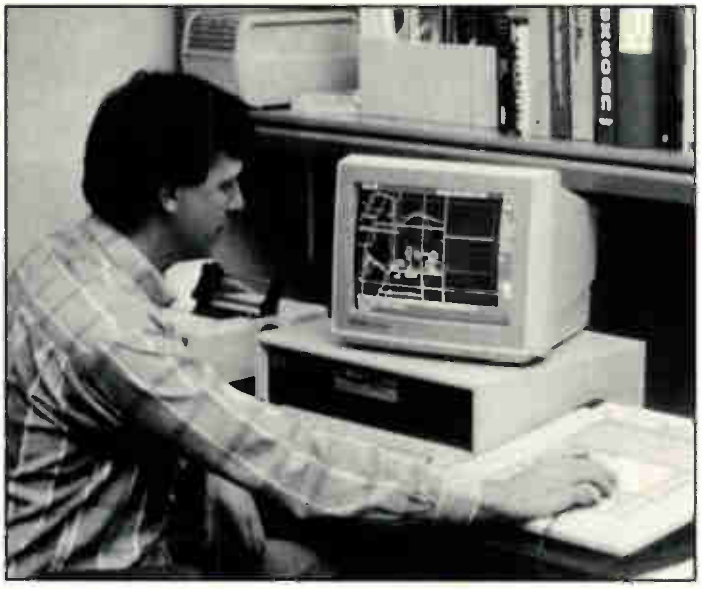
Not only does the computer contain many useful tools for preparing the initial drawing but it also eases the task of maintaining the finished diagram. Maps can easily be plotted at different scales, formats and at different levels of detail, still using just one master drawing as the source. This can virtually eliminate the task of updating many independent drawings, which soon become inconsistent with one another.

Still needed: A source of maps

As good as CADD has become, it still has a major drawback: Because it is a mapping operation, design of the system must begin with a set of base maps, showing the area that the system is to cover. Ideally, these maps should show existing streets, water courses, political boundaries, survey information and whatever other features that might affect design.



System parameters are entered into the CADD system's data base of digital maps.



Since each drawing is layered, different map features can be turned on and off on the computer display or removed entirely.

A variety of sources of paper maps are often available, but these maps are sometimes out-of-date, inaccurate and inconsistent with one another. They are seldom drawn to accurate scale, which makes any engineering calculations derived from them subject to error. Finally and most importantly, before these maps can be used in a modern CADD system, they must be tediously "digitized" or hand-drawn into the computer. This is an expensive, time-consuming process that enormously increases the cost of the project and makes the whole CADD-based mapping system look much less practical.

Star Cablevision Group of Fond du Lac, Wis., faced this problem about a year ago when it decided to purchase a CADD system for its design and drafting needs. From the beginning, it appeared that Star would be an ideal candidate for CADD mapping, since it owns and operates several CATV systems scattered over a wide area. Most of these had been purchased from original owners and were not built by Star. Many required maintenance or needed to be rebuilt. Star faced a wide range of different types of system documentation, drawn and maintained by various people. The development of mapping standards was essential because these systems could not be operated efficiently without them.

The CADD system was purchased and set up, but the problem of obtaining base maps remained. Too much time was being spent copying unreliable paper maps. Star's system designers faced hours of drudgery before they could start their real work of laying out the cable system.

Star was not alone in its need for digital maps. Users in many different industries needed a source of computer-based maps but none existed until 1988, the year the U.S. Geological Survey (USGS) completed work on several major data bases. These files contained maps in digital form, made from USGS paper maps of the entire continental United States. For the first time users could obtain consistent, reliable and up-to-date digital maps for the entire country.

Unfortunately, the USGS data files are not directly usable by most small computer CADD systems; they must be converted to the proper format before they can be compatible with the rest of the software. This task was accomplished by American Digital Cartography (ADC), a firm specializing in the conversion and distribution of digital maps. The company furnished Star with the maps required by its CADD system.

Digital map contents and accuracy

The digital maps obtained by Star contain a variety of information from several USGS data bases. This information is drawn on many different "layers" in the PC CADD system. Since each drawing is layered, different map features can be turned on and off on the computer display or removed from the drawing entirely. The effect is much the same as if the map were made on a large number of transparencies, which could be

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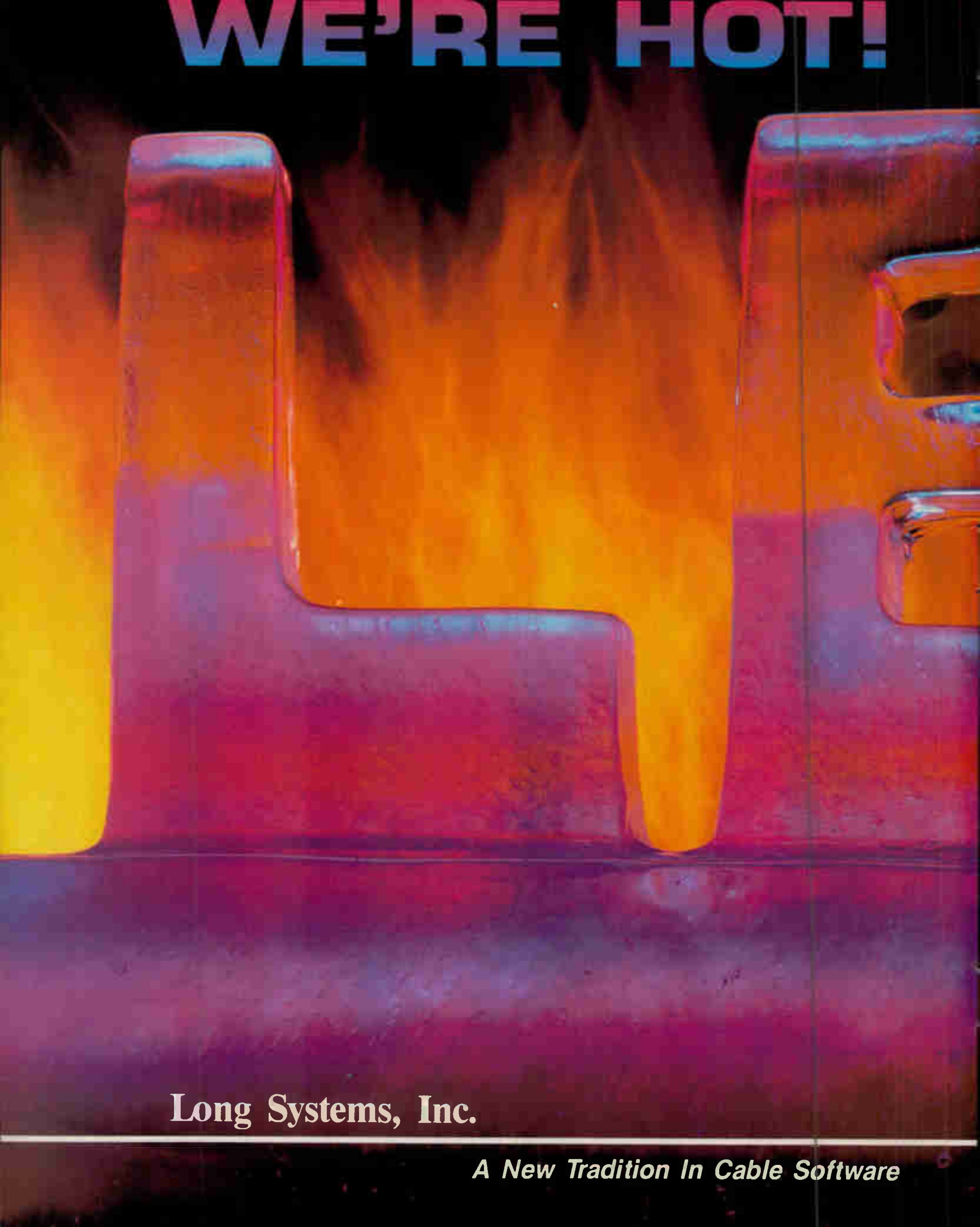
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Advances in status monitoring

By Lee Thompson
Director of Distribution Engineering and Fiber-Optic Products
Scientific-Atlanta Inc.

In today's competitive CATV marketplace, there is an increasing emphasis on quality of service. Subscribers are now encouraged to compare their signals with off-air broadcast. Better and more exotic electronic video equipment is now becoming more prevalent in the home. Deregulation offers the opportunity to alter revenue streams if the subscriber can be convinced the services are of greater value. There are now some added risks to existing operators; it is sometimes possible for a new operator to overbuild a system to compete for a franchise. As the industry is digging in for the long haul, operational costs are now becoming an important focus in the business plan.

All of these issues point to one practical goal: There is a definite need to offer consistent, high quality signals delivered to the home with mini-

Figure 1: Status monitoring system

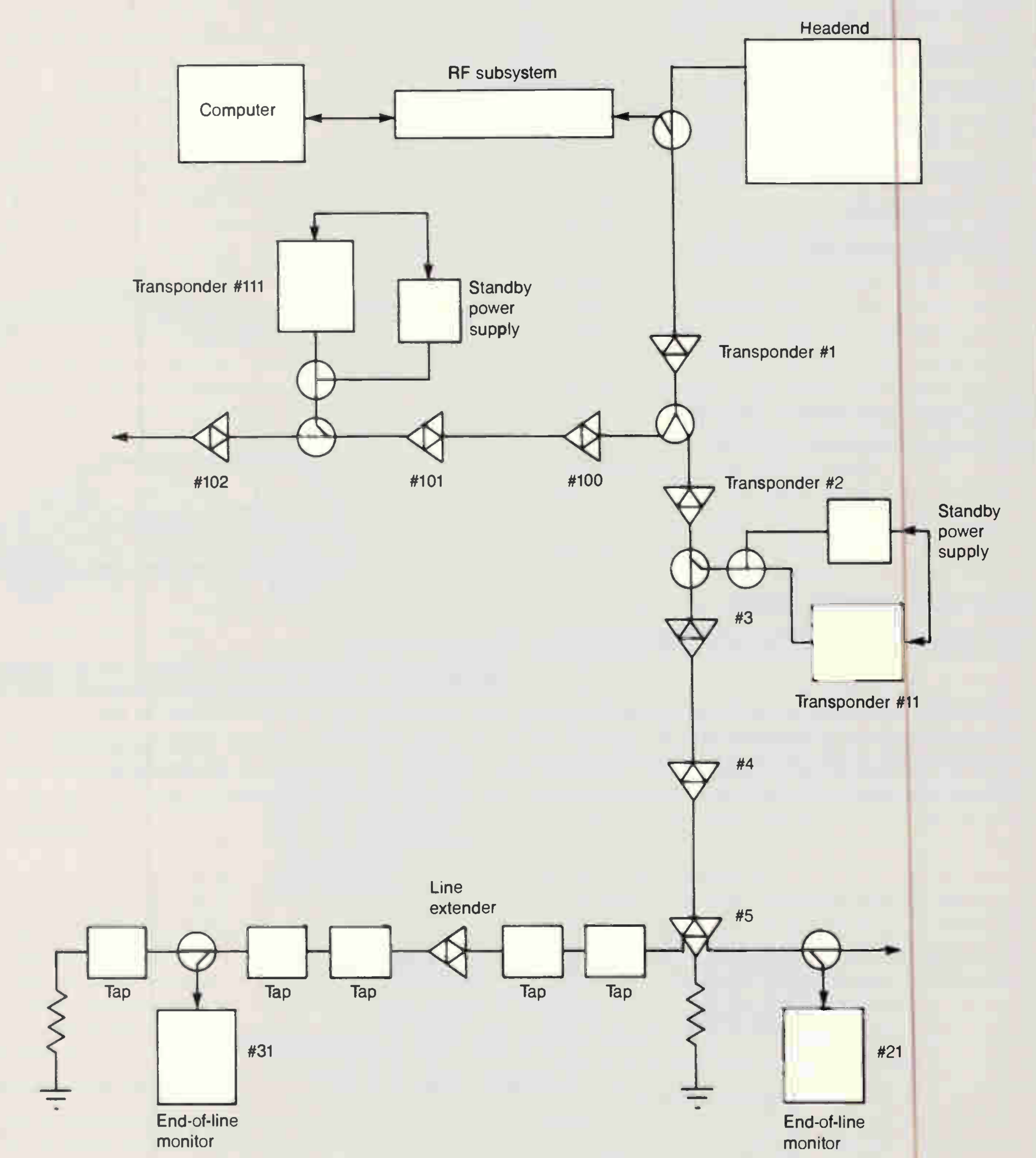

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Figure 2

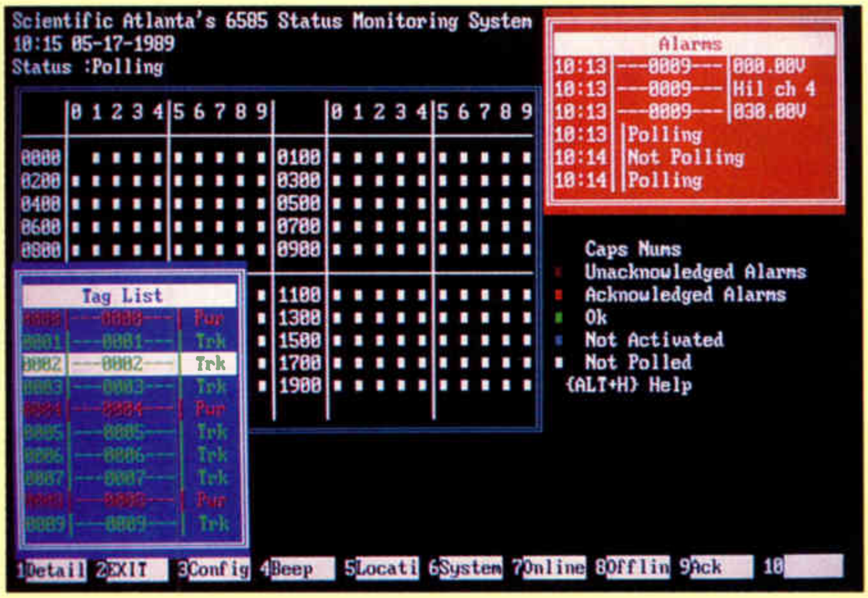
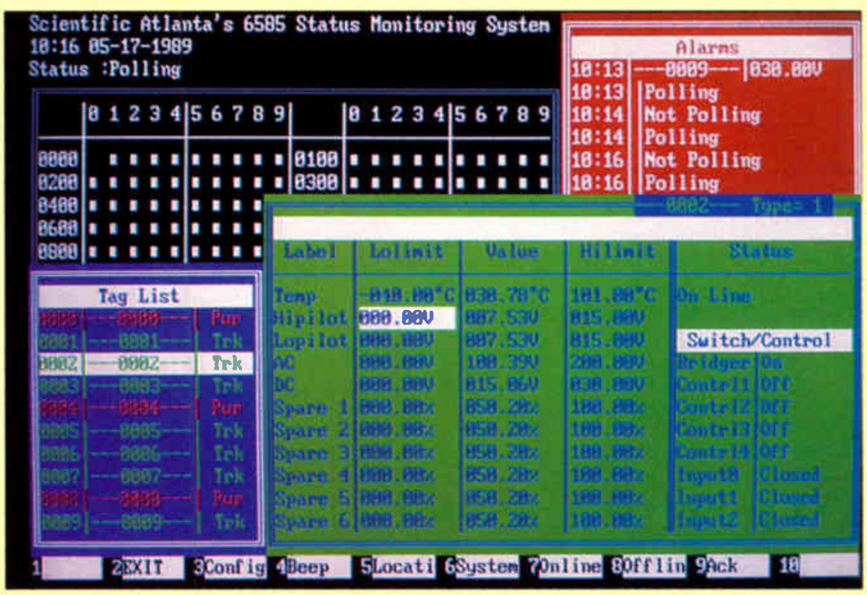


Figure 3



mal downtime. One of the tools to achieve this goal is the selection of reliable distribution equipment. An additional tool is the use of status monitoring (SM) in the distribution plant for early detection of problems, trend analysis, analog measurements, as well as ingress control. An emphasis on the human interface is essential as the system is used and operated by non-technical personnel (i.e., dispatchers).

What is status monitoring?

Most distribution manufacturers offer some form of SM as a sideline product. The basic systems are usually PC-controlled and utilize an FSK (frequency shift key) modulated RF data carrier generated in the headend to communicate with individually addressed transponders (Figure 1). A rack-mounted modem or RF subsystem is used to generate that RF data carrier; the carrier is selected to avoid interference with other video and FM signals.

The system can be simply described as a computer terminal (IBM PC or equivalent) that is continuously talking (300 to 9,600 baud) and listening to transponders located throughout the CATV or LAN (local area network) plant. Transponders are simply two-way radios in conjunction with a microcomputer and a remote controlled digital voltmeter (DVM). The DVM can be utilized to measure temperatures, voltages and currents in the station or standby power supply. In addition, the transponder also can note switch lines or activate/deactivate other switches.

These transponders can be located within a trunk housing or mounted near a standby supply. They function essentially the same in that all transponders have a receiver that is always listening to a data carrier (typically at 109 MHz) for its unique ID code. Only when the transponder's microcomputer recognizes its ID code, its transmitter (29.8 MHz) is activated and an appropriate response is sent to complete the transaction.

In some systems, all of the intelligence is located inside the transponder, thus making it free to decide which message to send back to the controller. This can save precious polling time since on most occasions there should be no status changes to report.

When there is an error condition, all details of the parameters are sent to the controller when polled. One common misconception is that an alarm is sent back independent of a polling cycle. If this were the case, imagine the communications problem if a problem existed that affected more than one transponder. All affected nodes would report back at the same time with a garbled result. It is for this reason that a transponder reports back only when interrogated.

Two-way communications

RF return path: The telcos have long been believers in SM for every aspect of their network. In fact, telco engineers have made it clear that they feel insecure unless printers and alarm systems are constantly providing feedback on system performance. A very important difference in their network requirements, however, is the inherent need for two-way communications. Whereas telco networks are switched-star and thus ultimately are point-to-point communications, CATV networks are broadcast in nature by tree-and-branch techniques.

An analogy to explain the two-way problem is this one: The broadcast (tree-and-branch) downstream is similar to a speaker with a podium and microphone presenting to a silent crowd. The return path, however, is better described as active microphones at each individual seat amplifying the coughs, hiccups, whispers and questions all at one time and delivering them back to the overwhelmed speaker on stage. This phenomenon is called "noise funneling" and is a problem to be controlled in a two-way system.

CATV networks are predominantly two-way capable but are seldom fully activated. For an SM system to be valuable, real-time (or near real-time) communications must be established from every monitored point. This is necessary in the diagnostic process to interrogate each site or to implement preventive maintenance testing (i.e., exercise battery backups, etc.).

This two-way issue has been the biggest hurdle to the decision of SM value. Traditional system designs have required RF return to be activated. Although this has been shown to work particularly well for a data return, most operators tie activation of reverse to countless ingress/egress problems.

Many of the same experienced engineers and chief techs also will suggest that when RF return is properly implemented, the distribution system is usually tighter and operating at a more consistent level of quality. This effort usually requires some "extra" personnel, it is argued and thus an added operational cost. If this is true, the perceived system integrity and subscriber satisfaction may be justifiable. The fact remains, however, that less than 10 percent of all existing cable plant is activated two-way RF. Video on the return path is used even less frequently. Recently the RF return has become more popular for data return of impulse pay-per-view (IPPV) services. This is still in an early stage since most communications of this type are handled by phone return.

Too much concern has been raised for the effort required to offer video return and that consideration should be given to a simple RF return system (perhaps narrowband requiring fewer return amplifiers of a simple nature). Those amplifiers might be pad selectable only, since there would be no need for signature correction or equalization if video transmission was foregone. This would be a valuable data return path then and further utilize the existing tree-and-branch systems.

Phone return path: Some systems, especially those that incorporate indoor electronics at the monitoring point, utilize phone lines as the return path. This technique offers many advantages in that the downstream signal is still using the RF CATV plant while RF return is not activated. The transponder is then connected back through to the controller by means of a leased phone line. The disadvantage of this is that each monitored site requires a full-time line.

Low frequency return path: Recent [illegible] for the use of very [illegible] have been reported by one [illegible] This technique [illegible] and 150 kHz to transfer [illegible] power supply to the next, ultimately [illegible]ing it on different VLF carriers until reaching the controller. Advantages are clearly that this approach may save the RF return activation while avoiding the continuing operational costs of leased phone lines. The risks to implementation of a system operating at VLF is the fact that existing equipment is not specified for performance (i.e., path loss) in this frequency range.

Fiber-optic return path: Discussions of fiber-optic return paths now appear to be much more practical. With the introduction of fiber systems, particularly AM, more emphasis on status monitoring is naturally occurring. Given that an AM fiber link is often the equivalent of an AML microwave link to a hub site and serves a large number of subscribers, it makes sense to invest in basic monitoring functions. To many operators, the cost is mainly in providing an extra fiber dedicated for this purpose within the existing bundle.

The return signal could then be accomplished on the fiber by means of a low performance laser if only low frequency data is used or a somewhat better laser should compatibility with existing upstream RF equipment, including SM transponders for trunks and power supplies, be desired.

Operator interface

Probably the most important aspect of an effective SM system is the control system interface and software. Most systems now offer liberal use of color and window techniques since they were f[illegible] offered in 1986. These features result [illegible] identify symptoms as quickly as possible.

> "With the introduction of fiber systems... more emphasis on status monitoring is naturally occurring."

A "macro" screen is usually provided, giving the operator a system overview. Included in this screen are typically time, date, polling status, green colors (if all is OK), a window (usually red) for alarm activity and special function key command descriptions.

For example, one system (from Scientific-Atlanta) offers three screens for normal usage: The "macro" screen (Figure 2) offers the previously described features without a cluttered effect. Each block represents a contiguous block of 10 unique addresses. A cursor is used to choose a block for further information. (Recently a mouse technique was incorporated on the latest software update.) After selecting the block of interest, F1 (detail) is selected to access the second level window of detailed information. On this particular screen is provided summary information on all 10 transponders. If all parameters are within the preprogrammed limits, the transponder number and optional 10 character tag will be green. If any parameter is outside of the limits, red is utilized to flag attention.

Again, cursor control is used to pick the transponder of interest for rather specific information. F1 (detail) is selected and then the third-level window is now available for all detailed parameters including limits, actual measurements, control status and switch monitoring status (Figure 3). Note that in this screen, real-time monitoring of a particular site is established and observations of voltage or current changes are possible as the transponder is polled. The screen descriptions for each analog and digital line can be modified by the operator so that the language can better suite the user; this includes foreign translations. The limits can be changed at will. Password access to some of these features is desirable to maintain system consistency.

A 40 character line is available to provide a custom description of the individual site. An example might be "3rd + Main; behind 7/11; P.S. 8B12; Map H8," which signifies that this is the amplifier at 3rd and Main streets behind the 7/11 store served by the power supply Number 8B12 on Map H8. When this screen is printed out by the dispatcher, the field technician has some good information to use for the preliminary diagnosis.

Trunk amplifier parameters

Since the transponder consists of a microprocessor and analog-to-digital (A/D) circuits, it has all the attributes of a digital voltmeter. The logical analog points to monitor in a trunk station include: 24 volts DC power supply, 60 VAC power to trunk, auto gain control (AGC) voltage, auto slope control (ASC) voltage, trunk station ambient temperature and feedforward main and error amplifier currents.

In most user-friendly systems, the high and low limits can be programmed in at the controller and can be changed at will (for example, 24 VDC ± 0.5 VDC). This permits the user to narrow the alarm windows after the system is better understood to pick out anomalies and thus to trigger preventive maintenance. All systems will bring out alarm reports as they occur; the better systems will provide additional information like amplifier location, map number and other user-loaded messages.

Other trunk amplifier transponder features often include controls such as bridger reverse switches. This feature allows the operator the capability to break the RF return path at bridger transponder locations to search for ingress sources. This is a valuable tool on active two-way RF systems to control the noise funnelling phenomenon and to switch off offending portions of the system that otherwise might impair communications for RF IPPV or other systems. Another job that a trunk-type transponder can do is switch monitoring. The most common switch monitored is a tamper switch or housing open/closed sensor.

The compromise to monitoring too many items is that access to proper points in the trunk housing may require additional wiring if the connections are unavailable in the existing wiring harness or motherboard.

Standby power supply and signature monitoring

Many operators can argue that in areas where standby power supplies are required, monitoring of those locations offers a direct payback. The greatest benefit is in the ability to check battery status and capacity. This system is often offered by the 60 VAC power supply manufacturer and also by distribution product manufacturers (who can offer this service with trunk monitoring compatibility).

Analog parameters that can be monitored vary by power supply manufacturer, but generally include 120 VAC primary, 60 VAC output voltage, battery voltage, charging current and load current (AC). Switch monitor features often include housing open/closed sensor (tamper), standby alarm (loss of primary) and general "health" status.

An uncommon parameter is electrolyte level sensing to indicate when to service batteries. Switch control features will generally include the ability to remotely switch the power supply into standby to check the battery conditions and capacity. The battery capacity can be characterized by observing the voltage under load conditions.

At least one manufacturer offers an outdoor end-of-line signature monitoring device that is SM-compatible. It has features similar to spectrum analysis for flatness (peak-to-valley) characterization. Another manufacturer offers indoor signature monitoring for headend or other controlled environments. This system can be accessed by phone remotely to record stability performance over time.

Computerized information services

By Frank D'Alessio
President, Compusen

In the coming decade, businesses without access to up-to-the-minute information may find themselves at the end of the productivity spectrum. The '80s have spawned computer services for both industries and consumers with various offerings such as Lexis, Dow Jones News/Retrieval Service and CompuServe. Most of these seemed to attract computer aficionados when first available.

But the services are now finding a wider base of users, growing more popular each day. Online services generally identify the needs of a particular industry to produce a vital source of up-to-date information. This is then supplemented in various ways and the subscribers themselves become suppliers as well as recipients of the never-ending stream of activity.

The cable industry has become a focal point for information services; this is highlighted by the recent entry of services (such as Compusen of Glen Rock, N.J.). We have developed a base of information that enables operators to list items they wish to sell and, conversely, look for and buy items from other systems. This puts cable operators in touch with the available inventories being offered for sale nationwide. A service such as this can be expanded into a major source of information simply by identifying the needs and desires of the subscribers.

Information, as we all know, is only as important as the use to which it is put. MSOs, with their ever expanding geographic reach, need to obtain and use information from each system they operate as well as from outside sources that impact (or could impact) their operations.

Independent operators, with a more limited staff, also must avail themselves of pertinent data as quickly as possible to assist them in staying competitive and informed. Nowhere can this be gathered more precisely and more quickly than from a computerized information service. Searching out topics, specific references, items for purchase and other requests are as simple as entering a few keystrokes.

The new genre

Information providers (IPs) are the new genre of business communicators. They develop methods to deliver specific or general data to their subscribers; information is sped to the reader as soon as it is entered into the computer. To relate to the need and use of an information system, imagine the stock market working in today's marketplace without one.

Constantly changing information, such as stock quotations, would be impossible to communicate without computers. Think of how difficult it would be to try to accumulate information on a particular stock when trying to make a decision to buy or sell. What was the last selling price? What has been the range of prices in the last 30 days? How many shares were sold today? Yesterday? During the last 30 days? IPs give you that data immediately.

Buying or selling products for your cable system can require the same amount of information. This especially is true when you are either buying or selling in the used marketplace. It is no longer acceptable to simply "unload" used equipment at prices someone is "willing to pay" when it is so easy to gather information that will help you receive the fair market value. Given the vast amounts of used equipment bought and sold in the CATV marketplace, it is easy to understand why operators are subscribing to an information service.

Most IPs develop a very simple searching procedure that takes the user to the specific data requested. IPs want you to use their services and, in that regard, some make it just about automatic. IPs know that a significant part of their worth to their subscribers is the retrieval of information. If difficult to retrieve, not timely or in any other way disappointing to the user, the value of the network diminishes. Also, IPs are careful not to announce services with too much hype and promises. Most know that a little information, delivered in a very useful manner, is far more valuable to a subscriber than a lot of data that is either too hard to access or not very useful.

"By observing the marketplace over time, the operator can determine the best time and place at which to buy or sell."

CATV operators are seeking every possible way to improve their bottom line. With overbuilds, escalating hardware costs, programming choices, rebuilds and other capital-demanding problems, smart managers are trying to find every way possible to keep dollars from flowing out of the company. The easiest way to accomplish that task is to be informed.

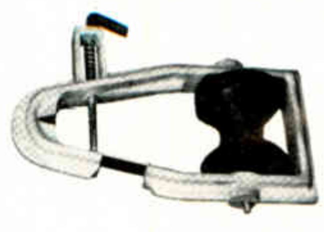
The information provided from Compusen can help operators manage their surplus assets such as converters, line equipment, headend equipment and the like. Information such as free market value and availability of surplus equipment gives operators a greater knowledge of the worth of the items they are seeking to buy or sell. By observing the marketplace over time, the operator can determine the best time and price at which to buy or sell.

In addition, we offer MSOs the option of a private network to manage their assets through our host computer. An MSO can enter its entire systemswide inventory; enabling its systems to draw from one another on an as-needed basis. The cost savings of this feature can generally save large operations millions of dollars a year.

This additional network of information enables large and small MSOs to operate as independent IPs themselves throughout their entire company, without the additional expenses of creating a network, developing a sophisticated software program and incurring the ongoing expenses of maintaining the system.

Successful IPs generally research an industry, study its needs and develop an information service to fill them; the needs do not have to be created. IPs fill needs and do it more quickly, more efficiently and at lower overall costs.

Information needed to run a large or small cable system remains essentially the same. If the information necessary to run a large system were made available to a small operator, the latter would realize it is the same data necessary to run a business. The difference between businesses, large or small, is the application of the data. If too cumbersome to obtain, not readily available or not exactly on target, then the information wastes the time used in its gathering and becomes burdensome and ineffective.



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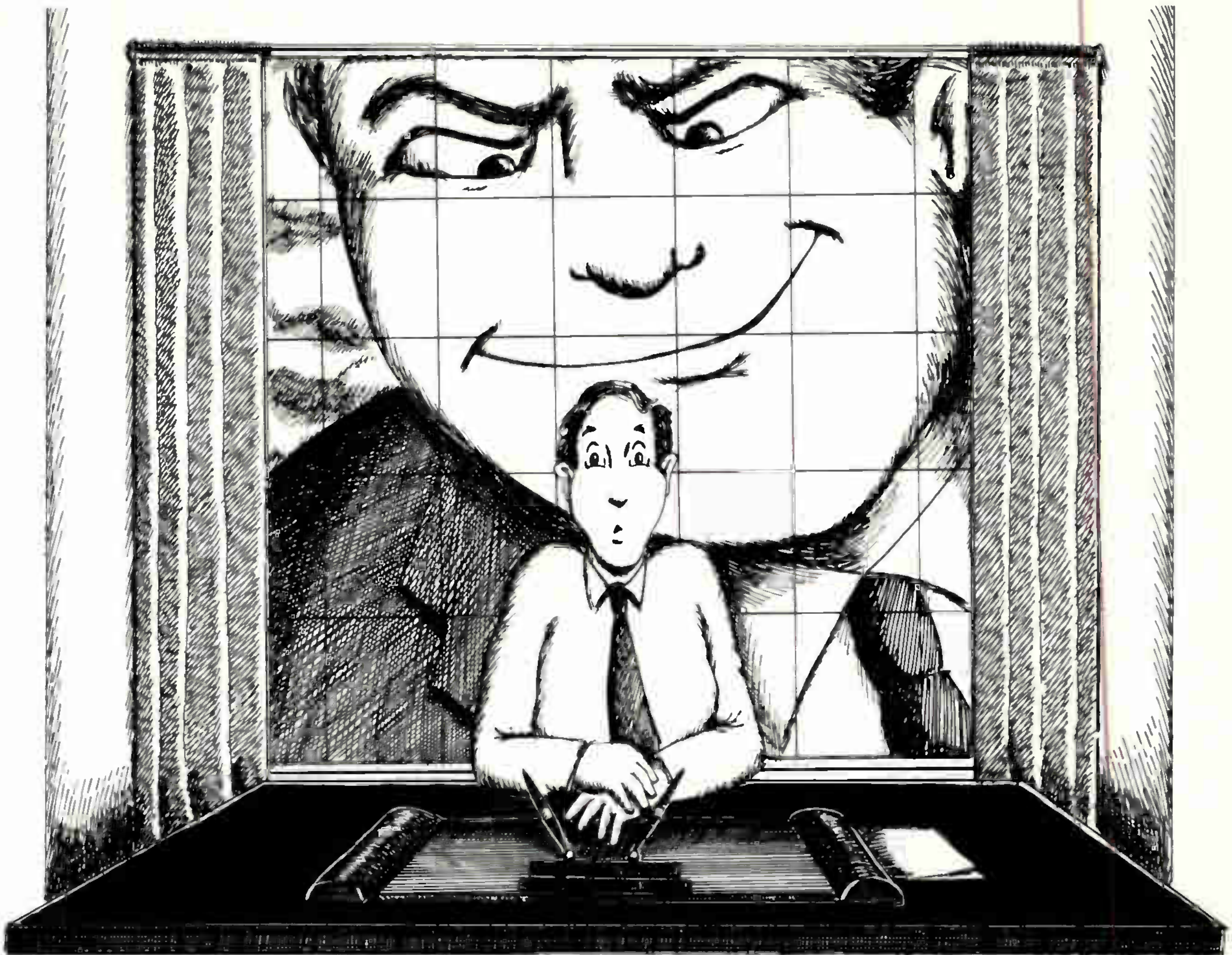

Reader Service Number 52.

Help Wanted

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Equipment For Sale

Co-channel, adjacent channel interference

In conjunction with his column "Biro Co-Channel Locator Maps," the author is providing a two-part series designed to show applications of the locator maps. This is the first installment.

By Steven I. Biro
President, Biro Engineering

With the proliferation of low-power UHF stations and translators, achieving the reception of distant UHF stations can become a vexing problem. There is really a difference between the reception of distant and local stations, rural and urban sites and VHF and UHF channels. The selection of an interference-free antenna site, a sufficient antenna tower height, effective receiving antennas and array configurations and the proper preamplifiers and signal processors will require the full attention of the engineer in charge of the project.

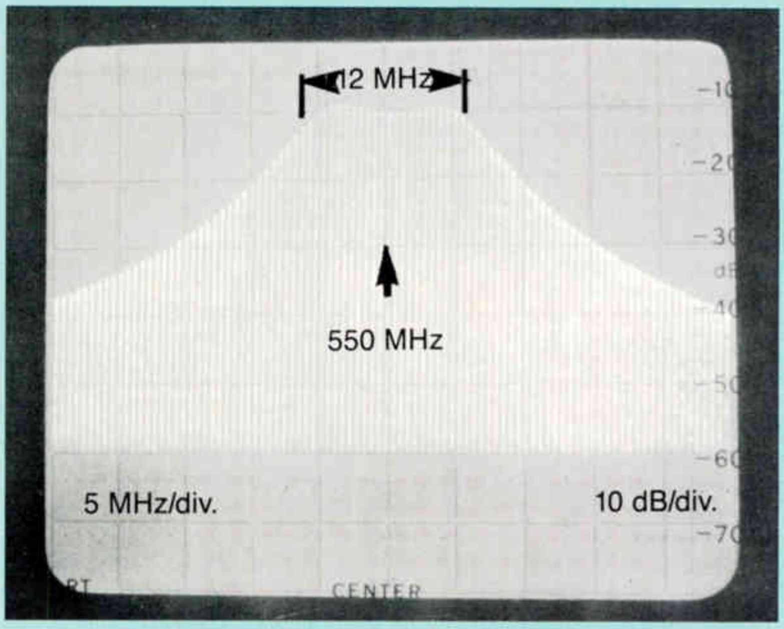
When UHF interference strikes, the first reaction is often: Could we install a filter or trap? Let's investigate the application of filters and traps for the specific purpose of eliminating co-channel and adjacent channel interference in the 470 to 800 MHz frequency range.

Co-channel beats appear either on-frequency or ±10 kHz from the video carrier. No bandpass filter or tunable trap could protect the desired channel from interference beats that close to the carrier. So keep in mind: Only properly selected antennas and correctly designed antenna arrays may provide the necessary protection against co-channel interference.

Can bandpass filters or tunable traps efficiently and reliably protect the desired UHF station against a strong adjacent channel video or sound carrier? High quality bandpass filters, which are very effective on low band and still acceptable on high band, generally do not exhibit the necessary adjacent channel selectivity in a frequency range 10 times higher than low band or three to four times higher than high band. Observe the frequency response of the bench-tested two-stage UHF bandpass filter tuned to Ch. 27 (Figure 1). Since the measured bandwidth was found more than 12 MHz wide, its adjacent video and sound carrier protection capability is nil.

The other alternative, the multistage narrow-tuned bandpass filter, can lose sound and color subcarrier information, accompanied by increasing insertion losses. Such narrow filters also can cause excessive chrominance-luminance delay distortion, a video impairment that affects picture quality. The filter must be placed in front of the antenna-mounted preamplifier. Otherwise, the high amplitude adjacent carriers could create permanent intermodulation beats in the desired spectrum. The relatively high 2 to 3 dB insertion loss of the multistage UHF filter network will in turn reduce the carrier-to-noise ratio of the signal by 2 to 3 dB, a sometimes unacceptable reduction in performance.

Figure 1



A properly designed low band trap in the headend can provide stable 30 dB protection against an adjacent channel sound or video carrier. The same type of antenna-mounted trap, operating in the 500 to 700 MHz frequency range, may deliver 10 dB protection on the day of its installation. However, tower-mounted traps are exposed to changing temperature and humidity conditions, which can cause them to drift in frequency. The need to retune the trap means a climb to the top of the tower is necessary.

Co-channel or adjacent channel interference problems are efficiently and reliably eliminated by properly selected antennas and correctly designed antenna arrays.

Using parabolic dishes

Parabolic reflectors have a proven history in microwave, space and military applications. Considering their size and shape, they are still extremely efficient for reception of weak RF signals in the 470 to 800 MHz range. For CATV applica-

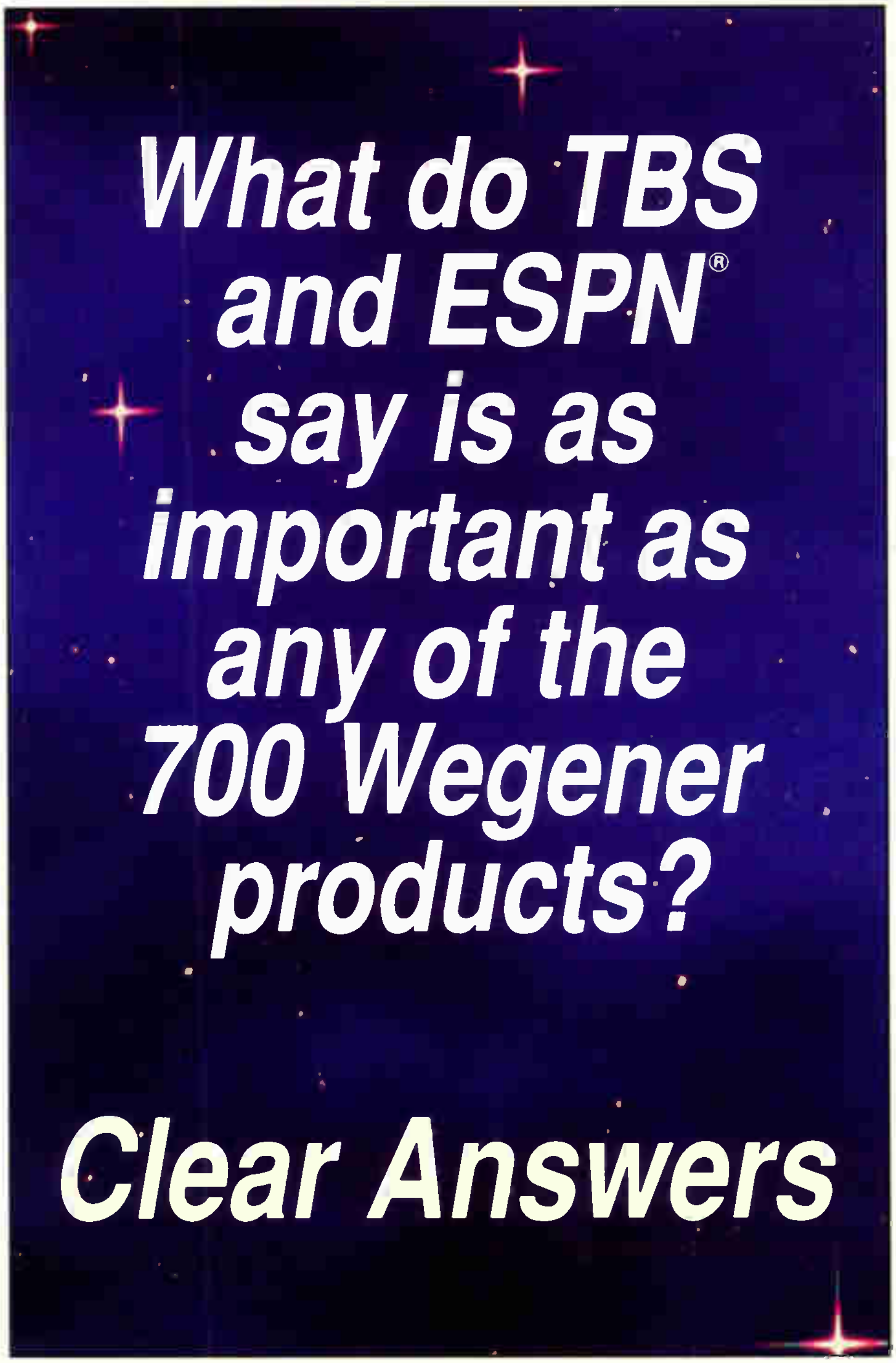


Figure 3

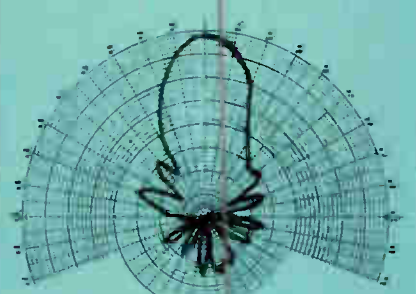
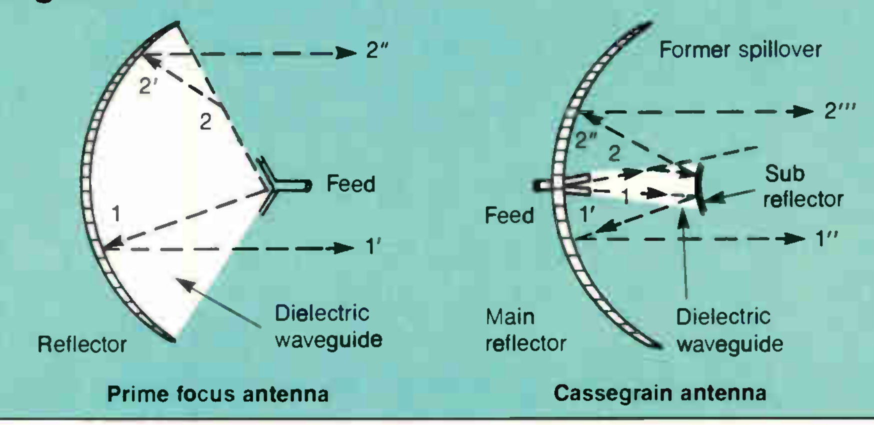


Figure 4

Figure 2



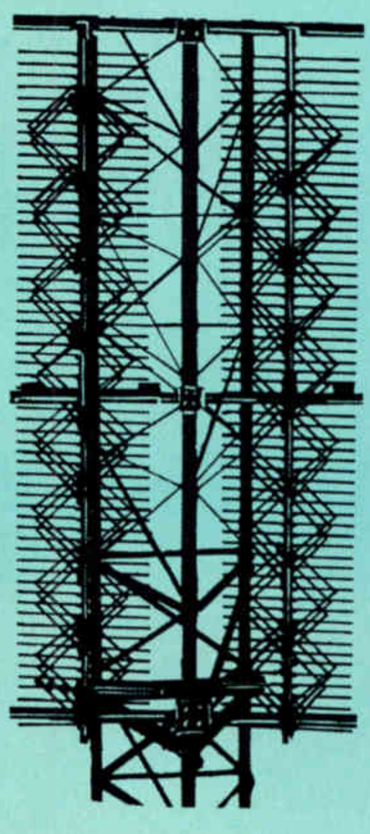
tions 4-, 6- and 8-foot diameter dishes are readily available in grid reflector and spun dish versions.

Properly designed and constructed spun parabolic dishes with prime focus or Cassegrain-type feeds (Figure 2) deliver high antenna gain and low side lobe radiation patterns. Typical 8-foot prime focus specifications call for 20 dB gain over a reference half wavelength dipole, accompanied by 20 to 25 dB side and back lobe protection. Figure 3 illustrates the radiation pattern properties of a high quality spun dish. It is not exactly a "pencil beam" but its average −25 dB back and side lobe levels are impressive.

Generally, a parabolic is among the best UHF antennas available for antenna gain, as well as for co-channel protection purposes. However, there are situations when even it does not

"Tower-mounted traps are exposed to changing temperature and humidity conditions, which can cause them to drift in frequency."

Figure 5



measure up to minimum interference reduction requirements. Then, serious considerations should be given to the application of the horizontally spaced array of zigzag antennas.

Consider a co-channel interference situation where the offender arrives from a 20° relative angle. According to the radiation pattern of Figure 3, the 8-foot parabolic dish provides only 10 dB protection; this is less than acceptable. At a 52° relative angle, about 25 dB protection can be attained with the same 8-foot spun dish. That is a very respectable achievement. However, phased array configurations can easily surpass that protection level by 5 to 7 dB.

Caution: Published antenna radiation patterns such as that of Figure 3 represent antenna range test results at certain frequencies, such as 500 or 550 MHz, etc. While at 10 or 20 MHz off the test frequency the radiation pattern remains essentially the same, at 20 or 25 percent frequency deviations those deep nulls may change drastically in depth and relative angle.

Arrays of horizontally stacked antennas are more efficient in protecting the reception of distant UHF stations against a particular co-channel or adjacent channel interference source. Theoretically any type of antenna can be arrayed. However, in the real world of CATV antenna engineering, large parabolic dishes are not adaptable to the phased array-type horizontal stacking requirements. Traveling wave-type zigzag antennas, consisting of a center-fed vertical zigzag radiator system and enhanced by a grid-type reflector, can easily be arranged into any computer-calculated horizontal stacking configuration.

The single zigzag's (Figure 4) horizontal beamwidth is relatively wide, about 43 to 45°. The antenna gain is provided by beam compression in the vertical plane. A commercially available two-bay, horizontally stacked zig zag antenna (Figure 5) has lower gain than an 8-foot parabolic dish. However, it has a capability not easily attained with the parabolic: variable horizontal spacing. The two-bay zigzag array can be designed and adjusted to force a deep (30 dB) radiation pattern null as close as 10° from the main beam. That is a 20 dB improvement over the 10 dB rejection of the 8-foot parabolic (Figure 4). ■

Reader Service Number 63.

PPV equipment

Pioneer announced the Model LC-V330 LaserDisc Autochanger System for use in standalone pay-per-view services. The product allows a cable operator to design and customize a pay-per-view channel according to individual demographic factors and marketing needs. It can contain up to 72 discs that supply approximately 145 hours of video. According to Pioneer, any point on a single disc can be accessed within seconds.

For more information, contact Pioneer Communications of America, 600 E. Crescent Ave., Upper Saddle River, N.J. 07458-1827; or circle #121 on the reader service card.

System analyzer

Wavetek RF Products introduced the Model 1882A Sweepless Sweep system analyzer for measurement of critical system parameters of signal level, carrier-to-noise, cross-modulation and second/third-order composite distortion. The 1882A's leakage detection function provides a means of patrolling for leaks between amplifier test stations. In addition, it provides a non-interfering, normalized system frequency response test capability.

For further details, contact Wavetek RF Products, 5808 Churchman Bypass, Indianapolis, Ind. 46203-6109, (317) 788-5965; or circle #130 on the reader service card.

PPV system

International TeleSystems is offering a new positive trap technology that is said to make nonaddressable homes pay-per-view capable for under $20 per home. It also offers security with more than 7,000 distinct scramble combinations. The TickeTV system provides operators with an encoder at the headend to generate and mix the system's scramble carrier(s) into the channel's signal. The signal is received at the viewer's home through the use of a set-top base unit. This unit, along with "tickets" for any featured event, can be purchased at convenience stores, supermarkets or retail outlets.

For additional details, contact International TeleSystems Inc., 415 N. Crescent Dr., Suite 120, Beverly Hills, Calif. 90210, (213) 274-7411; or circle #117 on the reader service card.

AM fiber system

Magnavox CATV Systems introduced the Magnahub advanced AM fiber-optic system. Its optical transmitter and receiver are said to allow cable operators to extend fiber deeper into their systems. The Magnahub is available in various RF amplifier technologies for operation up to 550 MHz and uses a modular design for upgrading purposes. Options include an A/B switch for fault tolerant capability, status monitoring for preventive maintenance and a return transmitter for two-way capability.

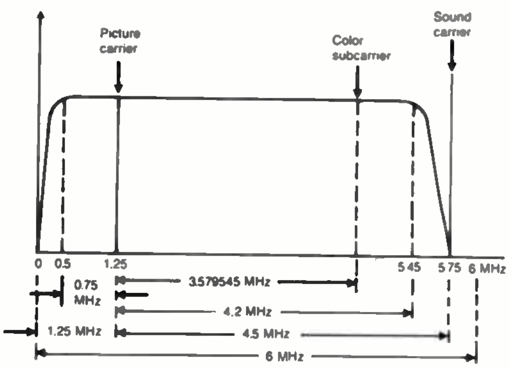
For further information, contact Magnavox CATV Systems Inc., 100 Fairgrounds Dr., Manlius, N.Y. 13104, (315) 682-9105; or circle #131 on the reader service card.

NTSC broadcast TV reference data

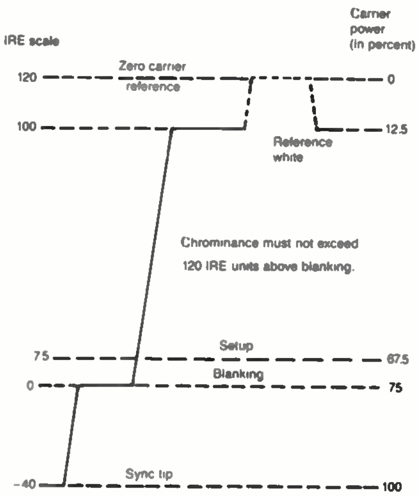
By Ron Hranac
Jones Intercable Inc.

Channel bandwidth at RF: 6 MHz
Visual carrier location: 1.25 MHz (±1 kHz) above lower channel edge
Color subcarrier frequency: 3.579545 MHz (±10 Hz) above visual carrier
Sound carrier center frequency: 4.5 MHz (±1 kHz) above visual carrier
Scanning lines: 525 lines per frame, interlaced 2 to 1
Scanning sequence: horizontally from left to right, vertically from top to bottom
Horizontal scanning frequency: 15,750 Hz (monochrome), 15,734.264 Hz (color)
Vertical scanning frequency: 60 Hz (monochrome), 59.94 Hz (color)
Aspect ratio: 4 horizontal units, 3 vertical units

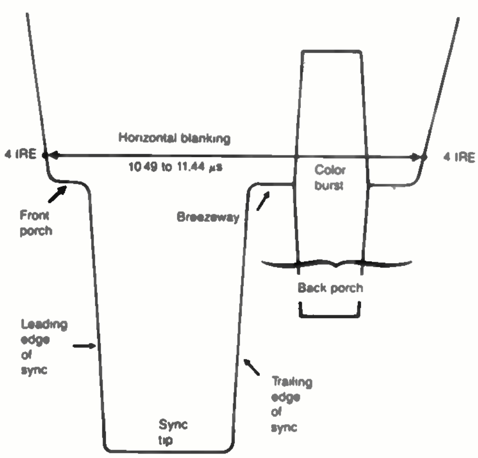
TV channel spectrum at RF relative to lower channel edge



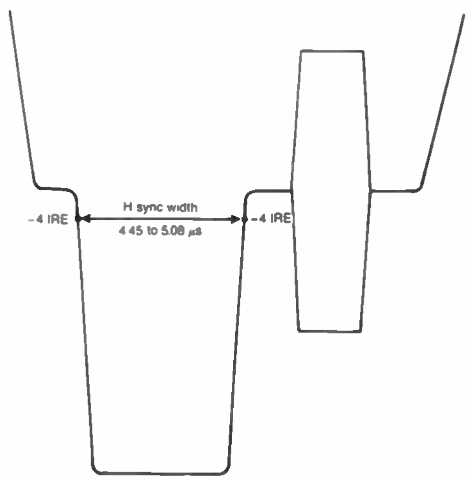
Relative levels of sync, picture and zero carrier



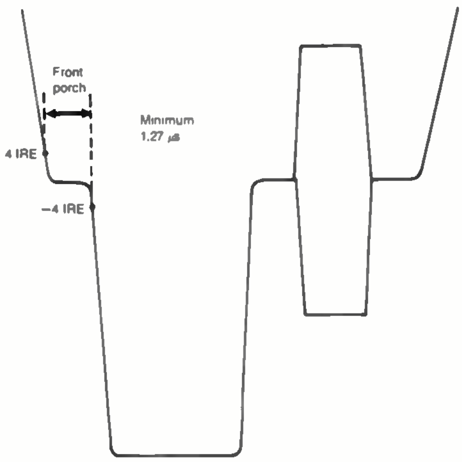
Elements of NTSC signal



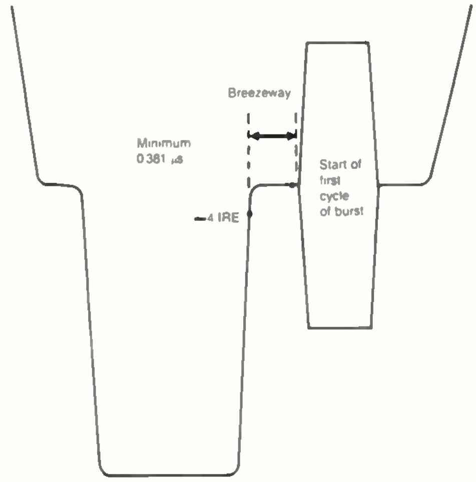
Horizontal sync



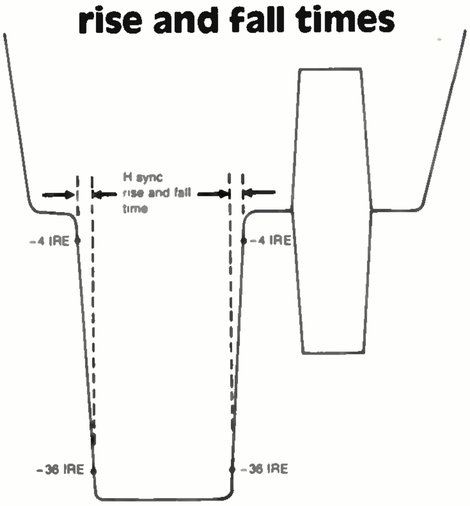
Front porch



Breezeway

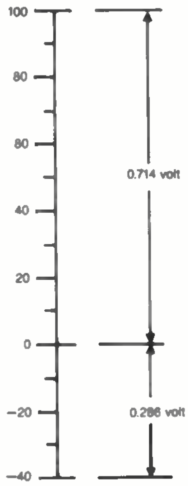


Horizontal sync rise and fall times



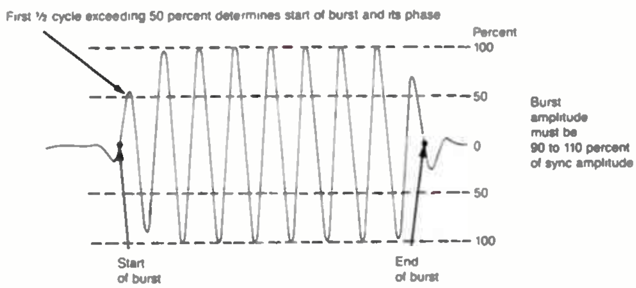
The rise and fall times of horizontal sync—measured between the 10 and 90 percent points on the pulse leading and trailing edges—are not to exceed 0.250 microsecond.

IRE scale units relative to 1 volt peak-to-peak video amplitude



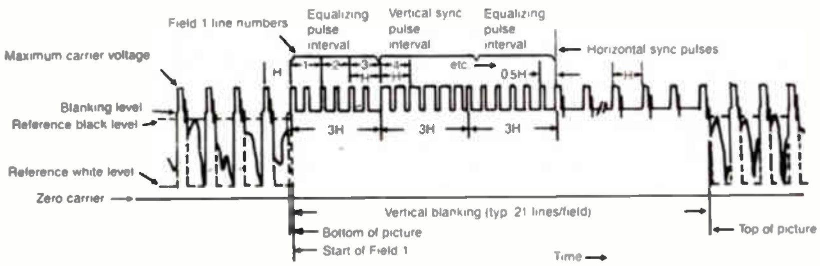
1 IRE unit = 0.0071429 volt

Burst characteristics



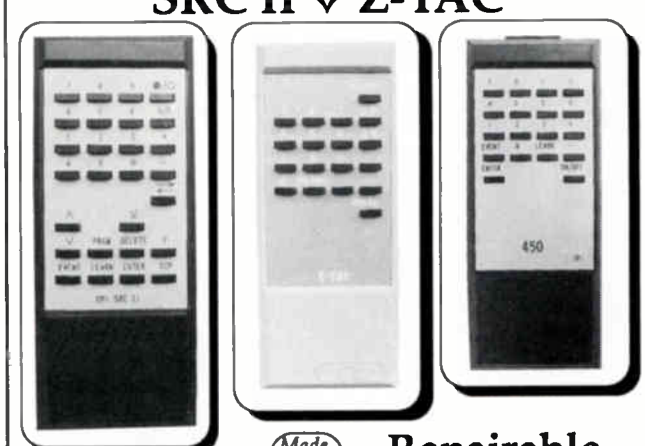
Specification for burst requires 8 to 11 cycles

Vertical interval



Serrations in vertical sync pulse must each be 3.8 to 5.1 microseconds in width. Equalizing pulse width should be 2.0 to 2.54 microseconds.

AD INDEX



Off-air Ch. 7

By Steven I. Biro
President, Biro Engineering

This is the sixth in a series of maps with technical and program parameter listings for off-air Channels 2-69, designed to be used when the cable system experiences co-channel interference. With this information, the headend technician can pinpoint the closest (i.e., the most probable) offenders, determine their directions and start the verification process with the rotor-mounted search antenna. Based on the tabulated technical information, the search can be concentrated on the most powerful stations or those that have the highest transmitting antenna towers.

The computer program for the maps was developed and data for the listings was collected by the staff of Biro Engineering, Princeton, N.J. The information is accurate as of Sept. 1, 1988.

Key to listing

Call letters: Ch. 7 station identification

City: Station location or the area served by the station

Network affiliation:

C/A	CBS and ABC programming
C/N	CBS and NBC programming
A/N	ABC and NBC programming
ACN	ABC, CBS and NBC programming
ED	Educational station (PBS)
IND	Independent station
CBC	Canadian Broadcasting Corp.
CTV	Canadian Television Network
SRC	Societe Radio-Canada
SP	Spanish language programming

Power: The effective visual radiated output power (in kilowatts)

Offset: The offset frequency of the station

0	No offset
–	−10 kHz offset
+	+10 kHz offset

HAAT: Transmitting antenna height above average terrain (in feet)

Call letters	City	Network affiliation	Power	Offset	HAAT
WCIQ	Mt. Cheaha, Ala.	ED	316	–	2000
KAKM	Anchorage, Alaska	ED	163	–	781
KUSK	Prescott, Ariz.	IND	9	0	2810
KATV	Little Rock, Ark.	ABC	316	–	2006
KABC	Los Angeles	ABC	141	0	3213
KRCR	Redding, Calif.	ABC	115	0	3620
KGO	San Francisco	ABC	316	–	1670
KMGH	Denver	CBS	316	0	1010
WJCT	Jacksonville, Fla.	ED	316	0	915
WSVN	Miami	NBC	316	–	960
WJHG	Panama City, Fla.	NBC	316	+	870
KAII	Wailuku, Hawaii	NBC	30	0	5940
KTVB	Boise, Idaho	NBC	195	0	2645
WLS	Chicago	ABC	56	0	1688

Call letters	City	Network affiliation	Power	Offset	HAAT
WTVW	Evansville, Ind.	ABC	316	0	1000
KWWL	Waterloo, Iowa	NBC	316	+	1980
KAYS	Hays, Kan.	CBS	316	0	710
KOAM	Pittsburg, Kan.	CBS	316	+	1092
KPLC	Lake Charles, La.	NBC	316	–	1480
WVII	Bangor, Maine	ABC	316	–	819
WNEV	Boston	CBS	316	+	1000
WXYZ	Detroit	ABC	316	–	1000
WPBN	Traverse City, Mich.	NBC	316	+	1349
KCCO	Alexandria, Minn.	CBS	316	0	1120
WDAM	Laurel, Miss.	NBC	316	0	529
KCTZ	Bozeman, Mont.	ABC	200	–	816
KMNE	Bassett, Neb.	ED	316	–	1484
KETV	Omaha, Neb.	ABC	316	0	1360
KOAT	Albuquerque, N.M.	ABC	87	+	4240
WKBW	Buffalo, N.Y.	ABC	100	+	1420
WWNY	Carthage, N.Y.	ACN	316	–	720
WABC	New York	ABC	65	0	1611
WITN	Washington, N.C.	NBC	316	0	1950
KQCD	Dickinson, N.D.	NBC	316	0	730
WHIO	Dayton, Ohio	CBS	200	+	1140
KSWO	Lawton, Okla.	ABC	316	+	1050
KOAC	Corvallis, Ore.	ED	263	–	1230
WITV	Charleston, S.C.	ED	310	–	1870
WSPA	Spartanburg, S.C.	CBS	316	+	2000
KEVN	Rapid City, S.D.	NBC	262	+	672
WBBJ	Jackson, Tenn.	ABC	316	+	1060
KVII	Amarillo, Texas	ABC	316	0	1703
KTBC	Austin, Texas	CBS	316	+	1268
KVIA	El Paso, Texas	ABC	316	0	820
KOSA	Odessa, Texas	CBS	316	–	740
KLTV	Tyler, Texas	ABC	316	0	990
KUED	Salt Lake City	ED	155	–	3000
WDBJ	Roanoke, Va.	CBS	316	–	2000
KIRO	Seattle	CBS	316	0	820
KSPS	Spokane, Wash.	ED	316	+	1830
WTRF	Wheeling, W. Va.	C/A	316	0	962
WSAW	Wausau, Wis.	CBS	316	–	1209
WJLA	Washington, D.C.	ABC	316	+	770
CFAC	Lethbridge, Alberta	IND	325	0	668
CFRN	Lougheed, Alberta	CTV	21	–	723
CHBC	Vernon, British Columbia	CBC	1	–	870
CBWG	Fairford, Manitoba	CBC	4	–	310
CKY	Winnipeg, Manitoba	CTV	325	+	1003
CKCD	Campbellton, Maritime Provinces	CBC	2	–	640
CHMT	Moncton, Maritime Provinces	CBC	325	0	1128
CBHF	Mulgrave, Maritime Provinces	CBC	106		665
CBHT	Shelburne, Maritime Provinces	CBC	38	+	425
CBNA	Buchans, Newfoundland	CBC	3		24
CBWC	Atikokan, Ontario	CBC	6	–	385
CKNC	Elliot Lake, Ontario	CBC	25	–	577
CBLF	Geraldton, Ontario	CBC	4	–	670
CBFO	Hearst, Ontario	CBC	17	0	611
CBLF	Sturgeon Falls, Ontario	CBC	18	0	617
CICA	Timmins, Ontario	ED	141	–	650
CBST	Baie Comeau, Quebec	CBC	4	–	340
CHAU	Gaspe, Quebec	IND	1	0	285
CBGA	Port Daniel, Quebec	CBC	1	+	340
CHAU	Riviere Au Renoir, Quebec	CBC	1	0	710
CKRT	Riviere Du Loup, Quebec	CBC	49	+	1156
CHLT	Sherbrooke, Quebec	IND	316	0	1840
CIEW	Carlyle Lake, Saskatchewan	IND	170	+	1100
CKMJ	Marquis, Saskatchewan	CTV	55		768
CKMJ	Moose Jaw, Saskatchewan	CTV	98	–	775
CICC	Norquay, Saskatchewan	CTV	69	–	353
CBKF	St. Brieux, Saskatchewan	CBC	1	+	180
CBCP	Shaunavon, Saskatchewan	CBC	9	+	685
XHAD	Saltillo, Mexico	SP	11	–	5
WSTE	Ponce, Puerto Rico	SP	186	+	2710

Loughead (−)
St. Brieux (+)
Norquay (−)
Fairford (−)
Marquis
Moose Jaw (−)
Vernon (−)
Lethbridge (0)
Shaunavon (+)
Carlyle Lake (+)
Winnipeg (+)
Geraldton (−)
Baie Comeau (−)
Atikokan (−)
Hearst (0)
Timmins (−)
Campbellton (−)
Seattle (0)
Spokane (+)
Dickinson (0)
Elliot Lake (−)
Riviere Du Loup (+)
Sturgeon Falls (0)
Bozeman (−)
Alexandria (0)
Sherbrooke (0)
Corvallis (−)
Wausau (−)
Bangor (−)
Rapid City (+)
Traverse City (+)
Carthage (−)
Boise (0)
Detroit (−)
Buffalo (+)
Boston (+)
Bassett (−)
Waterloo (+)
Chicago (0)
Omaha (0)
Wheeling (0)
Redding (0)
Salt Lake City (−)
New York (0)
Dayton (+)
Denver (0)
Hays (0)
Washington, D.C. (+)
San Francisco (−)
Evansville (0)
Pittsburg (+)
Roanoke (−)
Jackson (+)
Albuquerque (+)
Amarillo (0)
Lawton (+)
Prescott (0)
Washington (0)
Spartanburg (+)
Los Angeles (0)
Little Rock (−)
Mt. Cheaha (−)
Charleston (−)
Tyler (0)
El Paso (0)
Odessa (−)
Laurel (0)
Lake Charles (−)
Panama City (+)
Jacksonville (0)
Austin (+)
Miami (−)
Saltillo (−)

Competitive cable ATV and motion artifacts

By Walter S. Ciciora, Ph.D.
Vice President of Technology
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In previous columns and in presentations, I've mentioned that I believe CATV's advanced television (ATV) priorities include ensuring that we can be competitive with other media over the short and long term. Also, we must carry the signal chosen by the broadcasters for their ATV efforts. In addition, the fundamental modulation techniques of the various media almost require that there will be more than one ATV technical standard. This has caused some alarm, especially among consumer electronics manufacturers.

The competitive threat

The principal near-term competitor to cable's ATV position comes from prerecorded media such as discs and tapes that will be sold and rented. Several Japanese manufacturers have demonstrated baseband VCR prototypes that make excellent pictures. In addition to being high resolution and wide screen, the video is free of motion artifacts. This is because no special technique is required to reduce bandwidth from 20 or 30 MHz down to some smaller number such as 6 or 9 MHz. The concern for cable is that there might be a noticeable difference in picture quality when a subscriber turns from watching a videotape to, say, a pay channel. This could potentially change the way subscribers view ATV movies.

It's important to appreciate that this threat comes from a source whose ATV plans are not likely to be limited by the Federal Communications Commission. No one had to ask for permission to introduce Super-VHS machines. Likewise, no one will need permission to introduce baseband ATV VCR machines. It is the consumer electronics industry that is most concerned about the possibility of multiple standards for ATV. The irony is that they are most likely to force the need for multiple standards through their ability to introduce prerecorded media products that might render cable's video non-competitive.

Recording is the video technology that has made the most progress in the last 10 years and has the most potential for further advances in the next 10 years. It is important to watch recording technology carefully and understand what it may mean for the future of the cable business.

Another longer term competitor is the video that may be delivered by telephone companies using digital signals over fiber to the home. It would be reasonable to expect that digital signals will produce excellent quality pictures with little or no motion artifacts.

What is needed?

Cable needs competitive ATV video. This includes resolution, adequately low levels of noise, distortions, cross-modulation, microreflections and motion artifacts. It also means adequate numbers of channels and adequately low cost. This last parameter must not be forgotten, since subscribers judge it carefully. If in our zeal to be competitive in every other way we sacrifice being cost-competitive, subscribers will reject our efforts just as soundly. This is why we must not try to bring ATV to subscribers before they are ready for it. Doing so increases costs and destroys cost competitiveness before there is a need for ATV competitiveness.

As with so many things, timing is critical. There is no need for ATV video on cable when no ATV receivers exist in subscribers' homes. Since the HBO and Massachusetts Institute of Technology viewer studies have shown that people can't tell the difference between ATV and good NTSC when viewed from more than five times picture height, ATV video isn't needed for small screens. Very high quality video won't be needed until subscribers have really large-screen displays. This most likely gives us seven to 12 years to prepare.

If we think about how the prerecorded media pictures are likely to compare with those proposed by most of the current ATV proponents, we find the most probable difference to be in motion artifacts. All proponents should produce great still pictures; some may have advantages over others in ruggedness and ability to operate in noise, distortion or heavy signal loading. Nearly all proponents have to squeeze 20 or 30 MHz of video down into something much less, sacrificing motion fidelity. But prerecorded media have no need to do this. They will be essentially free of motion artifacts.

To be competitive, cable doesn't need more scan lines or more pixels per scan line. It simply will need to be as free of motion artifacts as prerecorded media. The good news is that one of the most expensive elements of the ATV receiver is not affected; the display can be the same.

"There is need for an option to trade bandwidth at some future time for motion fidelity."

In the event that the transmission standard initially chosen for cable does not of itself yield adequate freedom from motion artifacts to be competitive when truly large screens are in common use, cable needs a way of augmenting that signal to eliminate the motion artifacts. In the best of all worlds, this will be unnecessary: The original transmission standard will be competitive. But if this isn't the case, cable's ability to trade bandwidth for video quality should be an available option. In the time frame when ATV is commercially significant and when large screens are practical, fiber and other techniques will provide the extra bandwidth in a very cost-effective manner.

What about broadcast signals?

Broadcasters have the same need to be competitive with prerecorded media. If the limits of physics preclude this in the available over-the-air spectrum, it will be in all our best interests if we can provide carriage to the home with direct studio links to the headend.

In conclusion, to satisfy cable's need to retain its ability to deliver competitive ATV, there is a need for an *option* to trade bandwidth at some future time for motion fidelity. This is only an option. If the initial transmission standard provides adequate quality, the option may never be invoked. The cost impact on an ATV receiver will be in the portion most amenable to cost reduction—the signal processing part. The display elements are not affected. The additional processing can be done outside of the display unit with some sort of plugable module.

Design department

(Continued from page 62)

different cables and active equipment, the effects on the total equipment necessary and its financial impact can influence choices for the overall plant.

A lot can go wrong for the designer. The cable or the active gear used by the construction department can be changed at the last minute, which can cause the design to be less than adequate. The initial fielding can be grossly inaccurate, which will present an insurmountable problem in determining what the equipment requirements will be and how construction will progress. Fielding should include drop length to the subscriber's TV set in addition to cable requirements at the street or pole.

MDUs present unique requirements because they are never the same. Accurate fielding is always required in order to provide an adequate signal. All of this will affect the subscriber's signals and ultimately determine marketing's effectiveness and the system's cash flow.

Good designers are a breed apart, a vital ingredient in the forces that made CATV an industry. The position was not created as a parasite but grew into a need of the industry. The need is still there, even greater in this age of technological advances and Federal Communications Commission regulations. As with other businesses, the CATV industry is required to provide a quality product to the consumer; this is one of the few industries where the product is viewed constantly. There is no marketing scheme or management process that will convince subscribers to buy a product that is perceived as poor, not with the current availability of alternatives.

Allocation of tolerance

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

HDTV (high definition TV) seems to be moving out of the laboratory and into the political theater. Line rates, field rates, bandwidth compression, compatibility, dimensional filtering and all of those esoteric technical issues have taken a backseat to the issue of restoring America's leadership in consumer electronics and chip technology. The hot issues are no longer progressive scanning vs. interlaced or 50 vs. 60 Hz field rates. The issue now is whether government help should be provided by direct subsidy and tax credits or by such non-monetary means as changes in antitrust and patent laws and policies.

But while economists and politicians, the American Electronics Association (AEA) and the Electronic Industries Association (EIA) analyze and debate the policy issues, the search for realistic standards for advanced TV (ATV), if not truly HDTV, goes on. In the inner councils of the Federal Communications Commission, the broadcast network boardrooms, and the working parties of the Advanced Television Systems Committee and the Advanced Television Advisory Committee, the heaviest emphasis is on baseband video in the production studio and the home display system.

Some standards, like line and field rates, synchronization, polarity and chromaticity definitions, are required to match the receiver to the camera; yet they relate only incidentally to picture quality. Other specifications having to do with noise, interference, reflections, differential gain and phase, linear and non-linear amplitude distortions, group delay error, subcarrier intermodulation and others are needed to define the overall performance of the transmitter and receiver, including the effect of the transmission media between transmitter and receiver.

Functional standards

The major work to date has been on functional standards. Transmission performance characteristics have not been entirely ignored but specifics have yet to come forth. Cable TV has little cause for concern about purely functional standards except for the extent to which they may result in more or less vulnerability to various performance defects. Functional specs are established to assure that the receiver will track the camera; they have little to do with the quality of the transmitted signal.

However, 30 years of experience with NTSC color standards provides substantial cause for concern regarding performance specs. For many years, broadcasters struggled with a variety of signal quality problems resulting from the almost totally uncoordinated peformance goals and specs of the program studio producers, network operations, Bell System interconnections and their own transmission facilities. The Joint Committee for Intersociety Coordination in 1970 undertook its intensive Ad Hoc Color Television Study to identify various reasons for degraded color TV performance. It reported faults at every stage, from producer to studio monitor setup, transmitter and receiver characteristics and CRT phosphors. They even blamed the "propagation path." By 1975, the Network Transmission Committee had issued its Seventh Report (NTC-7) with comprehensive definitions of performance objectives for that portion of the transmission path represented by video network facilities leased from the Bell System.

Receiver performance is not presently subject to significant standardization (except for noise figure and sensitivity in the all-channel UHF rules). Receivers are designed to produce subjectively determined "marketable" picture quality when receiving the TV broadcasts that happen to exist in the manufacturer's locale. If they don't sell, the manufacturers try to fix them up somehow. While individual receiver manufacturers do have their own proprietary standards, there is no forum for coordinating these with overall transmission performance goals.

Performance specs should be based on subjective ratings of the picture quality of the end product, as finally seen by representatives of the general public on their own TV sets, with tolerances allocated among all potential contributors. For example, if 10° differential phase is shown to be objectionable to the average viewer and NTC-7 allows the Bell System up to 5° maximum, how much should the transmitter be allowed? The receiver? Cable TV? Typical transmitters are specified at 2° to 3°; cable TV modulators and satellite receivers, 1° each. What if the receiver introduces 3° or 4°? All components, rated separately, would be well within tolerance, while the combined differential phase might actually exceed the limit. In such circumstances, cable has frequently been adjudged to be the cause of objectional quality since the picture looks better without cable. Although the broadcaster, the Bell System and the receiver are each clearly within the 10° limit, the finger is nevertheless pointed at cable (the new kid on the block).

It now seems possible that the transmission system adopted for ATV (or HDTV) may be the 50-year-old vestigial sideband AM (VSB/AM) standard. It has been knowledgeably suggested that SAW filters will provide sufficiently accurate phase characteristics to avoid the objectionable "close ghost" edge effect. This may be true for the transmitter/receiver combination. But then, would cable TV be required to generate zero group delay distortion in order to avoid blame for degrading the picture?

Two issues

There are really two issues at stake. First, is VSB/AM really too fragile for a satisfactory HDTV transmission system? Second, regardless of what transmission system may eventually be adopted, it appears to be essential that the total tolerance allowed for critical performance characteristics be allocated among the various components of transmission paths that may include not only transmitters and receivers but also telco network facilities, VCR, cable TV distribution, MMDS, MATV, SMATV, microwave and satellite relay, and fiber-optic systems with conversions between video and FM, AM or digital signals.

Cable TV has been accused in the past of deliberately degrading broadcast signals received over the air, although the accusation has never been documented. However, we all know of situations in which the cable signal is inferior to the direct off-air signal from the same source. This is the situation we must try to avoid with respect to ATV (or HDTV).

Never in the history of television has there been a specific allocation of tolerances between the separate system components. The original NTSC standards did recognize that in some cases pre-emphasis and precorrection at the transmitter would be more economical than maintaining tight tolerances at the receiver. FCC standards for TV broadcasting, however, are almost entirely functional. The simplistic FCC noise specification was suspended years ago. Amplitude response characteristics of the transmitter are specified primarily as protection against interference to other transmissions. The group delay specification that was intended to precorrect for the receiver sound notch characteristic tends to make matters even worse. The rules are silent with respect to differential gain and phase, chrominance-luminance cross-talk, linear and non-linear distortions and all the other characteristics related to signal quality.

Cable TV will once again find itself in the villain's role unless the ATV (or HDTV) standards adopted, officially or de facto, include a meaningful allocation of tolerances within the overall performance specifications. With well over half of all TV sets in use connected to cable, failure to achieve the expected quality of performance on cable could effectively frustrate government and industry efforts to encourage and promote the restoration of a domestic consumer electronics industry. ■