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THE MAGAZINE OF BROADBAND TECHNOLOGY / FEBRUARY 1990

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**Is there need for a new scrambling standard?** 26
When VideoCipher II was selected as the industry's *de facto* satellite scrambling standard, no one predicted the assault it would come under by pirates. With unit "cloning" now running rampant, General Instrument is rolling out VideoCipher II Plus in hopes of overcoming the piracy problem. This article, by *CED*'s Roger Brown, further examines how VideoCipher alienated the CATV industry through poor customer service and explores the company's efforts to regain the industry's trust.

**Fiber networking strategies in the U.K.** 32
With a new infusion of interest by American companies, it appears that cable television might finally have a chance to make it in the United Kingdom. Because the franchise and construction process has taken so long, systems have the benefit of utilizing large amounts of fiber optics in their networks. In this article, Jerald Crusan of United Artists International examines his company's network strategy and design of its U.K. cable systems.

CLI COMPLIANCE
**A few more thoughts on leakage management** 48
Although much has already been said about CLI, Roy Ehman at Jones Intercable, admonishes cable's technical crews to remember that signal leakage should be viewed as a management effort, not just an exercise in passing a test. He also explains the differences between $I_{3000}$ and $I\infty$, and describes how leakage detection equipment, including antennas, should be used.

**Ku-band: Is there a future for it in CATV?** 54
Now that programmers have spent millions to commit to another generation of C-band satellites for delivery of their product, the debate over using Ku-band satellites in the cable industry has finally subsided. Or has it? Ku-band technology is apparently far from dead. In this article by *CED*'s Kathy Berlin, both the technology and its possible users are examined. It could be that cable might find a use for it after all.

**Galvanizing line construction hardware** 74
It might seem like a minor issue, but many cable operators have millions of dollars of equipment hanging outside exposed to Mother Nature's harsh environment. Tom Niemiera of Joslyn Manufacturing Company and Lawrence White of Anixter Cable TV explain how hot dip galvanizing pole line hardware can add life to that equipment. Corrosion protection qualities, composition and method of process are all explored.

**CLI COMPLIANCE**

*Leakage management, pg. .48*


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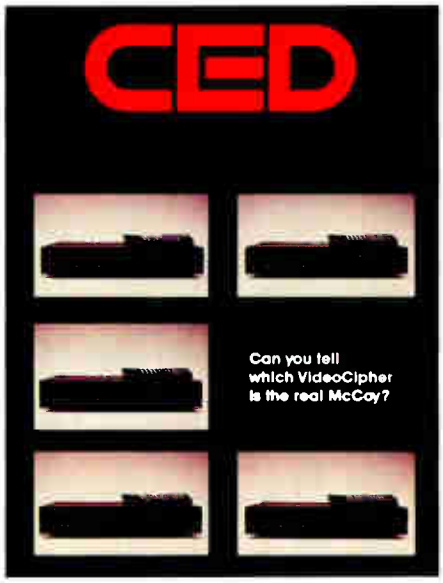


**About the Cover:**
*Cloning of VideoCipher II descramblers has made it tough to tell the pirates from the real thing.*

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The NTSC technical standard

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# MATERIAL

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Inspired by the radio wave theories of Heinrich Hertz, Guglielmo Marconi built and perfected the world's first wireless telegraph.

Spending tireless hours in the attic of his father's estate, Marconi attached extra wires to his spark transmitter, resulting in major transmission distance advances. And, when the experiments were moved outdoors, his greatest technical triumphs materialized—literally out of thin air.

He first discovered that by grounding a transmitter, the signal range was greatly increased. He then discovered that upright antennas would send messages the farthest. By 1901, transmissions from his radio towers were the first to cross the Atlantic. But perhaps Marconi's most important triumph was his ability to recognize, early-on, that technological success is totally dependent on viable commercial applications.

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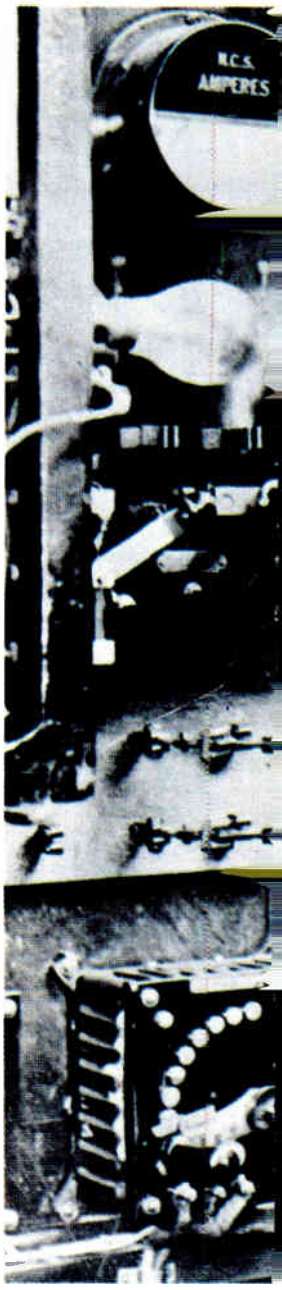


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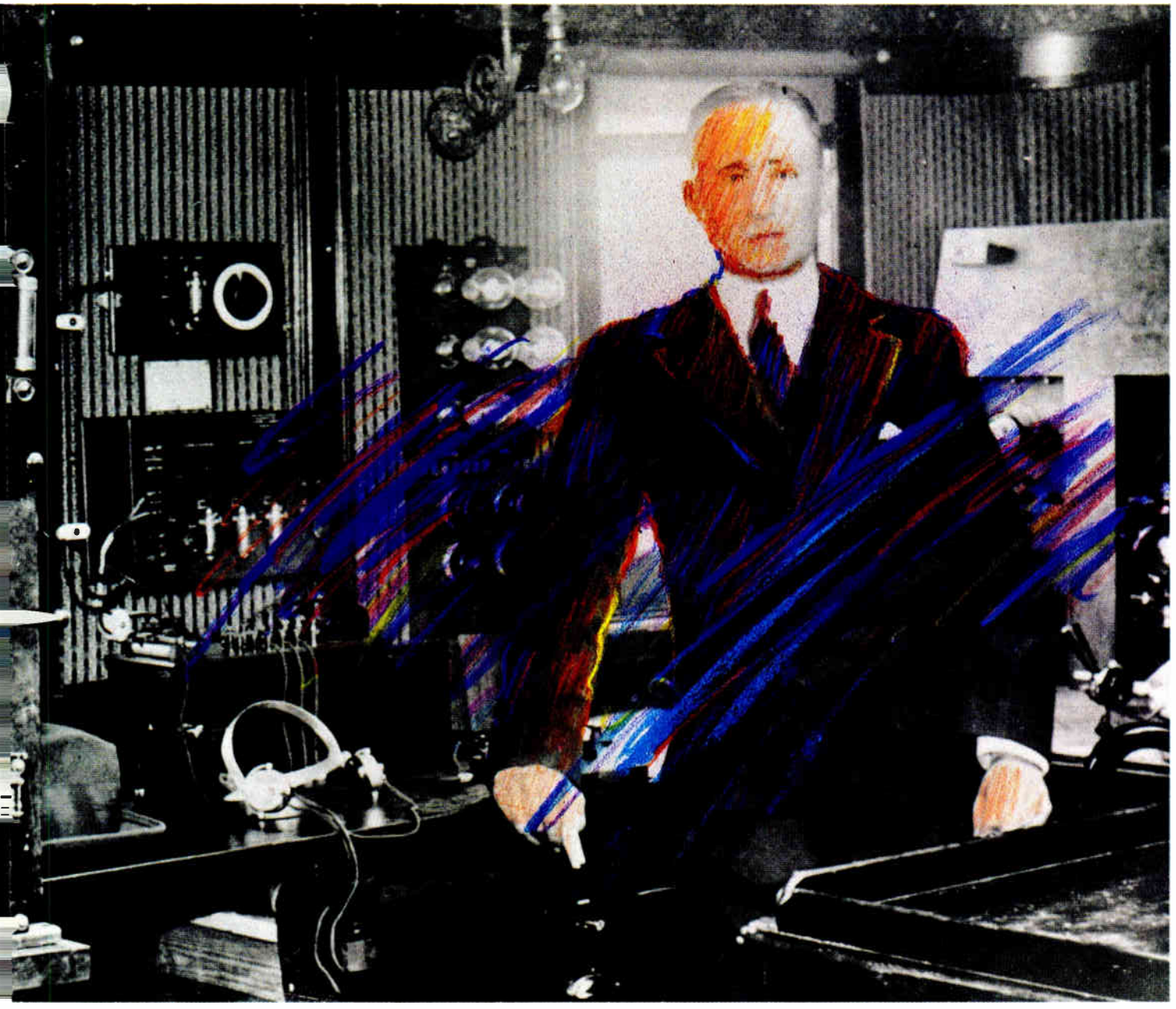
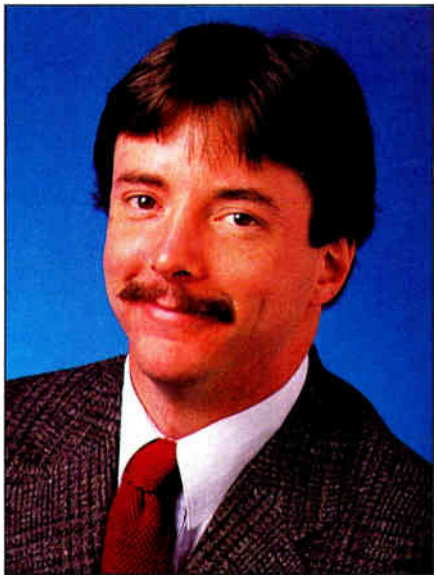


# Here's to hoping the technology works

Three cheers to the VideoCipher Division of General Instrument for finally responding to the call for improved signal security and customer service. As you'll read in the article beginning on page 26, the much-anticipated (and much-needed) roll-out of VideoCipher II Plus is finally now happening and the cable industry is now holding its breath, hoping the technology will keep the pirates at bay for awhile.

At the same time, VideoCipher officials have apparently swallowed their pride, admitted that numerous problems exist and have implemented new controls to shore up reliability and improve repair turnaround times.



It's hard to believe that General Instrument—the same company that controls Jerrold—allowed one of its divisions to alienate the very same group of people that is responsible for a large portion of its annual revenue for so long. Judging from the stories told by several CATV executives, it took repeated head bashings and some spirited dialogue to finally force VideoCipher to capitulate.

In VideoCipher's defense, it is important to remember, as one engineer put it, the rapidity of the encryption selection process. When HBO put out its RFP for an affordable scrambling system, it couldn't wait forever. What resulted was a unit that descrambled the picture, but took up too much rack space, ate up batteries and burned up power supplies regularly.

VideoCipher should be faulted for making two glaring errors: underestimating the viciousness of the attacks that would be made by pirates against its consumer descrambling unit; and failing to upgrade the unit until the eleventh hour. They could, perhaps rightfully, argue that it was only recently that all the security functions could be integrated into a single chip, but instead they chose to ignore the cable industry and its suggestions for improvement.

That has resulted in the formation of a sophisticated network of pirates getting rich by selling thousands of illegal decoders. While the authorization rate has been climbing lately, theft is still the norm, not the exception. (In fact, one engineer interviewed for the article told of a recent encounter with a VideoCipher dealer who offered a "fixed up" descrambler for just $150 over the unit's retail price.) Depending on how aggressively VideoCipher switches out existing VideoCipher II decoders for the new VideoCipher II Plus, programmers could continue to lose billions in revenue.

We applaud VideoCipher's new attitude and apparent willingness to at least attempt to correct past mistakes. We only wish it had happened sooner. But now that the new unit is finally in production, the biggest test of all is only months away. Here's to hoping VideoCipher passes the test.

Roger J. Brown

Roger Brown
Editor

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## COLOR BURSTS

# Interactive television inches toward reality

Ever since cable systems began installing real-time two-way communication capability, we've heard grand visions of the future and the role "interactive television" will have in our daily lives. From Qube a decade ago, to today's Interactive Network, Interactive Systems and Canada's Videotron, efforts continue to draw viewers into the programming.

Another familiar player who the industry hasn't heard much from lately also seems close to moving beyond the testing phase. For TV Answer, who up until a year ago could be seen on the floor of this industry's largest conventions, the question is: Where are they now?

Still on Media General's cable system in Fairfax, offering two interactive programs five nights a week to 600 homes equipped with low-power transmitters, according to Sally Olmstead, media relations director.

The patented TV Answer system, developed in 1983 and first demonstrated in 1987, consists of a device in the headend to print messages or questions on various channels and a transmitter located in the home to broadcast responses to those messages or questions over the air back to the headend for processing and tabulation. The impulse system can send and receive about 1 million answers per minute, according to company officials.

Despite at least two years of testing that shows the technology works, TV Answer has been unable to roll the system out nationwide because it needs spectrum space to operate.

TV Answer has petitioned the Federal Communications Commission for nationwide use of 218.25 MHz, the slot it has been using in Fairfax under an experimental license, but has not yet received permission because of the turmoil the FCC has experienced at the top.

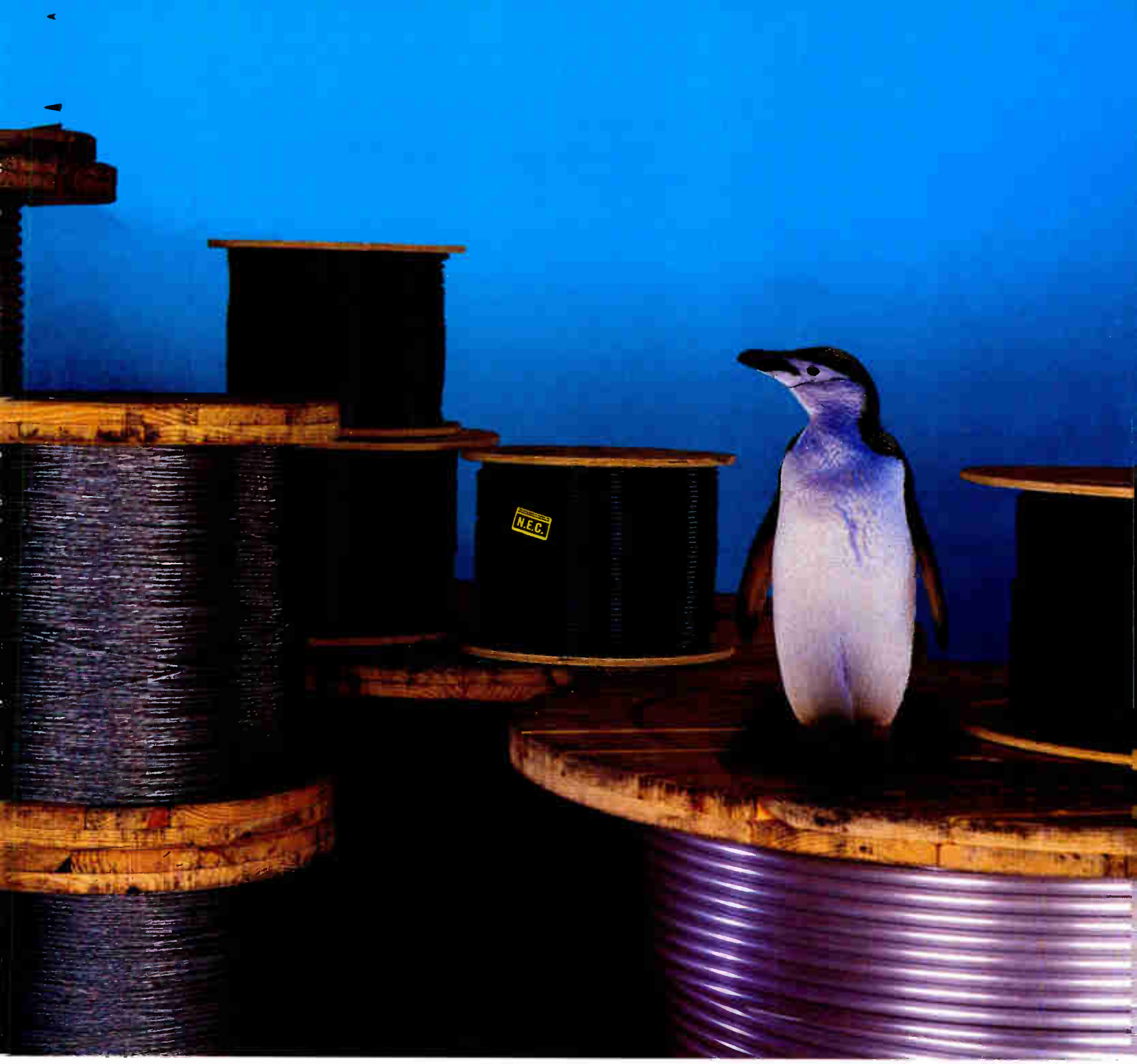
However, there may be hope, soon. Olmstead said TV Answer and the FCC have held "numerous meetings" that she characterized as "upbeat and encouraging" and were promised some resolution of the petition during the first half of 1990.

Although TV Answer has been unable to increase the size of its test, it hasn't been running idle. Two interactive programs—a news program and a music video show—are produced in TV Answer's own studio in McLean, Va. and offered five nights a week. In addition, viewers are continuously polled on current news and lifestyle issues "just to keep the viewers pushing buttons," said Olmstead.

On the hardware side, TV Answer has been working on developing second-generation equipment for the home. Most of the improvements are related to the hand-held remote control, which allows viewers to operate it with just one hand. "We're interested in being more than just an interactive service provider," Olmstead said.

# CableLabs plans staff expansions

As reported last month, the board of directors of CableLabs approved a $3.5 million operating budget for 1990, along with a $2 million allocation for research projects and a $750,000 capital budget for next year.

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*Richard Leghorn*

# Fighting to keep cable's advantage

Although battling for First Amendment rights, fending off "cable bashers" and scuffling with regulatory restraints would seem a tiresome entry into the cable industry, it was but a walk in the park for Richard Leghorn, president and CEO of Eidak Corp., who spent his post-college days flying fighter planes on reconnaissance missions for the D-Day invasion of Normandy.

In 1939, Leghorn graduated from MIT with a degree in physics before beginning a brief role as a development physicist for Eastman Kodak in Rochester, N.Y. While at Kodak, Leghorn was a reserve officer in the ordinance and waking at 4 a.m. to learn to fly, prompting a decision to transfer to the Airforce.

Six months before Pearl Harbor, Leghorn was ordered to Wright Field AFB in Dayton, Ohio, to develop equipment for the reconnaissance effort. On the day of Pearl Harbor, he requested an assignment to flying school. Upon graduation, Leghorn was put in charge of a reconnaissance squad stationed in England and flew reconnaissance for the D-Day invasion and subsequently in support of the first Army across Europe.

"We did some unusual things technically," says Leghorn of his wartime reconnaissance work. "We did some night flash photography with the late Dr. Harold Edgerton, who recently was honored as the father of flash photography at MIT, along with some unusual things with camera design. Our pictures were so good you could see where they put mines on poles to intercept the parachutists. It was exceptional photography."

As a final assignment, in 1946 Colonel Leghorn went to Bikini Atoll where he was responsible for the aerial instrumentation for the initial Atomic Bomb test. From 1947 to 1950, Leghorn returned to Kodak, where he managed various aspects of the company's international operations.

### Time well spent

In 1951, Leghorn was again pulled into military action during the Korean War as Chief, Reconnaissance Systems Branch, at Wright Air Development Center and later was put in charge of Intelligence Systems Development Planning, DCS-D headquarters in Washington, D.C. During this period he was responsible for planning and coordinating reconnaissance aircraft, satellite and balloon development.

For Leghorn, the time in the service was well spent. "The most significant thing," says Leghorn, "was my involvement with overflight which was carried on into U2 and reconnaissance satellite business. I was deeply involved in the satellite planning back in '51, '52—Sputnik didn't go off until '57. But the most significant thing," he adds, "is the use of information to stabilize the peace."

> 'The industry needs to develop its business capabilities to make television all the best it can be.'

In 1953 Leghorn, once again back at Kodak, put his military background to use and got Kodak involved with the satellite reconnaissance business advising the company—when it began working with CBS and Lockheed on a satellite system to electronically read out pictures—that it was possible to bring film back from space and have much better pictures.

To organize such a program, in 1957 Leghorn left the company to set up Itek, now a division of Litton Industries. Itek, the first high-technology company on Route 128 around Boston, specialized in electronic and photographic sciences in the aerospace and office equipment industries.

Leghorn's first foray into communications came with Dasa Corp., a manufacturer of communications equipment for the telephone and data communications industries including building of automatic dialing equipment for AT&T. He also became legally involved with several cases of phone company monopoly.

### And now for cable

In 1966, Leghorn had a vacation house on Cape Cod with a large antenna to receive off-air television. Complaints from his wife about the size of the antenna resulted in Leghorn suggesting she call the local cable company. But Cape Cod had no cable company, so Leghorn organized Cape Cod Cablevision—his first step into cable television.

"I probably made all the mistakes in the book," muses Leghorn. "I did a lease-back to the phone company from whom we subsequently bought the plant. The system grew and I became fasinated with the business." It was also at this time that Leghorn became interested in identifying cable as a member of the media—instead of a utility or a carrier—which entitled the industry to First Amendment protection. "I became a member of the board of directors of the NCTA and generally became known for my Fist Amendment views," states Leghorn. At the time considered controversial, this constitutional position now has more general acceptance.

Leghorn became owner or part owner of nine cable systems, which he sold in 1985 with plans to retire. However, the draw to new technological frontiers was too great. Leghorn attempted to start a R&D consortium for the cable industry. His first proposal was written in 1984 while the Cooperative Research Act was going through Con-

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## SPOTLIGHT

gress. Included in his vision for the consortium was the development of copy protection technology, but since nothing was done, Leghorn abandoned the idea and started Eidak.

Leghorn, along with "a technical group in Long Island," started Eidak Corp. in 1986 to develop systems for copyright protection of video and television programming. "I felt that if cable provided a distribution service and protected the rights of copyright holders, it would be easier for cable to get fresh product," says Leghorn.

### Founding CableLabs

It wasn't until late 1987 that Leghorn once again decided to "crank up this CableLabs idea" which took hold this time. "The industry was ready for it," says Leghorn. "The industry wasn't ready for it back in 1984." Because of his involvement in bringing CableLabs into existence, Leghorn was named its "father" by the CableLabs board of directors. "The only thing I didn't like about that is I am too young to be called its father," chuckles Leghorn.

At 70, Leghorn is still busy "making promising technologies work in the real world." His Eidak systems, which has attracted the investments of industry heavyweights such as TCI, Continental, Scientific-Atlanta and CableLabs is moving towards a rollout. In addition, Leghorn helped organize another company, call Magnascreen, along with Jerome Weisner, formerly the president of MIT and Science Advisor to Presidents Kennedy and Johnson, and Peter Brody inventor of active matrix technology. The company, which was recently awarded a defense department contract, is developing a large flat screen designed to be the "answer to high definition in the home, and for other applications." Although it will be five to 10 years before the flat TV will make its way into the home, Leghorn sees this as the same time frame for HDTV. "I happen to think like John Sie does," says Leghorn. "We've got to work first with improving NTSC."

During the next decade, Leghorn intends to "be involved where I can be helpful, particulary in the technological area." For Leghorn, this means the industry needs to "develop its business capabilities to make television all the best it can be. Cable speaks for television now," says Leghorn. "Cable's got to make television all the best it can be." ■

*—Kathy Berlin*

## Small telcos share CATV's obstacles

Politeness forbids me to tell you exactly what I think of your editorial ("Forget the single-wire telco theory," *CED*, December 1989, p.12). Your opinion is definitely not as broad as your technology. *Please*, please learn cooperation.

As general manager of a small telco, I know customers, fiber, competition, dollars, etc. Telco rates have gone down; therefore, your opinion seems wrong.

Small independent telcos have had inside wiring and phones taken off the books and "given" to customers; *compete* for installing lines *in our own franchise area*; are forced to "give" 911 and expensive enhanced emergency equipment; had to add free touch-tone service to customer bills; are required to give handicapped equipment and access; subsidize low income customers; are expected to police interexchange carriers, resellers, bypass and more at no charge; and...the list adds up.

Work here a few days. There is some truth to your opinion...you should be able to find more.

**Linda Gamble**
**General Manager**
**Hampden Telephone Co.**
**Hampden, Maine**

## In support of the Man of the Year

Please accept my congratulations on the selection of Nicholas Hamilton-Piercy as *CED*'s Man of the Year. I had the privilege of working recently with Nick on the NCTA technical subcommittee to the Blue Ribbon Committee on high definition television. Until the Blue Ribbon Committee was formed to provide NCTA board level leadership on HDTV, Nick Hamilton-Piercy carried the cable industry's load on this vital issue. We were, and still are, in good hands.

If the FCC chooses a high definition standard which is friendly to cable operators and if cable is a full participant in the television of the future, we will have Nick to thank. I also congratulate him on his fine choice of a first name.

**Nicholas E. Worth**
**Executive VP, Engineering**
**TeleCable Corp.**

## Offended by cover

The December 1989 cover illustration highlighting the top MSO's engineers was an effective means of recognizing our industry's leaders. However, I must take issue with the illustration's supposed theme of "Heading into the '90s."

The depiction of a woman dressed in a maid's uniform dusting off a television amidst the group of high-level professionals projects an image I find abhorrent.

Is this the role of women in the cable industry as we "get ready for the future?"

**Lisa Lyons**
**Senior Engineer**
**Scientific-Atlanta**

## Keeping the pictures straight

Regarding "Compression, limiting and clipping" ("From the Headend," December 1989, p. 28), who says only computers get "bugs?" Keeping pictures straight with text has plagued print media for years. Case in point: While the author correctly describes compression, its graphic (b) clearly shows peak - *limited* waveforms. Similarly, the text for "limiting" is correct, but refers to (c), which depicts compressed audio.

In fact, the audio chain in virtually *every* radio station is compressor▸limiter▸clipper. Yes, clipper. There's more of that done than people admit to. It is, however, quite sophisticated now, with "soft" clippers that don't "flat-top" the signal as indicated.

P.S.: AM stations also commonly deliberately unbalance positive and negative modulation peaks!

**Donald Kimberlin**
**Telecomm Net Architects**

## No computer error this time

In this letter, I make reference to your January 1990 edition of *CED* and to the article by Mr. James H. Kuhns on page 76.

As we all know, computers over the past several years have (in most instances) made the boring and repetitious actions of our lives considerably easier. However, a computer will only do *exactly* as it is told to do and I was concerned with the small program in Table 2 in the article. The program, as printed, contains errors which will frustrate anyone trying to utilize it on their office or home computer. Line number 70 . . . "minus sixty to zero step one" *appears* as "minus sixty to 'capital o' step one" and the unwary may not know to enter a zero at that point.

Line number 80 needs one more closing parentheis at the end of the line for the computer to calculate the equation. Otherwise, a "Syntax Error in Line Number 80" will appear on the computer screen.

Line number 90 . . . ((DBMV = 60) should be ((DBMV + 60). As it stands, the entire second column will contain exactly the same values for the entire length.

The formula could be rewritten to read:

80 UVM = 10↑(DBMV/20) * 1000 * .021 * FREQ

90 UVM2 = 10↑((DBMV+60)/20) * 1000 * .021 * FREQ

This would eliminate most of the parenthesis.

Also, there was no mention in the article that this program will produce the output on the printer rather than on the screen. For the inexperienced, this may cause grief as there will be no screen information except for the initial request of the frequency and then subsequent error messages.

Although the above items may seem to be of a simple matter, my experience with the Basic language and computers in general taught me to be critical of the "little" things. Programs I've written for use in our cable systems range from satellite look angles to in-field converter tracking and failure rates as well as a program written several months ago similar to Mr. Kuhns. I understand that these were probably just errors that occurred along the publication route, but feel that a correction should be printed in your next issue for those who may be interested.

**Kenneth W. Sterling**
**System Maintenance Technician**
**NewChannels Cable TV**

# Success includes engineering management

Some time ago I wrote an article for *CED* in which I bemoaned the fact that the cable television industry was losing some of its engineering stars. I got a lot of interesting comments from readers about that particular article, including some commenters who called up and said that it appeared the critical tone of the article meant that I was questioning their intelligence. My response was, "Well, there it is." What more could I say?

While that's not all behind us yet, I am happy to report that some of the people who had left the industry—and were the cause of my need to vent my concerns in this column—have come back to the industry, as we all hoped they would. The real thrust of the article, however, was not that these particular people were leaving, but that the industry, at a time of growth and technological change, needed certain kinds of people.

### Talent needed

They (we) needed and continue to need people who have multiple talents and skills. It is major mistake for executives to think that an engineer in the company only knows about decibels and megahertz. At the senior level in this profession—and indeed even at a large cross-section of the mid-level in the cable engineering population—we have multi-talented individuals who are as much businessmen as they are technologists.

The fact that more of these people aren't recognized internally, or indeed by outside contacts, is of concern to me. I am going to use an example and the name of someone I consider to be the kind of individual who brings credit to us all—Bob Luff, vice president engineering and technology at Jones Intercable.

Bob has a multitude of talents and some would say he learned these talents while working at the FCC and then at the NCTA (in my job). I would counter he wouldn't have had any of these jobs if he didn't have the talent to start with. Bob is not only an engineer, he is a manager. He is a motivator and a creative thinker. He gives as many business ideas to his company as calculations on dBs and MHz. But more than that, he brings credit to the entire engineering profession because he's an engineer who understands perceptions by outsiders when they visit the offices or workplaces of engineers and technicians. Bob is aware of how views are colored by things that don't really matter.

It is a major mistake for executives to think that an engineer in the company only knows about decibels and megahertz.

### Ambience colors perception

One example is how the attitude about our work is colored by the ambience of the office. If visitors come into an engineering office and see clutter—papers and books in disarray, or what appears to be a general lack of organization—it's easy to have the opinion that the person occupying such a space has thoughts and ideas that are equally cluttered, disorganized and disarrayed. You and I know that this isn't necessarily true and I'm sure that we've all chuckled at the sign that says "A clean desk is the sign of a sick mind."

I for one believe that the impression of a well organized work place, of a desk that is clearly in use but well organized, gives a subtle impression that changes the attitudes that non-engineers have about our particular profession. It doesn't make the calculations any more correct or the answers and explanations any more succinct, but it allows people to leave with the feeling that these people have special skills and knowledge along with their intelligence and business acumen. This is better than thinking that these people can be dressed up and put in an office, but can't do anything but use their singular or particular knowledge to crank out answers to engineering questions.

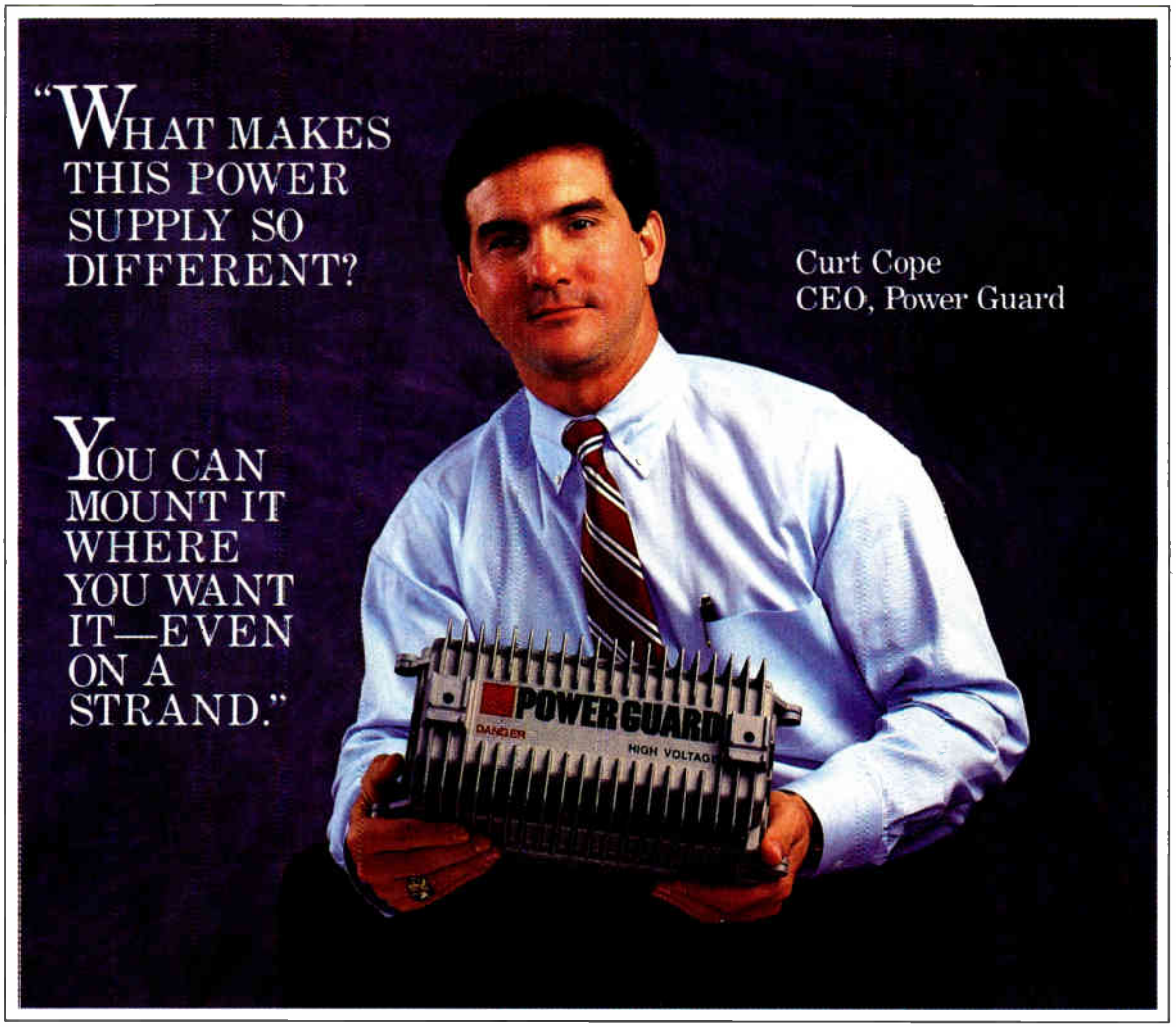
I don't mean to imply there aren't engineers out there whose one and only talent is in the technical nuances of esoteric items. But there are far more engineers out there who have an equal ability with technology along with a multitude of skills and training and an inclination to apply them in management, business strategy, creative thinking and personnel motivation.

### A team effort

As we continue to battle our critics in Washington, D.C. and around the country, the cable industry needs to show the good things it has done in bringing diversity and program choices to the American public. Giving the consumer these benefits at a fair price was a team effort—an effort that included engineers and technicians who participated in the success story on several levels and were not limited solely to the nuts and bolts in the headend.

Indeed, while Luff is a prototype for this type of engineer, there are many others—and you see their names every month in this and other magazines. These are the ones who are regularly consulted by other engineers as well as businessmen, bankers, brokers, programmers and others about their ideas. There are many others who are equally talented but who are not as well known and a lot of us could do a lot worse than emulating this group of our peers. ■

*By Wendell Bailey, Vice President Science and Technology, NCTA*

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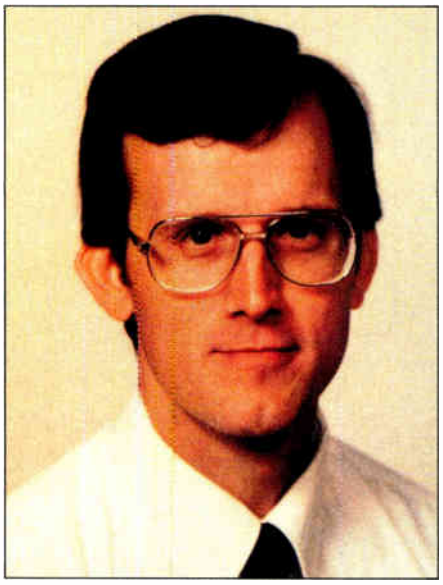


# AM/VSB and the Nyquist slope

In this month's column, we'll first take a look at the makeup of the AM-VSB signal as initially created by the CATV modulator. Then we'll investigate the demodulation process, with particular emphasis on the need for a Nyquist slope filter; what it is, and why it's needed.

With respect to video, the function of the CATV modulator is to take baseband video information from a multitude of different sources and modulate that information onto a particular RF carrier assignment. The modulation process that is used is, of course, amplitude modulation—where the amplitude of the RF carrier changes in accordance with the amplitude of the input video waveform. Therefore, when viewed on an oscilloscope, the envelope of the RF carrier would be seen as having the same profile as the modulating signal[1].

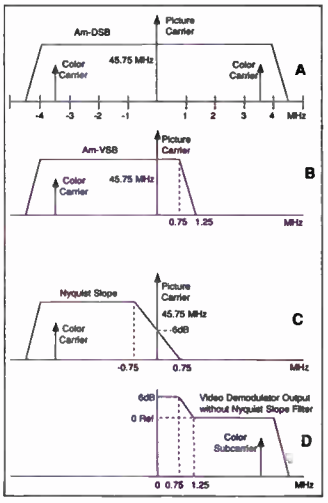
The output of the AM section of the modulator, when viewed on a spectrum analyzer, would appear as shown in Figure A, with an RF carrier center frequency of 45.75 MHz. This is the classical AM double-sideband spectrum which exhibits equal modulation sidebands above and below the RF carrier. The occupied spectrum of the video modulated double sideband signal therefore approaches 8.4 MHz (±4.2 MHz)! Note, however, that since both sidebands contain exactly the same information, the AM double-sideband modulation process is obviously spectrum inefficient.

*By Chris Bowick, Vice President Engineering for Headend Equipment, Scientific-Atlanta Inc.*

### Conserving spectrum

In order to conserve spectrum, the double-sideband signal is processed through a vestigial sideband filter, creating the IF spectrum shown in Figure B. Here, much (not all) of the redundant information is eliminated, leaving only a "vestige" of the upper sideband. For NTSC system M, here in the United States, this vestigial sideband is 750 kHz wide. Other systems would use a different width for the vestigial sideband (the PAL I standard, for example, is 1.25 MHz).

Note that FCC rules require (for broadcast transmitters) that the vestigial sideband response be down 42 dB at the color subcarrier and at the channel edge. This is to ensure that the vestigial sideband will not cause interference to the adjacent channel. In most modulators, these stringent filter requirements are taken care of by a surface acoustic wave (SAW) filter.




If we now try and AM demodulate the RF signal, an ideal demodulator would produce an output signal with the baseband video output spectrum shown in Figure D. Note that for baseband video frequencies below 1.25 MHz, where there exists at least some remnant of a vestigial sideband, the detector AM demodulates both the upper and lower sideband energy, effectively summing the two together. Since no video information exists beyond 1.25 MHz in the vestigial sideband, the AM demodulator detects only the wanted sideband energy. Therefore, for video frequencies below about 750 kHz, the baseband output spectrum of an ideal AM demodulator would show a peak in the response of about 6 dB. This peaking rapidly decreases to the "correct" amplitude between 750 kHz and 1.25 MHz, however, due to the response of the CATV modulator's SAW filter as it slices off the vestigial sideband.

The Nyquist slope filter was developed to eliminate the low-frequency peaking in the baseband video response of a TV's AM demodulator when demodulating a vestigial sideband signal. The filter precedes the video demodulator, and its response at IF is shown in Figure C. Note that the filter provides 6 dB of attenuation to the video RF carrier and produces an amplitude slope that is linear (ideally) from 750 kHz below the carrier to 750 kHz above the video carrier such that when the upper and lower sidebands are effectively summed in the demodulation process, the resultant is a flat video baseband response. Pretty clever, huh?

Yes, it was pretty clever at the time (late 1930s), but as Archie Taylor points out[2], the technique is not without its problems. Quadrature distortion becomes a problem because of the elimination of most of the "other" sideband and cannot be corrected except through use of synchronous detection in the TV set[3]. In addition, phase errors introduced to both the upper and lower sidebands as a result of the vestigial sideband and Nyquist slope filter networks can create what Taylor calls the close-ghost effect—ghosting very close to the leading and trailing edges of very-fast rise-time signals.

Other problems include residual PM to AM conversion in the Nyquist slope network due to incidental carrier phase modulation (ICPM) and/or phase noise imparted to the video carrier by the broadcast transmitter and/or CATV plant.

In summary, the AM-VSB/Nyquist slope method of transmission for television was a compromise allowed by the early proponents of television in order to allow 4.2 MHz of video bandwidth to be transmitted in 6 MHz of RF spectrum. Thus far, it has held up quite nicely in spite of its drawbacks. ■

### References

1. Bowick, Chris, "Video Depth of Modulation," *CED*, June 1988.

2. Taylor, Archer, "The Vestigial Sideband and Other Tribulations," NCTA Technical Papers, 1988.

3. Bowick, Chris, "Envelope vs. Synchronous Detection," *CED*, November 1989.

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# Cable and copyright

Until the advent of satellite-delivered programming in the late 1970s, the principal function of cable television was the retransmission of nearby and distant broadcast signals in communities underserved by local broadcast signals. Cable operators used tall antennas to receive signals off the air, which they then retransmitted to subscribers. Sometimes, signals were received off the air in distant communities and relayed to the cable headend by microwave.

It was never clear in those early days whether cable's retransmission of broadcast signals was subject to copyright liability. Cable operators maintained that they were simply providing an antenna for subscribers to enable them to receive what broadcasters were sending them over the air. Program owners argued that cable operators were appropriating their programming and selling it to subscribers without paying for it.

The issue actually reached the Supreme Court. In two decisions in 1968 and 1974, the Court held that cable's retransmission of broadcast signals was not a "performance" of the copyrighted programming on those signals and therefore did not constitute an infringement under the Copyright Act of 1909.

*By Michael Schooler, Deputy General Counsel, NCTA*

But by the mid 1970s, cable was clearly becoming more than a mere retransmitter of signals to rural areas. A political consensus was developing that cable was a commercial enterprise and that its retransmission of broadcast signals should be viewed as the use of copyrighted works. Therefore, when, in 1976, Congress enacted a comprehensive revision of the copyright laws, it included a provision, agreed to by the program production and cable industries, subjecting such retransmission to copyright liability.

### Laborious task

Ordinarily, this would mean that, in order to retransmit broadcast signals, cable operators would have to secure permission from the owners of the programs that appeared on those signals. This would be no easy task. Operators would have to know in advance all the programming that was to appear on all the broadcast signals that they carried, and they'd have to negotiate with and secure permission from each such owner. This would be an onerous burden, even if each owner gave permission. And if any owners refused permission, the cable operator would have to black-out their programs.

To eliminate the burdensome transaction costs of having to deal with each program owner and to facilitate the carriage of local and distant broadcast signals on cable systems, the industries proposed and Congress adopted a "compulsory license" for broadcast retransmissions. Under the compulsory license, cable operators could obtain the right to retransmit broadcast signals without having to secure permission from the program owners by complying with several statutory conditions.

Two conditions are most salient. First, the cable operator must pay a fee for the rights embodied by the compulsory license. That fee depends on the size of the cable system, and, in the case of larger systems, on the number of distant signals carried. For smaller systems, the fees are straightforward. Systems whose gross receipts for basic cable service are $75,800 or less in a six-month period pay $28 for that period; systems with gross recipts of less than $292,000 pay approximately 0.5 percent of their gross receipts.

For larger systems with gross receipts of $292,000 or more, the formula gets complicated—too complicated to explain fully here. The fee varies for each additional distant signal, but larger systems can pay as much as 3.75 percent of gross receipts for a particular distant signal. There's no additional fee for local signals, because, in those cases, the cable operator is simply providing the subscriber with programming that is already available over the air from a broadcast station licensed to serve the entire community.

Fees are paid seminannually to the United States Copyright office. A second agency, the Copyright Royalty Tribunal, then holds hearings to determine how to apportion the fees among various groups of copyright owners—e.g., motion picture studios, professional sports leagues and local broadcast stations (for news and other local programming). The Copyright Royalty Tribunal is also required periodically to review and revise the rates in light of inflation and other changed market conditions.

### No changes allowed

The second important condition with which cable operators must comply to obtain the compulsory license is that they must carry programs without alteration. What this means is that there can be no editing of the programs and, most importantly, no deletions or substitutions of commercials within the programs. Systems aren't required to carry a station 24 hours a day; they can carry some programs and not others. And they can carry programs from a number of different distant signals on a single "cherry picked" cable channel. But they have to carry each program unaltered. And they have to pay for each signal whose programming they carry at the full rate, as if they carried it 24 hours a day for the entire six-month accounting period, even if they only carried a single program on a single day.

That's the compulsory license in a nutshell. In the years since its enactment, it's resulted in numerous disputes between cable operators and copyright owners. There's been a general policy debate in recent years over whether the compulsory license should be retained. The Reagan-era FCC believed, for example, that the license simply interfered with the free market and recommended that it be repealed. But there are also less cosmic debates over the details of implementation of the compulsory license. ■

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Reader Service Number 11

# Re-regulation bills dominate news

The December meeting of the NCTA Engineering Committee was held in Boulder, Colo., and chaired by Walter Ciciora. The first item of business was the Washington update delivered by Wendell Bailey. There are a number of anti-cable bills being introduced in Congress to re-regulate the cable industry. The industry is viewed by some as overcharging, providing poor service and not responding to the wishes of the subscribers. The industry must reverse this perception and convince subscribers they are getting the programming they desire at a good price and with excellent service.

The broadcasters still desire the reimplementation of must-carry but with UHF stations carried on one of the standard VHF channel positions.

The increase in the number of sports shows carried on cable has resulted in congressional hearings to determine if sports programming is being denied to "free TV" watchers.

July 1, 1990 is the deadline for submission of CLI or flyover reports to the FCC. Failure to submit a passing report means that any channels in the aeronautical bands must be turned off or moved out of those bands.

The same date applies to the requirement that converters meet the new maximum output level and signal leakage requirements.

The Cable Act requires that the FCC review the cable industry operation under the Act and submit a report to Congress. The FCC plans to have the report finished in July 1990.

Satellite scrambling is under review to determine if it is necessary or desirable to have the FCC set a scrambling standard for channels delivered to the home dish market.

Appeals of the syndicated exclusivity rules have been denied and systems were required to comply with the rules as of January 1, 1990.

The FCC is reviewing the need for technical regulations to determine if, possibly, the rules should be reimplemented in some part as well as their applicability to other than class 1 signals. The National League of Cities has requested that NCTA meet with them to discuss the need for technical regulations.

*By Brian James, Director of Engineering, NCTA*

### New business

A safety alert monitor was demonstrated. The unit operates on the cable system using a 52 MHz carrier signal and will display an LED warning or sound an alarm and voice a warning in safety of life situations.

TV manufacturers are finally recognizing the need for a higher quality tuner capable of working on a fully loaded cable system. They are considering a double heterodyne tuner with a first intermediate frequency (IF) at 965.25 MHz. This frequency would be a problem when cable systems start operating to 1 GHz. It was recommended that the manufacturers consider an IF above 1 GHz however, this would be a technical challenge for consumer grade equipment. One possible solution could be channel mapping.

### Subcommittee reports

**HDTV**—Development of an ATV test plan is near completion. The final review took place during the Western Show. Through CableLabs, a test of the perceptibility of close-in ghosts has been completed. Additional support from the industry is still needed at the many FCC committee meetings to ensure adequate representation of the industry's position.

**Standards**—The second edition of the NCTA Recommended Practices is now available. The new edition contains BTSC and coaxial cable test procedures in addition to revisions to the existing procedures.

**Signal leakage**—Systems operating in the aeronautical bands must complete a CLI or flyover and submit the result to FCC prior to July 1, 1990. A new form, #320, will be sent by the FCC to all cable operators using these frequencies.

**In-home wiring**—The subcommittee is just being organized with Larry Nelson of Comm/Scope as chairman. One of its objectives will be to develop guidelines for use by contractors in pre-wiring homes.

**MultiPort**—There was a MultiPort booth at the Western Show and a MultiPort TV was given away. Bang & Olufsen demonstrated its MultiPort VCR at the booth. This is the only production unit presently available. Discussions with set manufacturers to encourage them to incorporate MultiPort have not been overly successful.

**EIA/NCTA joint committee**—A revision to the channel numbering plan is near completion. This plan will cover channel numbers for frequencies up to 1 GHz. This plan could have problems above 900 MHz if the set manufactures develop a dual conversion tuner with a first IF at 965 MHz.

FM receiver manufacturers have complained that digitally tuned receivers do not work on some cable systems because the FM channels are not on FCC frequency assignments. Operators should check to ensure their equipment is operating on frequency.

Some digital audio service providers are considering providing enhanced pay TV audio as part of their package. This could present a problem as most stereo TV sets do not have the provision to accept RF video and a baseband audio input. A separate speaker system would be required to take advantage of the service.

Program identification using a line in the VBI is under investigation. A major challenge is determining all the uses of the VBI at this time and determining if it is possible to protect one line for VBI purposes. The program identification could be used for starting VCR recording at the beginning of the show or, possibly, for syndex switching.

**ARRL/NCTA joint committee**—There have been no recent leaks reported by hams. The League is becoming concerned about leakage from SMATV systems.

**Satellite practices**—VideoCipher is working on reducing the repair time on returned equipment. Three field kits are being developed to improve the reliability of decoders.

**National Electrical Code**—Some electrical inspectors are requiring that power supplies be UL approved. Operators may want to check the local regulations to determine if there is an exclusion that can be applied to avoid the UL requirement.

**CableLabs**—Scientific-Atlanta has agreed to supply headend equipment for the Labs's headend. Subjective testing of the perceptibility of noise, intermod, etc. will be conducted in conjunction with Jerrold's Applied Media Lab. Raychem is undertaking corrosive testing of F connector fittings.

The next Engineering Committee meetings are tentatively scheduled for February 14-15, April 11-12, June 13-14, August 8-9, October 17-18 and December 13-14. ■

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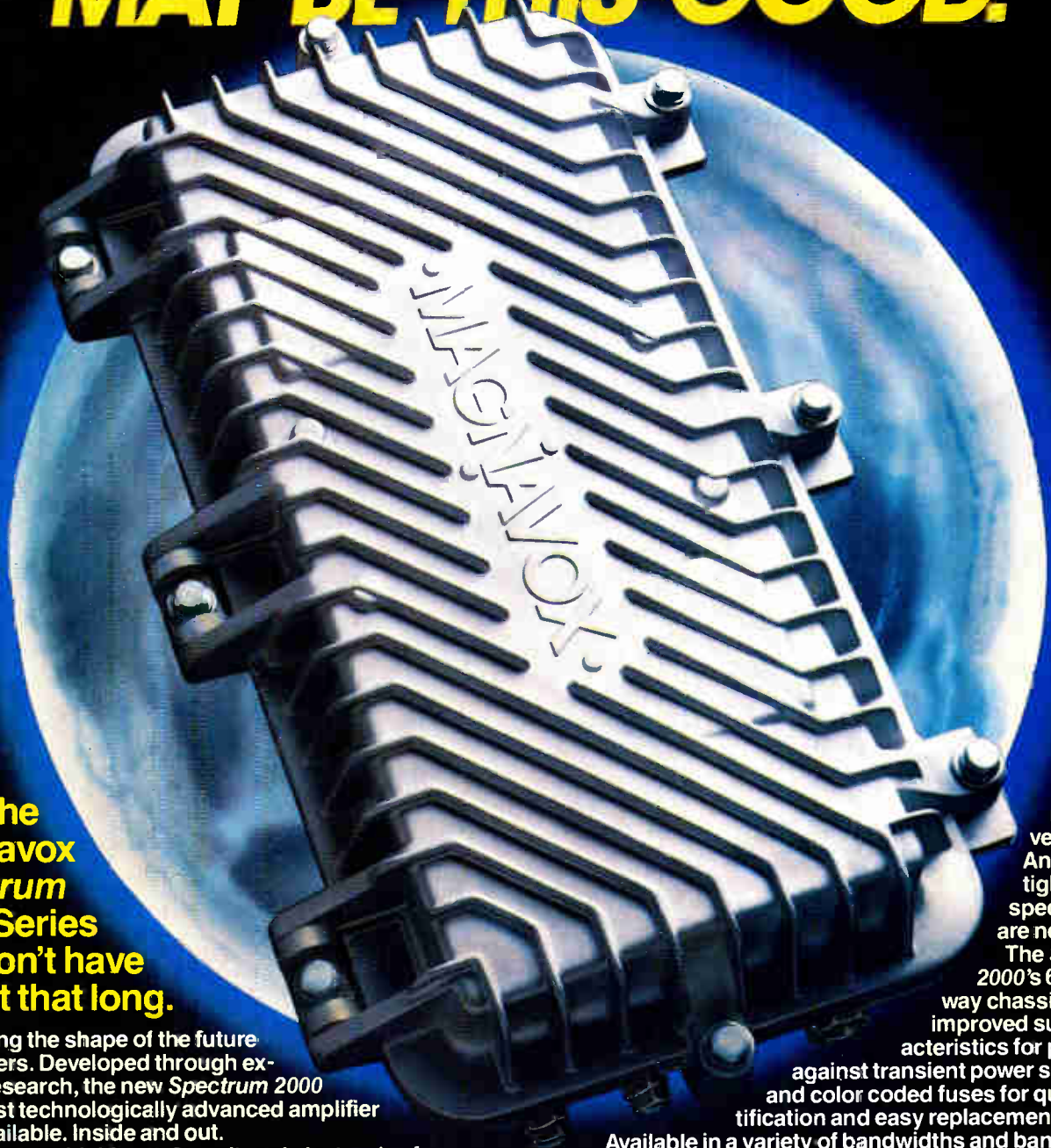


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# Can VideoCipher regain cable's trust?

Armed with new technology, a renewed commitment to battling piracy and improved customer service, the VideoCipher division of General Instrument is working feverishly to regain the trust of CATV operators and programmers, who have long felt VideoCipher signal security and service were woefully inadequate.

Four years ago last month, Home Box Office began scrambling its signal to protect itself from unauthorized reception by commercial and backyard dish owners, populations that were both growing astronomically. HBO chose the VideoCipher encryption technology and provided its cable affiliates with headend descrambling equipment. Since that time, all major cable programmers have followed suit, making the VideoCipher technology the de facto standard in the industry.

*The authorization rate is improving at VideoCipher's DBS Authorization Center.*

### Rampant piracy

Although the encryption process used to scramble the signals has never been defeated, the *system* has been compromised heavily, resulting in thousands of illegally authorized receivers being placed in homes around the country. If that wasn't enough, VideoCipher officials exacerbated the problem by ignoring the problem and generally refusing to work with cable operators to work out a solution, according to numerous cable engineers who chose to speak on the condition they not be identified.

"For the longest time, (VideoCipher) didn't recognize or admit the problem," says one engineer based in the Southwest. "And they've been horsey about fixing it."

Over the last three to five months, however, a new demeanor seems to have taken hold in San Diego. While many in the CATV community have adopted a wait-and-see attitude about VideoCipher's (the technology) future, even the most outspoken critics have noticed VideoCipher's (the company) new attentiveness to the grievances laid out by cable representatives.

> 'For the longest time, (VideoCipher) didn't recognize or admit the problem.'

And the grievances have been many. In addition to the piracy problem, which has been estimated to be as high as 75 percent, operators have complained about the commercial VideoCipher II's poor design, hideous reliability record and repair turnaround times that often stretched toward two *months*, necessitating the stocking of several expensive spares.

VideoCipher's future may well hinge upon the improved signal security offered by VideoCipher II Plus, a second-generation consumer descrambler that also features increased channel capacity by enhancing the number of available tier bits from 56 to 256. Manufacture of the new unit has just begun and all programmers' uplink sites have now been upgraded to offer VC II Plus scrambling.

### Integrated on one chip

The enhanced security comes from the use of a VLSI (very large scale integrated) chip that combines the security elements which previously required multiple chips. That one custom chip is extremely sophisticated and features unreadable and unwritable security keys, according to VideoCipher officials.

Over the years, the VideoCipher II technology has been so viciously attacked that entire organizations—complete with sophisticated distribution networks—have become wealthy and powerful by offering pirated boxes. While estimates vary, some observers project that of every four VC IIs that leave the manufacturing facility, only one ends up in the hands of a legitimately authorized subscriber. The rest

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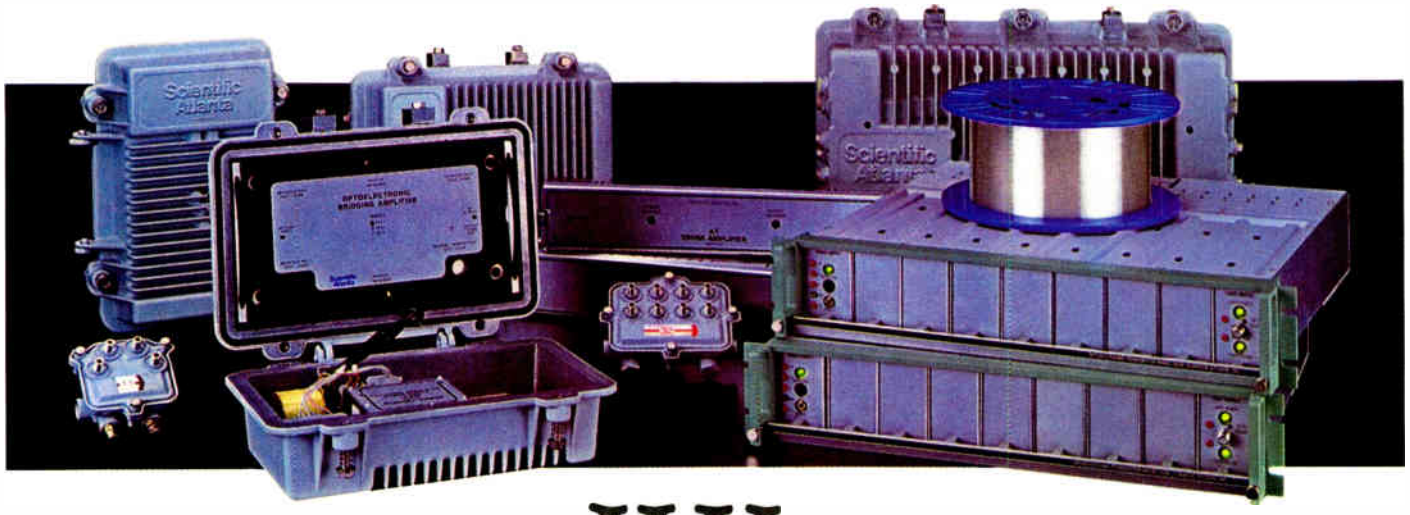


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Reader Service Number 14

have had their ICs tampered with to make it look as if they are authorized units, a process known as "cloning."

Stepped up prosecution efforts have resulted in an increase of authorizations (nearly 100,000 authorizations were made in the fourth quarter of 1989—the best quarter ever, according to Mike Walker of VideoCipher) but many say that if VC II Plus is compromised anytime soon, the industry may have to consider a different technology.

"It's one hell of a mess," said another operating engineer, "and I'm not sure it's survivable. A tremendous base of highly motivated pirates has been built—it could be that the technology won't survive."

Others are more optimistic. "We've been anxiously awaiting the development and production of this chip," says Bob Zitter, vice president of network operations at HBO. "If it works, I think it's fair to say we're happy. But will it work? Only time will tell. But if we can fix what we already have, that's preferable than going in a different direction."

Indeed, the huge installed base (there are an estimated 220,000 commercial units and about 2 million consumer boxes currently in operation) makes switching to a new technology a large pill to swallow. Add the expense of a changeout to the political ramifications of obsoleting all the backyard receive equipment and you've got a Gordian knot, some say.

So clearly, the best option is to make the present system secure. "We've been convinced (developing the VC II Plus) was the most prudent thing to do to fix the (piracy) problem because (the old VC II unit) was the *cause* of the problem," Zitter says. Now that the Plus units are in production and will be sold in stores by this spring, he believes it won't take more than just a few months to determine if the enhanced security will be strong enough. "For VC II Plus to survive, it has to be more than just a shield to keep people from breaking what they've broken in the past," adds Zitter.

### Some other problems

Beyond the piracy problem, the VideoCipher division, which enjoys a market monopoly on satellite signal scrambling and descrambling, has alienated most in the cable industry for carrying an arrogant, holier-than-thou attitude and failing to own up to the system's shortcomings. "Talk to people at the system level, the regional level or even the headquarter level and you'll run into bad vibes concerning VideoCipher," says one Top-10 engineering official. "Even talk to people in purchasing, you'll get bad vibes."

But even VideoCipher's staunchest critics see a new effort at being a good corporate citizen being put forward by the management in San Diego. Paul Resch of The Disney Channel, who's been first to criticize VideoCipher for a number of reasons in the past, now says there's hope for the future. "I do sense a flavor of change in the day-to-day operations" of the company, he says. "At least their representatives are coming to the (NCTA Engineering Committee) meetings."

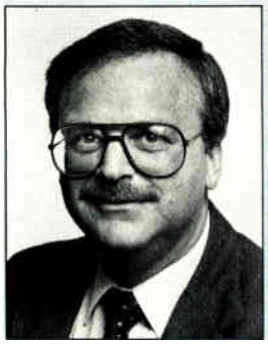
Resch, who has called for scrapping the system in the past, now sees a glimmer of hope. "It's a terribly flawed system, but I give VC II Plus a shot at making it. It might work."

Despite the luke-warm reception, VideoCipher officials should be thankful they aren't referred to as a series of

expletives anymore. The "new attitude" at VideoCipher is a direct result of the repeated hammerings the company has taken from a variety of CATV representatives which resulted in organizational and staffing changes.

"We've made some organizational changes that allowed us to focus on the issues and gave us a new product/customer focus we didn't have in the past," says Marvin Blecker, who was named vice president of engineering at VideoCipher last March. The result, says Blecker (who is VideoCipher's representative to the NCTA Engineering Committee), is the ability (and now, willingness) to work with customers to solve problems. Slowly, but surely, Blecker says they've made progress.

**MARVIN BLECKER**



*'But we're dedicated to providing audio and video security. The last four years have taught us how to design more secure hardware.'*

### Improving turnaround times

"Our repair center did have a response time that was unacceptable," often taking 40 days or more to fix and return units to operators and programmers, says Blecker. But staffing changes have led to dramatic improvements. According to Blecker, last December the average turnaround time was reduced to 12 days. By the time this story is read, VideoCipher will be promising its customers a 10-day turnaround time. For brand-new units DOA, replacements are promised within two days, Blecker adds.

The repair center's past track record only amplified the huge reliability problems experienced by VC II users. Operators complained of an inordinate number of units "dead out of the box," as well as consistent battery and power supply failures.

Over the last five months, Blecker and his staff has worked closely with the Engineering Committee's satellite practices subcommittee, chaired by Norman Weinhouse, to identify the problems, the causes and develop solutions. The problems boiled down to four major areas: battery circuits, the op amp circuit, the opto-coupler circuit and power supplies. Solutions include a combination of using new suppliers and VideoCipher's agreement to provide upgrade kits that can be installed in the field.

For example, the batteries used by VideoCipher were arriving from the supplier with faulty battery chemistry. VideoCipher is now using a new supplier for all new production units and is routinely replacing the battery in the repair center if it is more than a year old. Secondly, the original op amp circuit is being replaced by a new part which runs 20 degrees cooler than the original, says Blecker.

Also, the opto-coupler circuit is being replaced by a custom video chip and a new power supply vendor was being

phased in to the production and repair of VC units as this story was going to press. Also, VideoCipher is internally developing a switching power supply to reduce the amount of heat that builds up inside the unit.

The most welcome news, from the cable operator's perspective, is that VideoCipher has developed and will offer three field-installable upgrade kits. The first, available in March, consists of heat sinks on three ICs and an external battery; the second, also available in March, will consist of the new power supply, spare parts and documentation (the switching supply is due in June); and the third, available in June, consists of a complete descrambler circuit card upgrade.

"That is very welcome news," says Resch at Disney. "Lately, (VideoCipher executives) have been extremely responsive and I'm encouraged by these upgrade kits."

Despite the progress made to improve security and enhance customer service, the question remains: What if VideoCipher II Plus is compromised, then what?

### One step ahead

According to Blecker, VideoCipher engineers expect the new Plus unit to be attacked as vigorously as the previous unit was. One day, he admits, it could be compromised. That's why VideoCipher engineers are trying to stay one step ahead of the illegals and developing enhanced security, including some type of "moving target," for the future. "We don't expect them (pirates) not to attack VideoCipher II


*General Instrument's VideoCipher II*

Plus," Blecker says. "Our vendors (the ones who supply the new secure chips) have told us they've received offers to buy hundreds of thousands of the chips. But we're dedicated to providing audio and video security. The last four years have taught us how to design more secure hardware."

That "moving target" Blecker referred to could take many forms (and some are already in the breadboard stage), but the one cable operators and programmers would like to see is some method of changing the code keys on a regular basis. While cable engineers admit they're not cryptologists, they have proposed the use of "smart cards" that could be plugged in and out or perhaps an internal modem that could send and receive information back to VideoCipher's DBS Center.

Presently, the keys are distributed in two ways: burned into the unit at time of manufacture; and over the satellite. "There needs to be a third path," says Jim Chiddix, senior vice president of engineering and technology at American Television and Communications. Chiddix believes that if VideoCipher can correct the hardware security problem, the scrambling system itself will likely remain in use for a long time because it has yet to be defeated.

"They (VideoCipher) haven't done everything we'd like to see them do," says HBO's Zitter, who negotiated the first contract between HBO and M/A-Com for VideoCipher. "But they've done what is probably the best thing they could do for now. We'll wait and see if it's good enough."

*—Roger Brown*

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# Networking strategy and design for UK cable systems

The network strategy United Artists proposes is basically a mixture of old and cutting edge technology. A transmission network is primarily the application of concepts aimed at controlling the accumulation of distortions and maintaining them below the level that causes noticeable visual/audio impairment of the programming or errors within the transmitted data.

This goal must be achieved within financial reason, be maintainable at an acceptable operating cost and be accomplished within the necessary schedule.

The following is a brief view of the network planning we will be utilizing to achieve the above goals:

*By J.S. Crusan, United Artists International*

The network strategy United Artists proposes is basically a mixture of old and cutting edge technology.

### Fiber optic systems

The known attributes of frequency modulated fiber optic systems (Figure 1) and the emergence plus acceptance of the new amplitude modulated fiber systems will permit fiber optic trunking to become a key tool in the development of our United Kingdom cable networks.

Optical fiber systems provide important advantages for the transmission of broadband signals. The major advantage, attenuation of less than 0.4 dB per kilometer, results in extended transmission distances when compared to coaxial supertrunking. AM fiber, repeaterless optical trunks currently are capable of providing 24-channel, 12-mile spacings with current laser technologies. Since the signals are optical

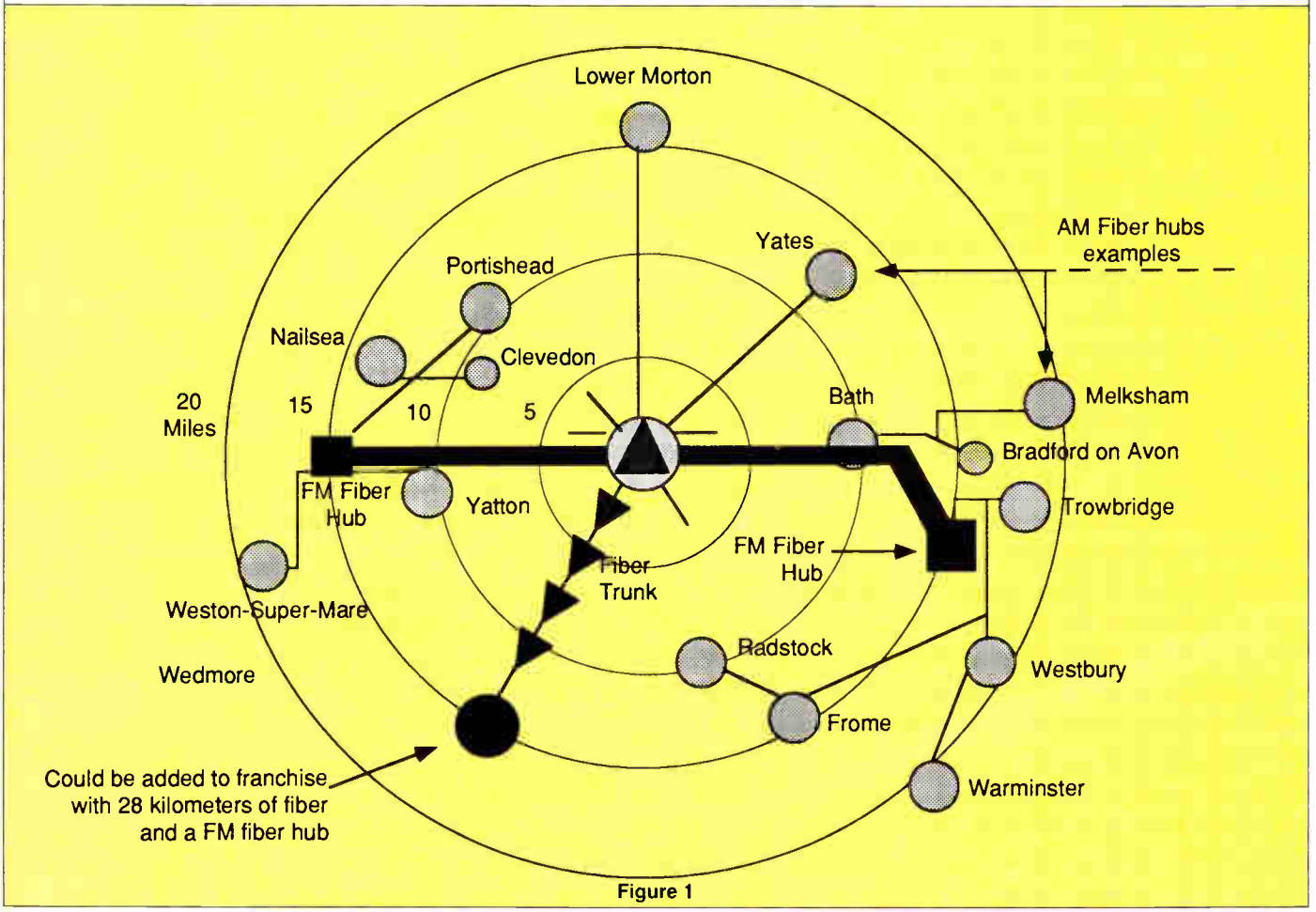



Figure 1

there is no problem with radiated or conducted electromagnetic interference.

Additionally, fiber is small, flexible, lightweight and corrosion resistant making it ideal for installation in the footpaths and carriageways of Great Britain.

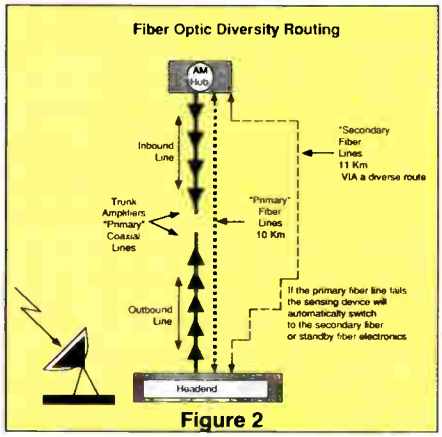


Figure 2

All AM and FM fiber optic cables will operate in the 1300 nm to 1500 nm windows. The VHF/UHF portion of the distribution system will operate between 5 MHz and 750 MHz grouped into 8-MHz channels for PAL-1 television and reserves for the wider bandwidths necessary to support HDTV,

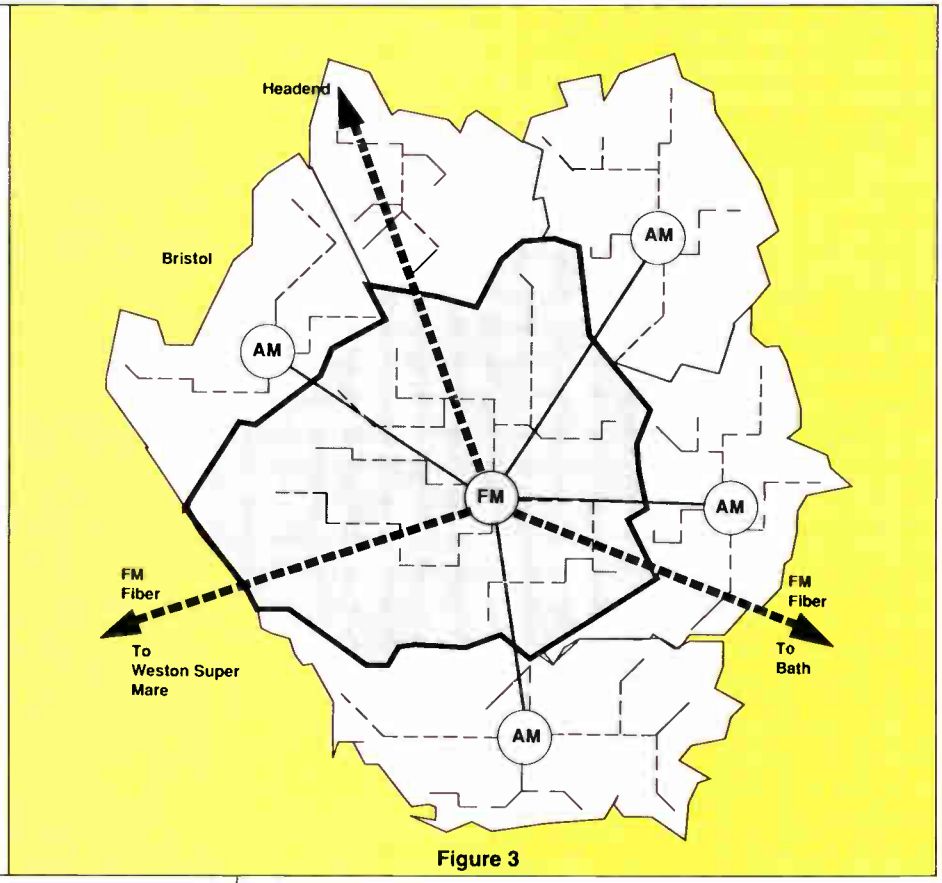
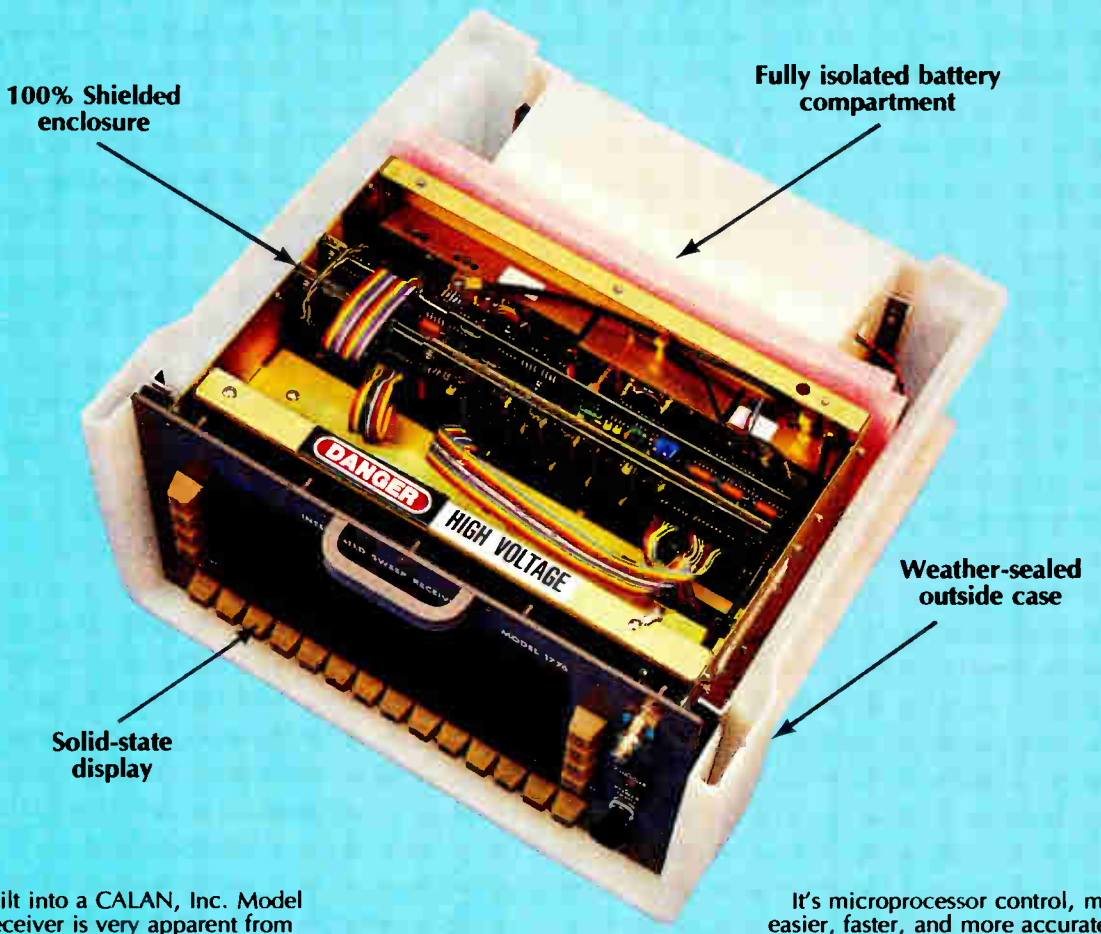


Figure 3

# The Inside Story on Reliability




Reliability built into a CALAN, Inc. Model 1776 Sweep Receiver is very apparent from the outside: the totally weather-sealed case; the ruggedized overall construction; the moisture-sealed key covers on the front panel.

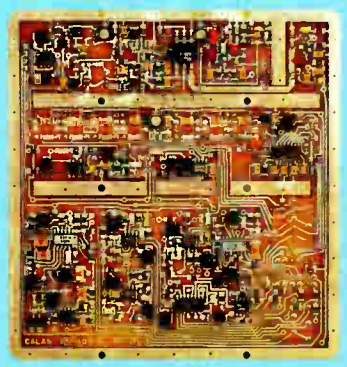
But what really makes this unique equipment reliable is on the ***inside***.

It's high-reliability components throughout the design, allowing incredible stability over temperature and humidity extremes.

It's complete RF shielding, allowing extended dynamic range for precise tests like Composite Triple Beat.

It's a solid-state Electro-Luminescent display, replacing the outdated CRTs.

It's new Surface-Mount RF Technology, making critical RF boards more reliable and more accurate than ever possible before. And a battery compartment that is totally isolated from the electronics, for absolute protection of the unit.



CALAN Surface-Mount RF Technology

It's microprocessor control, making testing easier, faster, and more accurate.

But all of these careful design criteria would be useless without the 75 years of CALAN engineering experience that went into the unit, making it the most reliable test equipment available today.

But if you ask a CALAN user, he'll most likely tell you that he hasn't seen the inside of his unit...just the outside, improving his system performance with no interference, and allowing more with his limited maintenance budget.

Maybe that's the **real** inside story.

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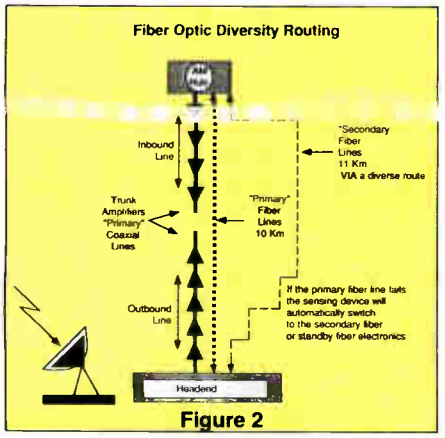

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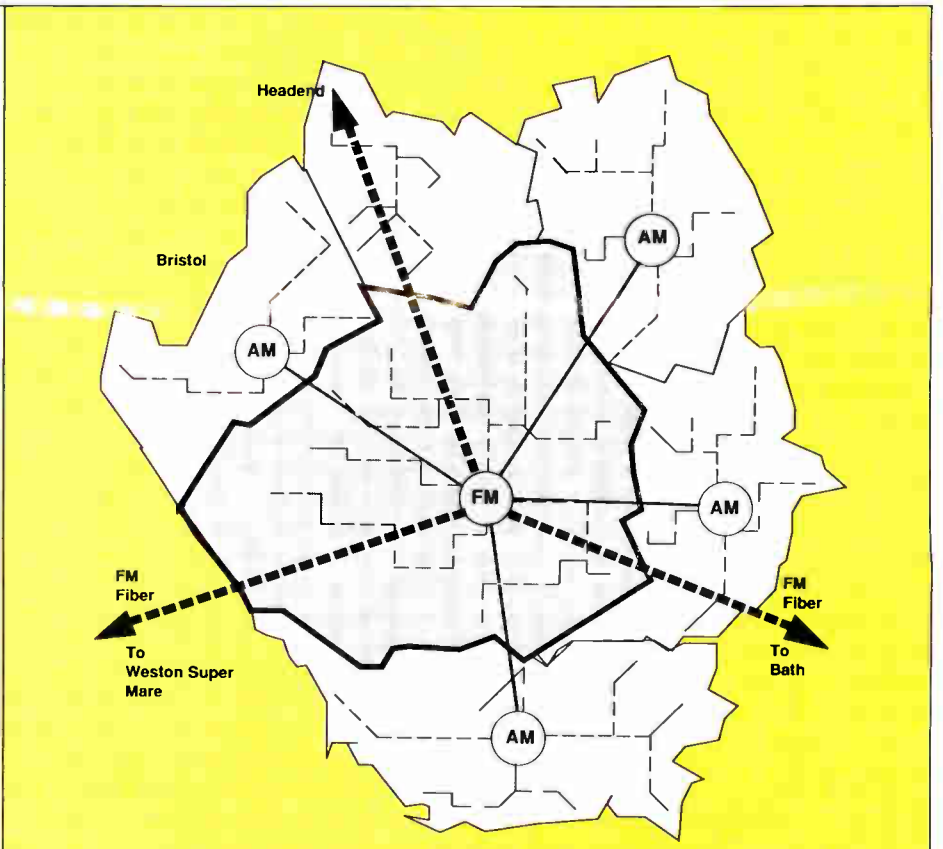

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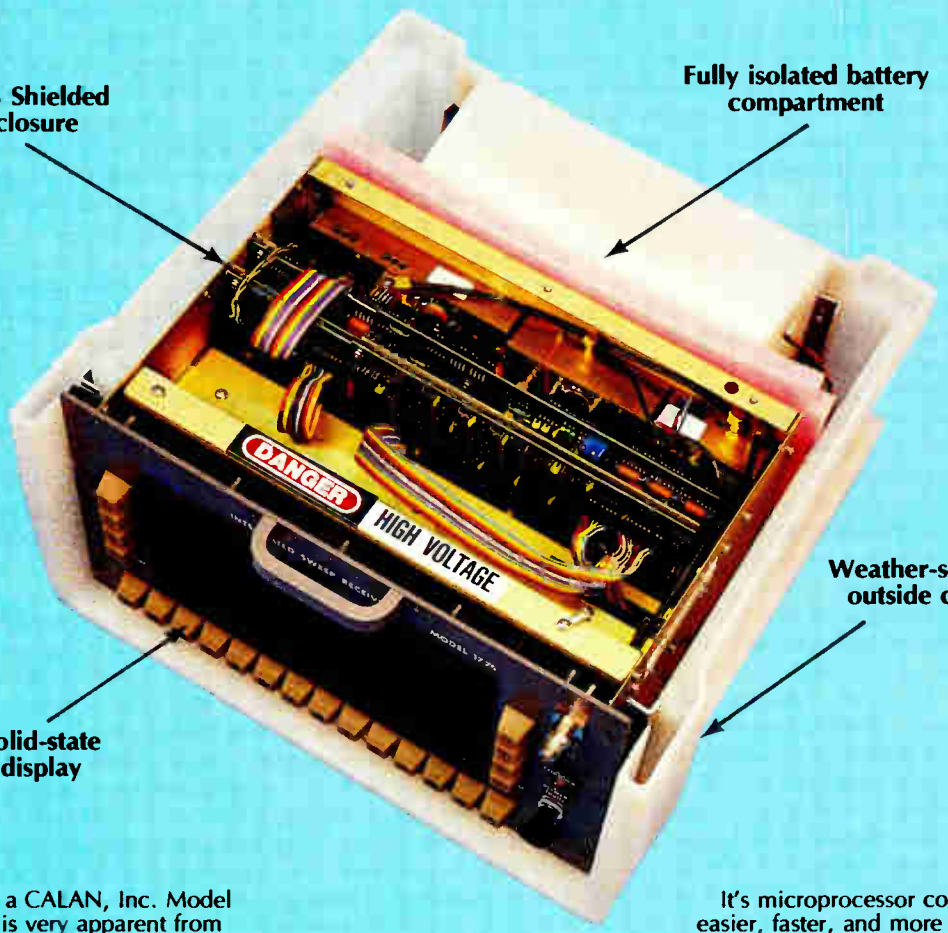


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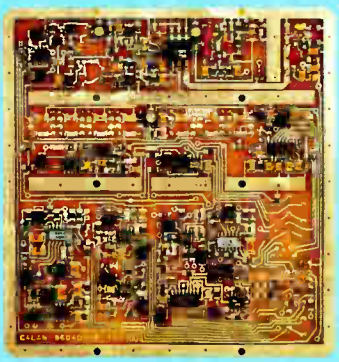

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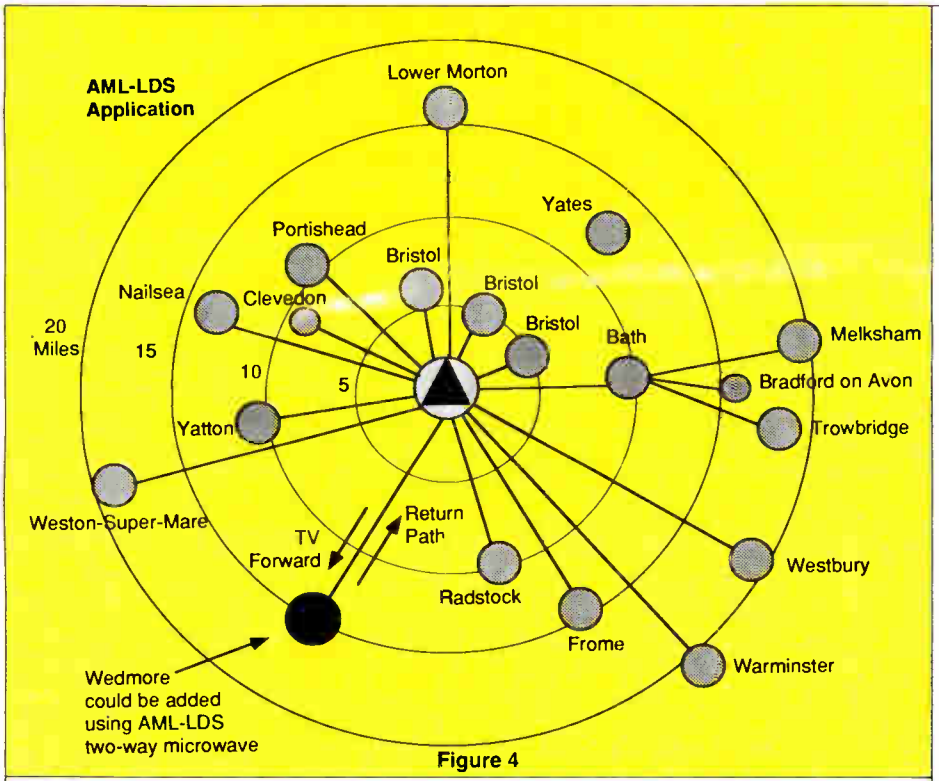



Figure 4

MAC and other future enhanced services.

Special precautions are planned when placing the fiber optic cables in ducts beneath footpaths and carriageways to insure the integrity of the optical trunk lines. Duct routes containing fibers will be buried, when practical, at a greater depth than normal coaxial cable construction procedures dictate. The special fiber express routes may be encased in concrete or otherwise shielded from careless digging related damage.

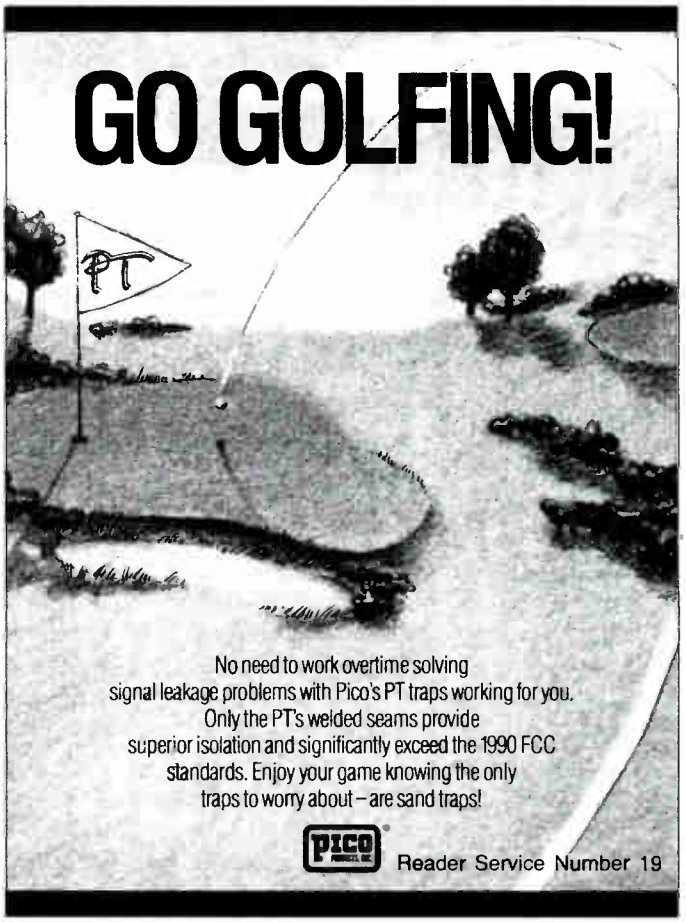
Routes to the AM fiber hubs (Figure 2) will be engineered to divert critical circuits from main carriageways to less congested routes with fewer utilities. Special instances requiring maximum circuit protection could feature a second, automatically switched redundant fiber optic cable following a diverse route to the AM fiber receiver.

Implementation timetables for the fiber optic systems will be primarily dictated by the number of homes that can be initially serviced from the master headend/hub within each respective franchise.

Rollout and activation of the AM fiber transmission systems (Figure 3) will be strategically delayed to permit initial construction, marketing and installation of homes within a three-mile radius of the master headend hub or FM fiber optic hub.

The phasing of the fiber optic rollout will permit the AM fiber portion of the





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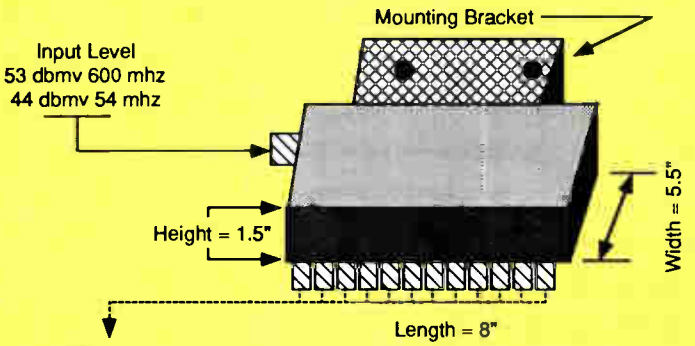
headend electronics to be delayed until a later date with a corresponding improvement in the timing of the capital expenditures while gaining a further one-half-year extension of time for the AM fiber suppliers to reduce prices and evolve higher levels in performance.

The activation of the AM fiber system requires access to the full HRC band of cable channels available at the output of the master headend or FM fiber optic hub. This full complement of channels directly modulates the AM fiber optic launch laser in the AM transmitter and the resultant signal is coupled to the optical fiber for transportation to the AM fiber receiver.

The AM fiber optic receiver reverses the process by converting the optical signals back to electrical signals in the VHF/UHF television bands. This group of television channels is then introduced to a standard coaxial cable line and creates a new hub providing trunking inputs for the immediate service area circumscribed by a circle with a three-mile radius.

The full implementation of the AM fiber system would be a replication of this concept and essentially creates a network of fiber optic receivers driving

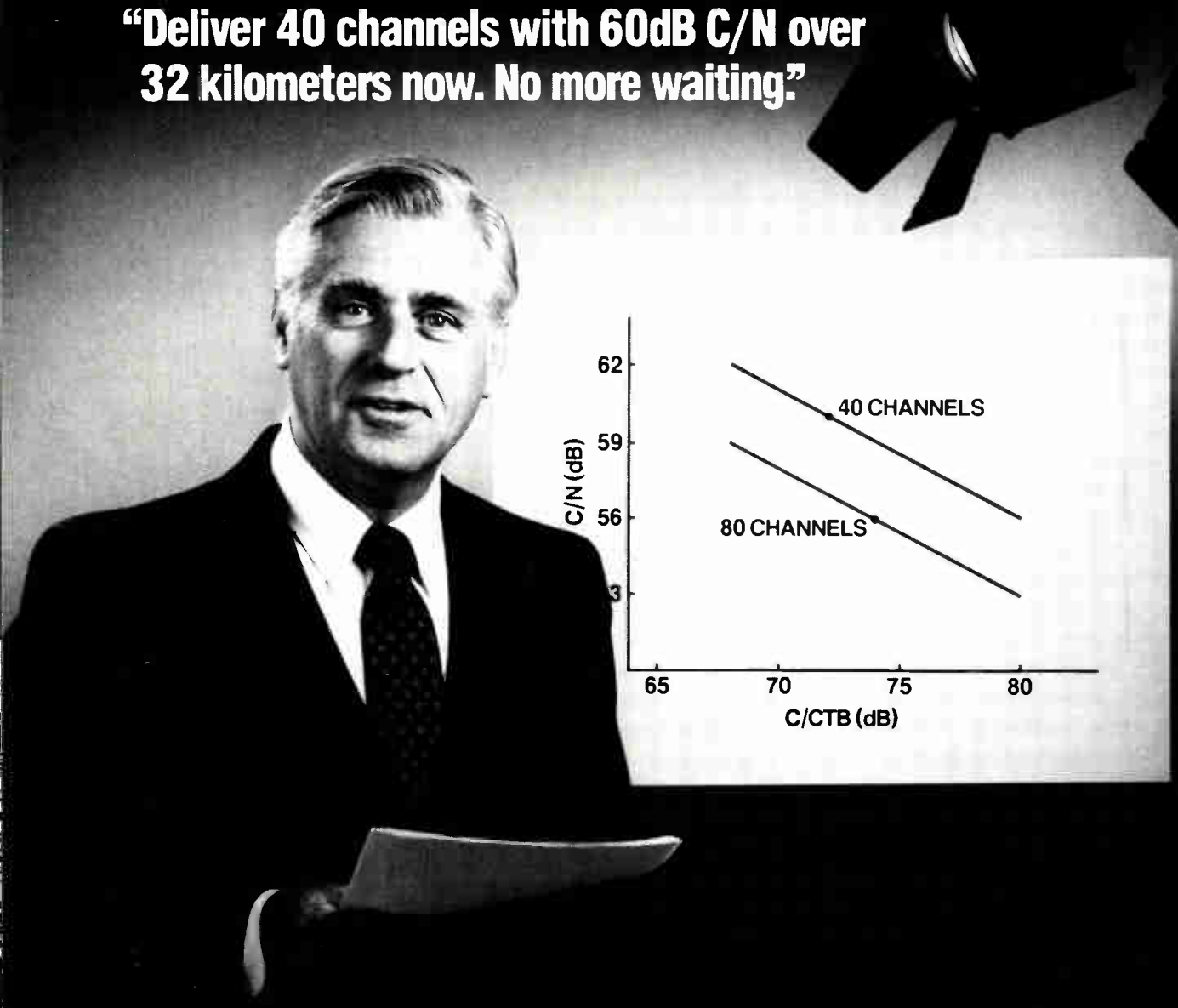



* Four rows of twelve F-fittings
* No equalizers or attenuators
* Mounts in cabinet in attitude that places the F-fittings downward
* Housing is non-enterable and sealed

* F-fittings are spaced to allow standard F-connector tightening with close quarter security tool
* All isolations greater than 25 dB
* Freq. response = +- 1.5 dB 5/600 MHz
* Prime design goal is high reliability
* Will be housed in cabinet or indoors
* Two-way design concepts required

**Figure 5**

# "Deliver 40 channels with 60dB C/N over 32 kilometers now. No more waiting."

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mini coaxial distribution networks.

Because of the size of the London, Avon and Estuary franchises, it will be necessary to co-design an FM fiber optic transmission loop. The current technology supporting AM fiber optic transmission is currently limited to approximately 12 miles for two 24-channel fibers (although laser manufacturers expect accelerated development of AM fiber technology permitting distribution paths exceeding 12 miles and 48 channels per fiber within the next few years).

The system design requirement (Figure 4) to extend distribution trunk lines from the master headend to the remote towns within the associated franchises will require a signal transportation technology with greater reach than AM fiber currently commands. Presently, these design constraints can be accommodated by existing FM fiber optic trunking technologies or, when approved, by utilizing AML/LDS, 12 GHz microwave.

Timing of expenditures for the full FM fiber optic trunking systems will be dependent upon three critical factors:

1) Licenses for AML/LDS microwave.
2) Availability of serviceable homes that can be reached prior to the exhaustion of AM fiber optic capabilities.
3) Business decisions affecting the sequence of construction areas.

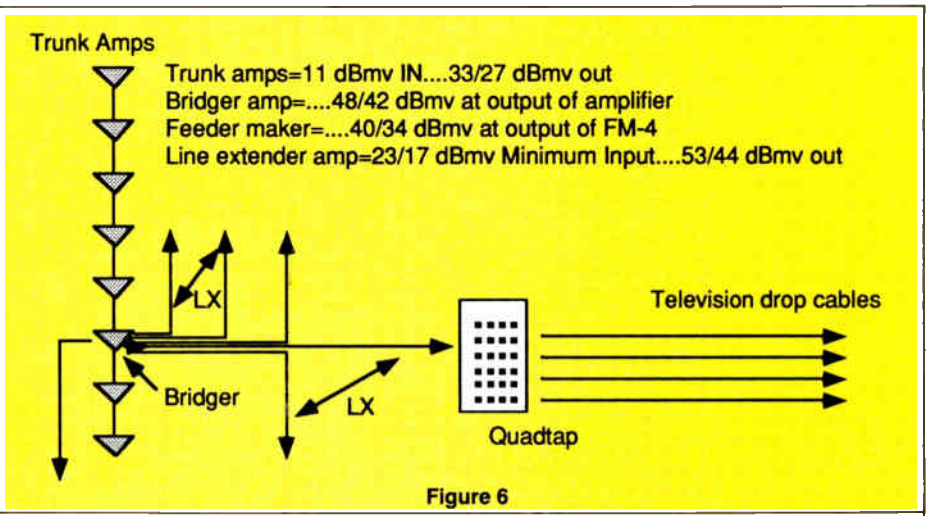


Figure 6

The application of FM fiber technology is well understood and is currently utilized extensively for transportation of cable television signals with distance requirements exceeding the limits for supertrunking and AM fiber.

One major inconvenience and price penalty for use of FM fiber optic trunking is the engineering requirement to construct an additional processing facility to translate the output of the fiber optic cable from the frequency modulated form as required for fiber trunking to the AM/VSB format required by the standard television.

Another major inconvenience is the inability to transmit and process sync suppressed, scrambled channels from the master headend through the FM fiber receive hub without the necessity of relocating the scramblers to the FM fiber receive hub (several schemes are

currently under development to resolve this problem and should be finalized prior to installing FM fiber hubs).

Practical applications for digital modulation are on the near horizon and may well become economic reality within the two to three years anticipated as the likely timetable necessitating the activation of the long haul fiber optic technologies.

### Headends

Headends are anticipated to be developed consistent with each specific franchise's requirement to commence service. The architecture and engineering master plan will be focused on a desire to create carbon copy facilities utilizing similar equipment and cabling techniques.

Corrective and preventive maintenance of these facilities will be directed from a central depot where spare parts, up-to-date literature and concentrated engineering talent will be responsible for supporting first echelon, system level maintenance.

### Distribution duct systems

The major capital required to construct a system in the UK is associated with the excavation and reinstatement of footpaths along the cable route.

A key consideration toward cost reduction of the duct infrastructure is the ability to reduce the size of cables and eliminate system architecture choices that demand disproportionate percentages of the available duct space.

Product development focused toward

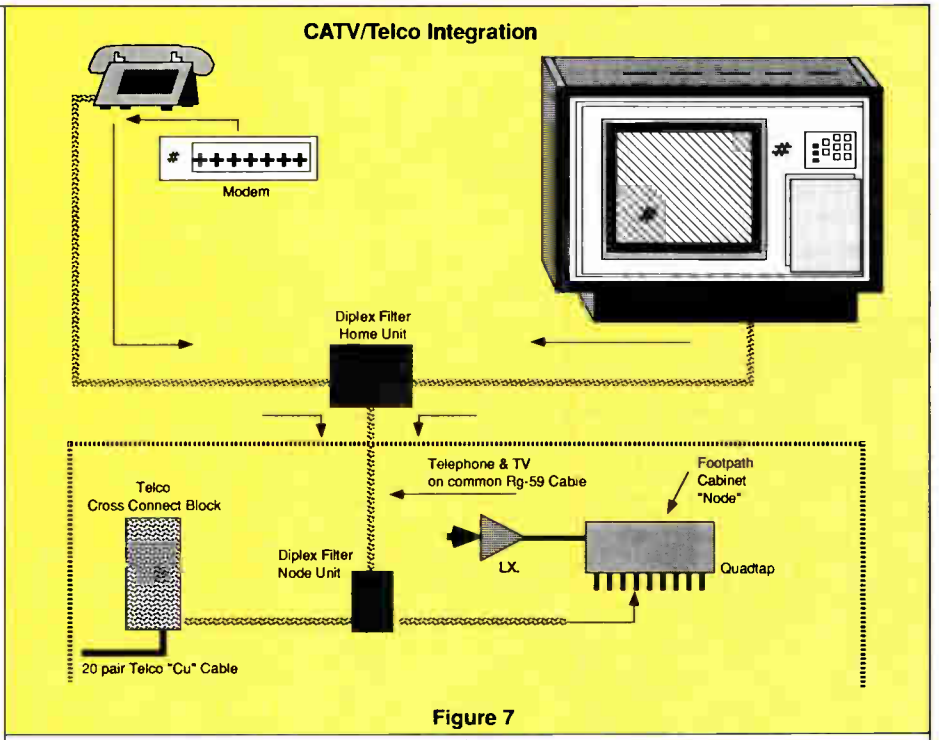


Figure 7

# THE ART OF ADDRESSABILITY

There's an art to creating an addressable cable system. The Pioneer BA-6000 converter brings all the right elements together to create state-of-the-art addressability.

The composition of such features as volume control, multi-vendor scrambling compatibility, PPV/IPPV capability, VCR program timer, VCR filter, four digit display, and unmatched security illustrate the lasting impression of a picture-perfect addressable converter.

The BA-6000 paints an attractive picture for cable operators.

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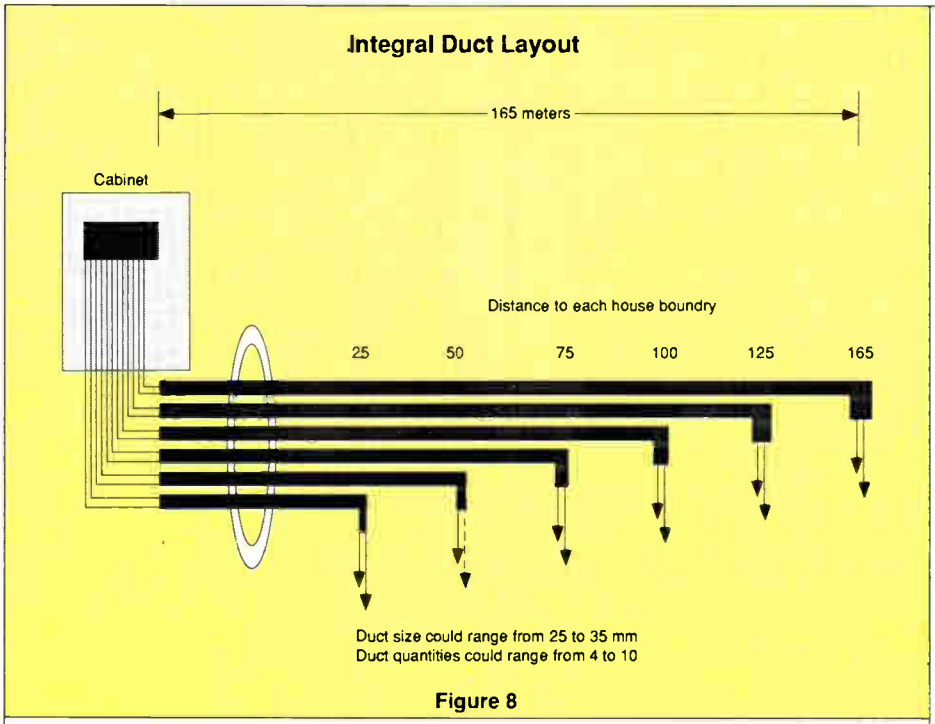


Figure 8

size reduction and reliability is essential to relief of duct space and future operating expenses.

The Quadtap (Figure 5), developed by Toner Industries for United Artists, is a significant example of European product development. This device displaces multiple 8-way taps and housing-to-housing connectors with a single 16/32/48 port centralized tap.

System operational levels (Figure 6) to support the Quadtap indicate that the system distortion budget for third order is concentrated in the final node to extend the capture area of the node and reduce street furniture.

Low cost diplex filters (Figure 7) (home) and (node) units, could enable telephone services to couple directly to CATV drop cable and eliminate the space consuming copper wires from each telephone subscriber to the Quadtap location.

Flush mounted cabinets that improve CATV public relations are also under priority development.

A crossover device to interface cable TV return data to telephone circuits located at common equipment points is another possible product required to promote telco/cable TV integration.

### Key difference

The basic underground duct system is the key plant difference between the UK and North America. Our major thrust toward cost reduction is directed toward reducing the displacement volume of the duct system, cost reducing pits/street furniture, altering the backfill material and minimizing the trench width to lower surface reinstatement charges.

The basic trench configuration (Figure 8) for analysis of the "seamless duct approach" utilizes individual conduits serving two potential adjacent subscriber locations. This configuration is one example of an alternate approach to ducting systems. The conventional approach currently widely utilized (Figure 9) is configured as a single large conduit for all subscriber drops. This subscriber drop conduit could be reduced in dimension at the ends where fewer subscriber drop cables exist.

Another important change may be the 100 percent preinstallation of drops to promote quality control of the installation work in the cabinet, lower the later year effects of duct congestion and reduce the time necessary to install the drops at a later date.

In all probability the final network planning will continue to evolve as we investigate new concepts and materials.

We must continue to apply downward pressure on capital costs and create new operational techniques.

Support of the revolutionary hybrid telco/CATV plant may require major revisions of currently accepted operational concepts. Technicians versed in both disciplines and dual plant designs overlaid on common base information are but a few new wrinkles in the evolutionary integration of the two industries. ■

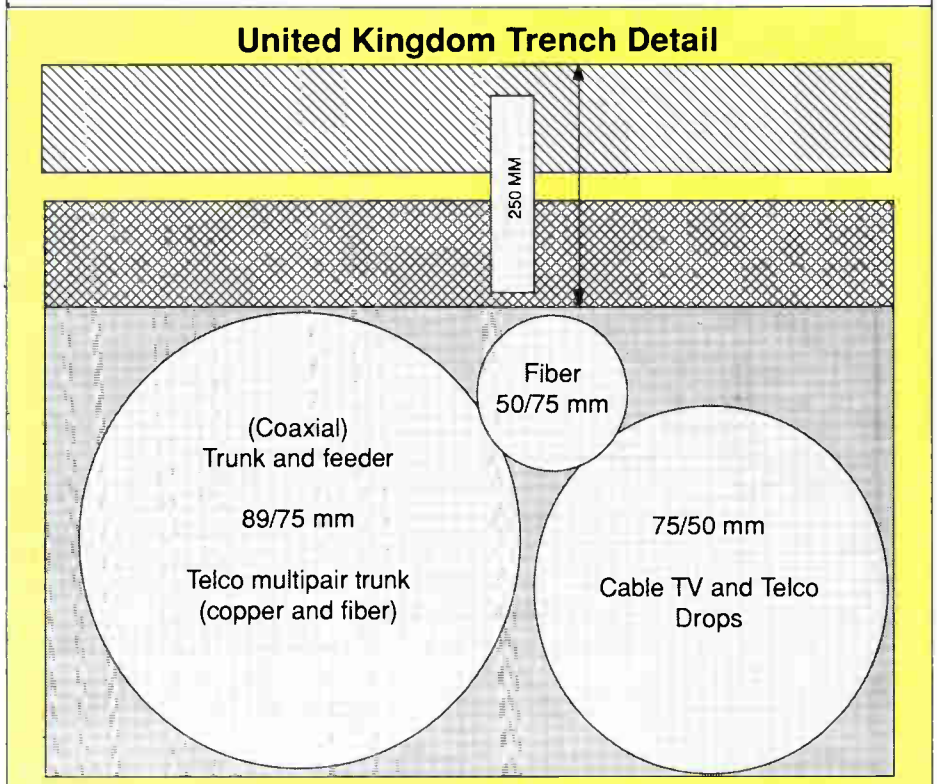


Figure 9


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Reader Service Number 30

# Some further thoughts on leakage management

COMPLIANCE

It seems that everything that could ever be said about signal leakage may already have been said. And yet—there appear to be some specific items and principles that need to be restated just one more time. On the other end of the spectrum there is an element of the cable fraternity that concentrates on elevating leakage management into an unnecessarily hi-tech science with expensive hi-tech accoutrements and overly focused on the details of data capture, transportation, manipulation and storage which may result in "tap-dancing" around the subject with very little actual leakage elimination accomplished.

Cable signal leakage is a well known fact of life and like any other ongoing project, it must be *managed*. The results of neglected leakage management are set out in Figure 1.

Leakage management breaks into three main, simple to differentiate, areas of concern:

- Leakage into the air space above the cable system.
- Leakage at ground level above 20 μV/m at 10 feet from the cable.
- Leakage of any level if it causes harmful interference.

**RESULTS OF NEGLECTED LEAKAGE MANAGEMENT**

- Interference to aircraft NAV/COMM
- Interference to radio amateurs
- Interference to off-air TV reception
- Interference to police, fire & industry
- Impaired pictures due to ingress
- Degraded overall soft pictures due to the addition of many degraded return-losses (Micro-reflections)
- Increased service calls
- Aggravated response problems
- Imposition of FCC fines & lost credibility
- LOSS OF CHANNELS

**Figure 1**

*By Roy Ehman, Director of Engineering, Jones Intercable*

The first possibility is evaluated by a figure of merit we call the cumulative leakage index. CLI may be defined as "a method of measuring and determining the probability that signal leakage from a cable system will cause interference to aeronautical radio services."

The sequel to the above is that "a successful air or ground CLI in no way absolves systems from carrying out a ground based leakage management plan per FCC Rules, Part 76, which include monitoring, logging and repairing leaks exceeding 20 μV/m at 10 feet or causing harmful interference at any level. The emphasis is on the word cumulative. For instance, you can't do a cumulative leak index on five miles of new plant because it does not represent the potential of the entire cable plant to interfere with the safety of life and property above the system.

And yet you will hear people say things like, "The new plant does not meet CLI" when they mean it does not meet Part 76 of CFR 47. A report was recently published which said in part that, a headend "did not meet CLI!" So let us instead talk about leakage management or leakage control and try to remember that the cumulative leakage index is just a measurement technique for evaluating the effectiveness of our leakage management/control programs in preventing interference in the air space above our systems.

### Easy way to do $I_{3000}$

There are two types of ground-based CLI measurement techniques. The first is called $I_{3000}$ and the second, a mathematical simplification of the first formula, is called I∝. Enough has been said about I∝ and most systems have done at least one by now, but questions still arise about $I_{3000}$. Because the I∝ number keeps growing with the size of the system involved, more leaks have to be fixed to a lower level for bigger systems to get a passing mark.

$I_{3000}$ on the other hand, takes into account the size of the system by allowing for the attenuation of the leakage signals from further out in the big system which arrive at an aircraft located at the center of the system. The slant height to the aircraft is factored into the formula which can be seen in the FCC Rules that we are all mandated to have on hand.

The extra factor that enters into the formula is the distance from the center of the system. Many questions are asked about how to arrive at this figure in a convenient manner. Thoughts of using Loran C arise but this degree of sophistication and expense is not necessary although some would jump at the chance to experience operating another piece of hi-tech gear.

All that is necessary is to locate the center of your franchise(s) and using this point draw concentric circles at 0.5 km, 1.5 km, 2.5 km, 3.5 km and 4.5 km as shown in Figure 2. Now the distance to be logged for the very inner circle becomes zero, the first annular area then, has an average distance from the center of 1 km, the next is 2 km, the next is 3 km, etc.

Each area or region is therefore identified by a simple integer number which is also the distance from the center. It therefore becomes unnecessary to divide large systems into innumerable little squares each with it's own identification code or number and each with an associated measured or estimated distance from center. Gone also is the need for lookup tables.

For example, to enter Zone 5 into your log or software just put 5 for the zone and 5 for the distance in kilometers and the job is done. This yields fewer zones so that a really large system may have less than 100 annular zones instead of 200 to 300 little squares or rectangles. Also, it is no harder to determine which zone you are in with ring shaped zones than it is with squares. Where the outer rings encompass too great an area, quadrants can be used yielding identifications such as 25N, 25S, 25E and 25W with the first two characters giving the distance from center.

With very big systems it is more efficient to obtain your passing CLI by

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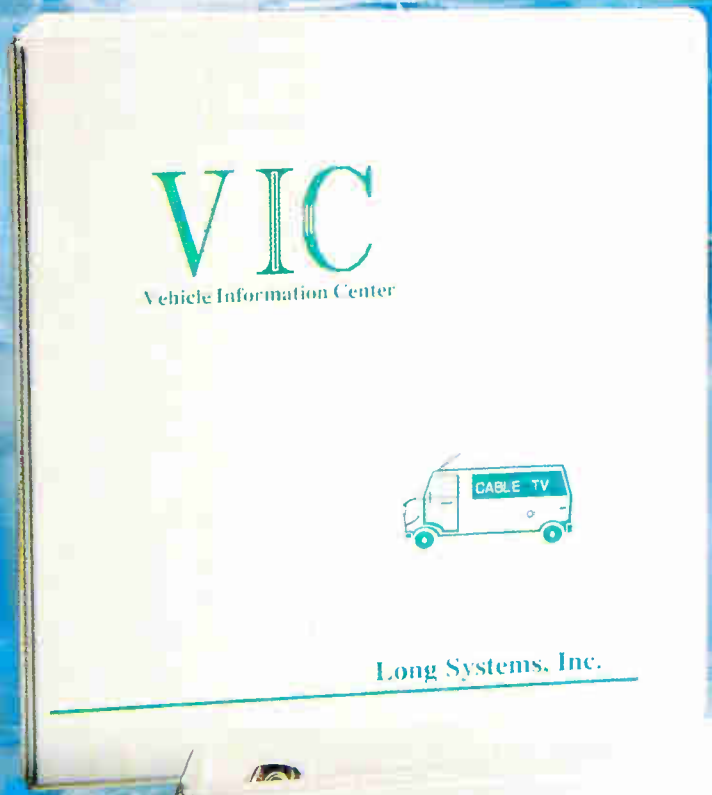


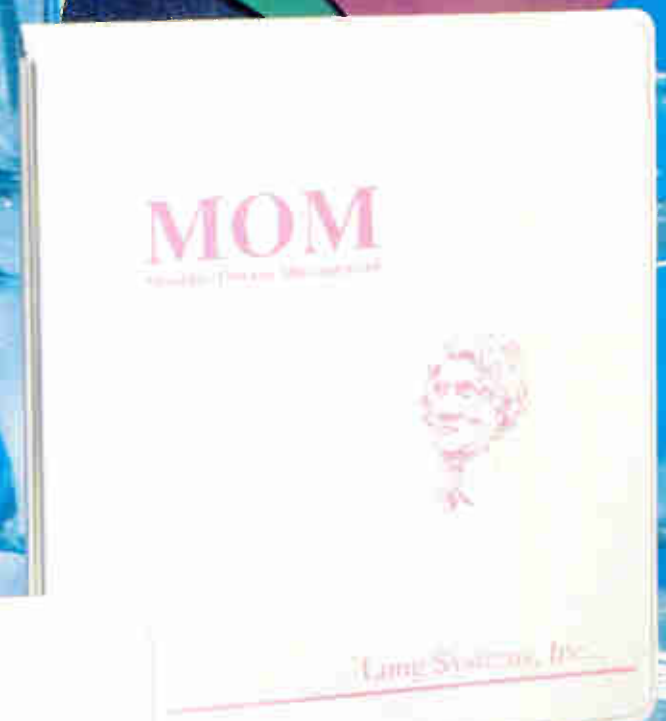


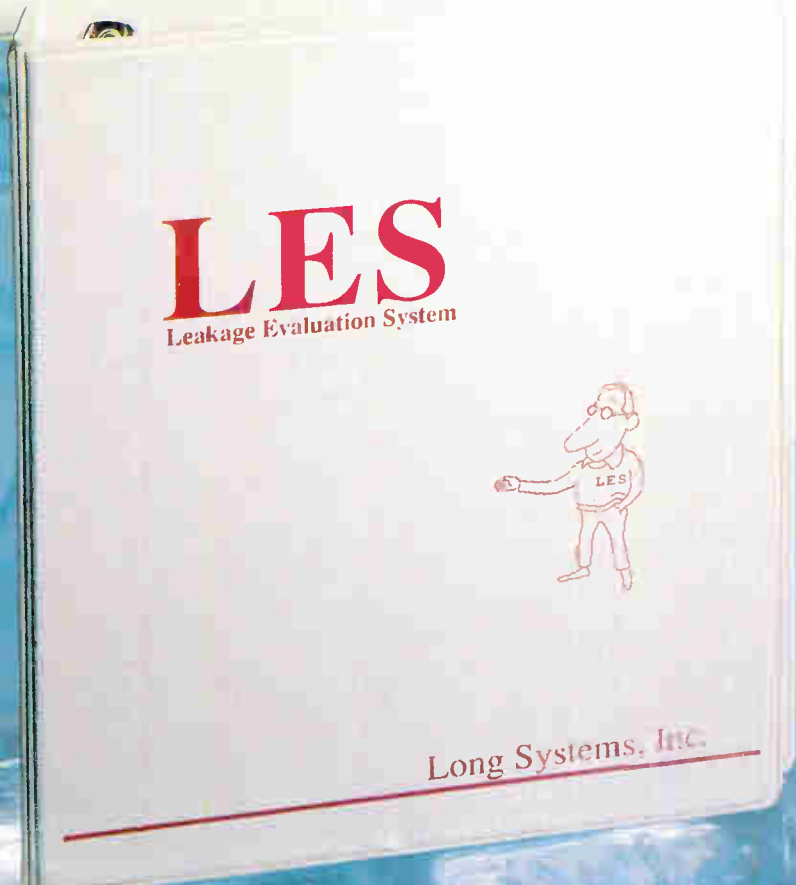


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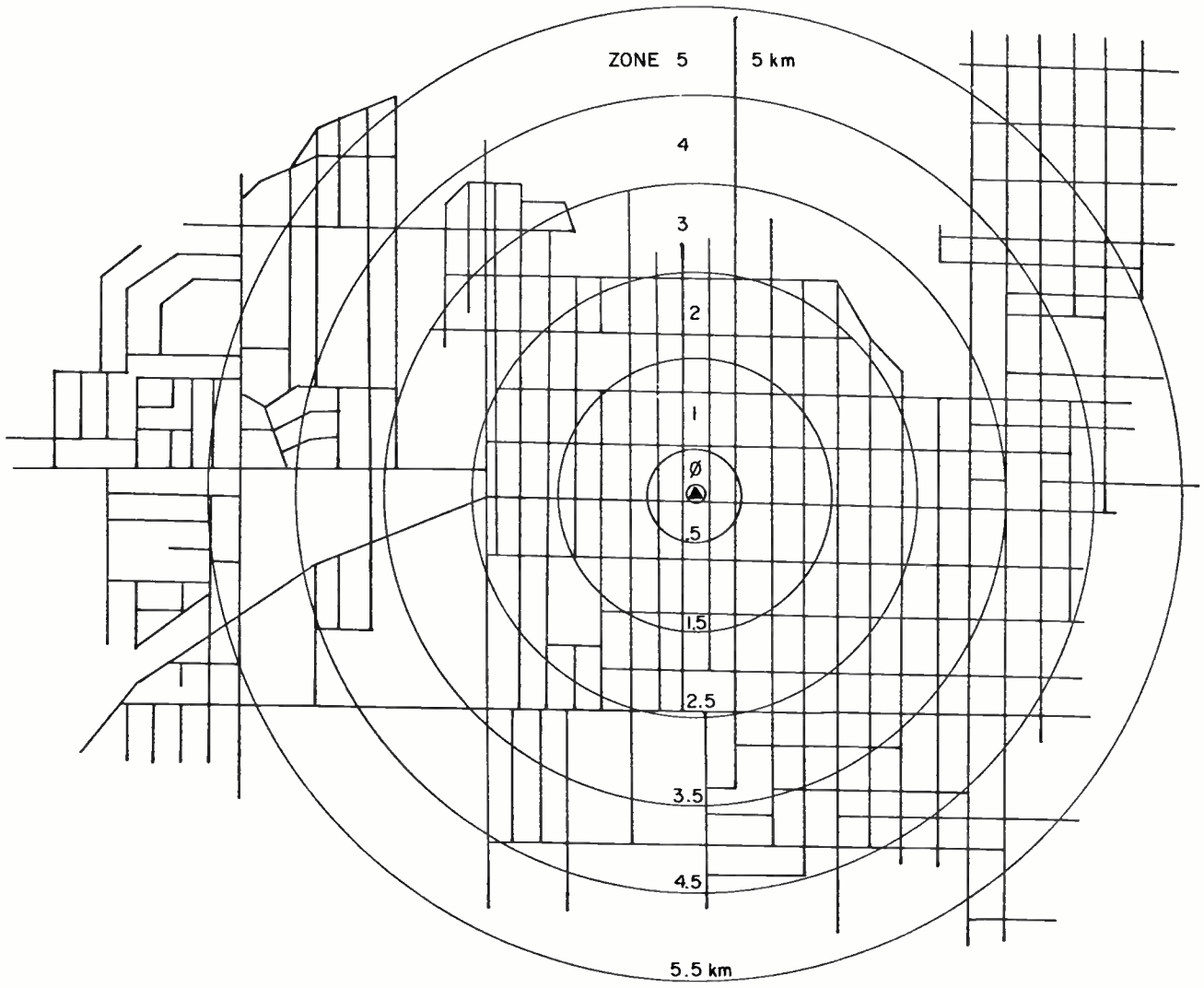
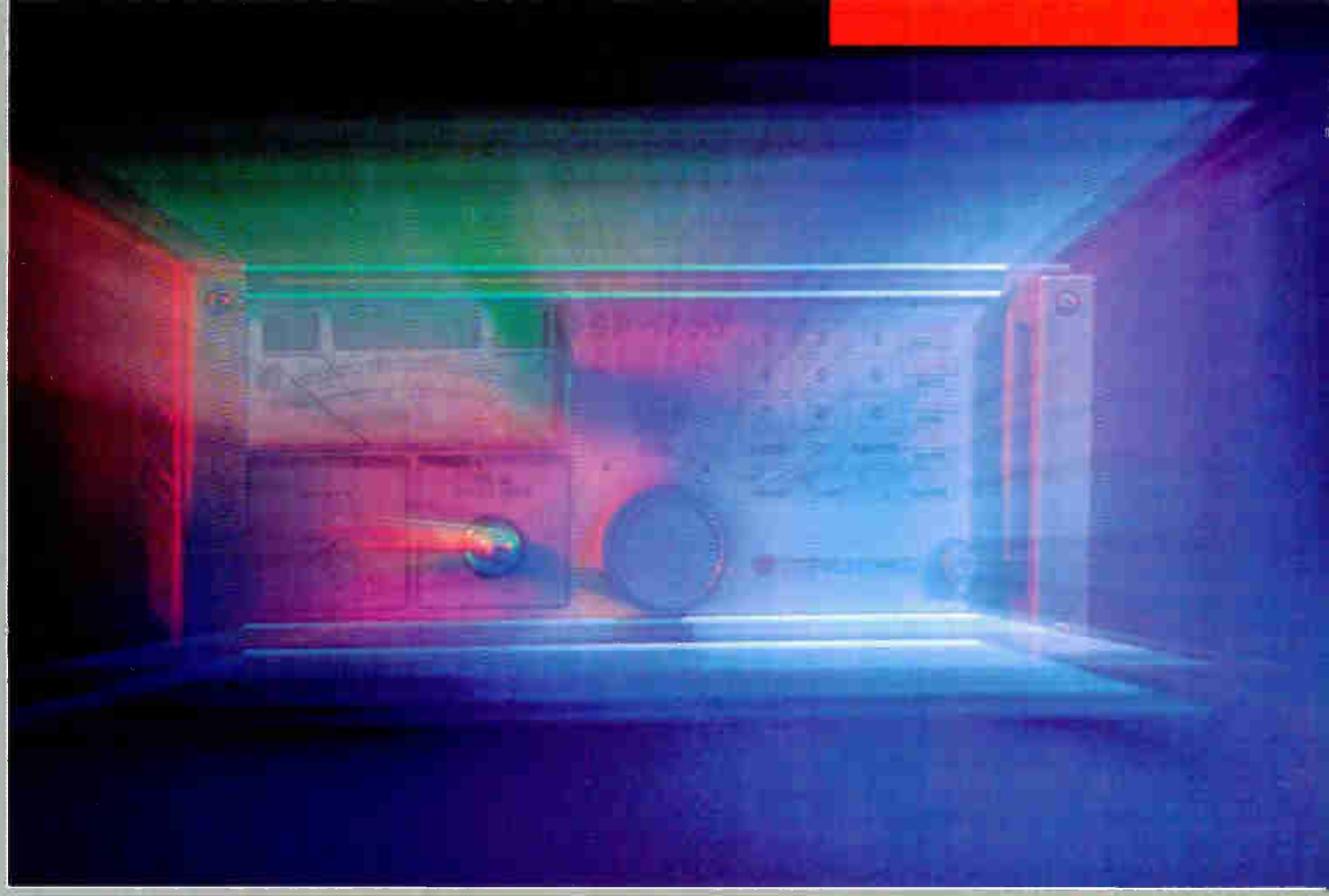



**Figure 2**

purchasing a third party flyover. Before scheduling the flyover it is most important to do a ground based rideout to make sure that there is a good chance of passing the aerial CLI. A mini CLI rideout of say, one-third of the plant, including known leak prone areas, and using your software to extrapolate the answer for 100 percent plant is perfectly satisfactory for in-house purposes. A pass mark of $I_{3000}$ = -10 or better (or $I\infty$ = 61 or better) should be aimed at to provide a cushion against equipment and human variations. A failed flyover means that the time and cost must be incurred a second time.

## Antennas

To accomplish your leakage management you will, of course, require among other things, antennas. To do a ground based CLI, the FCC requires you to monitor between 108 MHz and 137 MHz using a horizontal antenna. Part 76.609(H)(1) clearly states "A field strength meter of adequate accuracy using a horizontal dipole antenna shall be employed." For monitoring, logging and repairing leaks you can use any-



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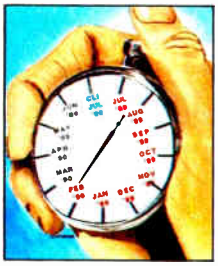
COMPLIANCE



thing that makes sense although following the FCC guidelines is obviously a prudent course. Figure 3 is a tabulation of antennas for the leakage monitoring scene as we know it today.

All systems should have received their Form 320s directly from the FCC by the time this is read. A Form 320 must be filed with a passing CLI for each community served on or before July 1. The regulations state that you may not commence to operate nor continue to operate a system with a non-compliant CLI after July 1, and systems are expected to voluntarily run all aeronautical channels "reduced" (below +38.75 dBmV anywhere in the plant) or shut them down until such times as they do meet the requirements.

Figure 4 graphically illustrates the channel losses that can be incurred on account of failure to pass and file the CLI by July 1. Note also, that if any system that is delinquent in respect of

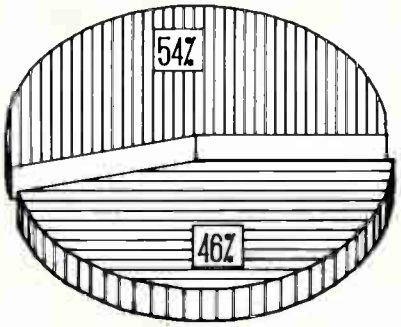
## LEAK MANAGEMENT ANTENNAS

| Model | Imped. | Price | Description |
|---|---|---|---|
| COMSONICS | | | 800-336-9681 |
| FW-1 | 75 | 59 | Mag mount 1/4 wave Monopole cut to frequency |
| FD-10 | 75 | 199 | Flip-up dipole. 36" PVC handle. |
| LINDSAY | | | 404-633-2867 |
| CLVA | 50/75 | 325 | Mag or fixed mount, 10 inch profile, 1/2 wave c/w ground plane, adjustable 104-140 MHz in PVC |
| 3LTA | 75 | 80 | Pistol grip, folding 3 element yagi, 18 MHz wide, |
| c/w LBA-10 | 75 | 139 | above with 10 dB gain battery powered amplifier |
| RTA-1 | 75 | 160 | Hand or fixed mount, 1/2 wave adjustable dipole |
| SCOTT WINFIELD | | | 800-346-1766 |
| N/A | 75 | 35 | Mag Mount 1/4 wave whip |
| LA-108A | 75 | 169 | Horizontal resiliently end-mounted Dipole by Linrose |
| TRILITHIC | | | 800-344-2412 |
| AVM-2 | 50 | 79 | Mag mount 1/4 wave whip 108-118 MHz |
| AVM-3 | 50 | 79 | Mag mount 1/4 wave whip 118-157 MHz |
| AFS-2 | 50 | 199 | Flip-up dipole. Fiber pole to 10'. 108 >157 MHz |
| AFS-1 | 75 | 169 | Tunable dipole. Sectional fiber handle to 10' |
| VITEK | | | 800-332-8428 |
| 1305 | 75 | 33 | Mag mount 1/4 wave whip cut to freq above 135 MHz |
| 1300 | 72 | 180 | Horizontal center mag mnt dipole. Height A to C = 39" |
| WAVETEK | | | 800-428-4424 |
| RD-1 | 75 | 450 | Adjustable dipole with pre-amp and handle |
| VMA-1 | 75 | 95 | Mag mount 1/4 wave whip |

**Figure 3**

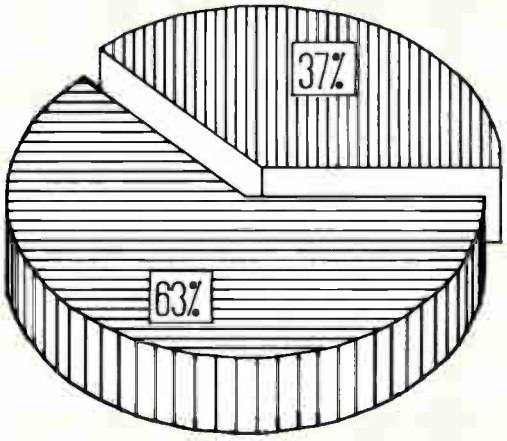
## Effect of CLI Non-Compliance

**37 Cannel System**
Remainder = 20




Lost Channels = 17

**54 Channel System**
Remainder = 20




Lost Channels = 34

A1. A2 included

Figure 4

COMPLIANCE

Part 76 and the CLI rules in particular, the FCC is empowered to levy a fine of $2,000 per day, per offense to a maximum of $20,000 per offense while the problems remain uncorrected. Bear in mind that a CLI∞ over 64, every leak over 20 μV/m and every out-of-spec offset channel is an "offense."

In connection with meeting Part 76 before commencing operations, the rules specifically provide in section 76.611(f) for turning on new plant and proving that it meets Part 76. This also applies to dropping in an unfiled, (but properly offset) test carrier into a system for leakage testing, flyovers, etc. for temporary periods.

Filing a passing CLI does not absolve anyone from the second item, Part 76 at ground level. This is taken care of by an ongoing leakage management program. It is altogether possible to pass a ground based or flyover CLI and still have leaks at ground level exceeding 20 μV/m at 10 feet from the cable. Bear in mind that this is typically the way the FCC evaluates a system. It has neither the time, manpower nor budget to do mass flyovers as some imagine.

The third item, harmful interference, is defined as "any emission, radiation or induction which endangers the functioning of a radio navigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service operating in accordance with this chapter" (76.613). Note that in order to qualify as harmful interference the leakage must interfere with a legitimate authorized communication. A scanner that hangs up on a 1 μV/m leak is not receiving a "communication" per se, and hence this particular case would not be one of harmful interference.

### Offset matters

A question that comes up from time to time goes something like this: "My system feeds a 50 apartment complex and recently an in-room movie company has put their signals on the high end of the cable (in the aeronautical band). These signals are not offset and the company says they do not have to offset as they are a SMATV operation. Moreover, they are operating at levels of +55/+56 dBmV."

Well the answer is that an apartment is not a SMATV system, but becomes a system when it is connected to a cable system and the the cable system operator is responsible for all FCC parameters of that installation—especially leakage and offsets. Regarding the high levels used, we will see more of this in the future. As fiber becomes more prevalent and is used to drive high level 750 MHz to 1000 MHz amplifiers with outputs approaching +60 dBmV, we will need to file for permission to use the audio carriers in the aero bands. They are automatically correctly offset when spaced 4.500 MHz from the picture carrier, but nonetheless, would need to be filed because if run 15 dB to 16 dB down from picture as currently recommended, they would come out at +39 when associated with a +55 dBmV picture carrier and hence above the +38.75 dBmV exemption limit for offset filing.

While we're on the subject of offsets, remember that *all* carriers in the aero band including jammer carriers, signal leakage monitoring carriers (this is

often a blind spot in offsetting and filing for offsets), pilot and control carriers running above +38.75 dBmV anywhere in the plant, and standby carriers (the ones in the processors that come on when the primary feed closes down or fails) must be properly filed and offset.

With jammer carriers, we are on unfamiliar ground as to what constitutes an acceptable target frequency. Table 1 is a list of the standard FAA frequencies centered around where jammers usually occur, along with the target offset frequencies, the lower limit (-5 kHz) and the upper limit (+5 kHz). Only the four significant digits are shown with XXX representing any channel from 'A' upwards, (except for FF of course). For example, on channel 'C' XXX would be 133 (MHz).

### Type of equipment

The best advice is to use the least costly (professional) equipment you can get. As mentioned earlier, there is sometimes a tendency to raise leakage management to the status of a science, which it is not. It is an *art* and the motto is typified by the *double F* approach which will save you equipment, time, money and heartache. The name of the game is to Find 'em and Fix 'em! If you do that wholeheartedly, then Part 76, CLI and all other associated problems go away. If you Find 'em and Fix 'em, then CLI∞ will be zero.

For ongoing routine patrolling that meets the quarterly monitoring requirement, all that is necessary is a device that allows us to log the presence of the leak. It is then handed in for issue as a SRO (Service Request Order) or simply a work order for repair. Repairing leaks is maintenance and should be budgeted and given credit for it as such. The FCC logging requirements are very reasonable. All it asks for is: date leak found; location of leak; date repaired; and probable cause.

Notice it does *not* ask for the level or the names of the finding or fixing technicians, although the latter is desirable for internal control and assignment of responsibility. Therefore, use a simple instrument that makes a noise on detecting a leak. These units cost relatively little and the system can therefore equip more field personnel with detectors. The more the better.

These can be given to all service techs and even to the installers as well, so that they can have the responsibility of never walking away from a leaking drop installation. These units work in cars and trucks just lying on the dash board or can be connected to a whip (monopole) roof antenna. These same units can be hand carried into customer premises for troubleshooting as well.

When repairing the leaks, it's a good

| FAA FREQS | JAMMER TARGET | LOWER LIMIT | UPPER LIMIT |
|---|---|---|---|
| XXX.4750 | XXX.4875 | 4825 | 4925 |
| XXX.5000 | XXX.5125 | 5075 | 5175 |
| XXX.5250 | XXX.5375 | 5325 | 5425 |
| XXX.5500 | XXX.5625 | 5575 | 5675 |
| XXX.5750 | XXX.5875 | 5825 | 5925 |
| XXX.6000 | XXX.6125 | 6075 | 6175 |
| XXX.6250 | XXX.6375 | 6325 | 6425 |
| XXX.6500 | XXX.6625 | 6575 | 6675 |
| XXX.6750 | XXX.6875 | 6825 | 6925 |
| XXX.7000 | XXX.7125 | 7075 | 7175 |

Table 1

COMPLIANCE

idea to prioritize fixing the bigger leaks first since it's the big leaks that kill your good CLI quickly. It's often asked how to prioritize when you use a detector that has no meter. Bigger leaks have a different sound and they also last longer as you drive. You could easily put in an arbitrary code, say a '3' μV/m for big leak that needs immediate attention, a '2' for a medium and a '1' for a small one.

All software will recognize these as levels and then have the leaks printed out by highest first. Also, these units have a spring loaded pad button which can be used to evaluate the severity of the leak. Unfortunately, the pad is rather big, at around 12 dB to 15 dB. To overcome this you might want to build a batch of "CLI pad boxes" using the values shown in Figure 5.

The utility box is a mere 1 inch by 1.5 inches by 2 inches and the spring loaded buttons hold 6 dB and 12 dB respectively and the two together give 18 dB. The parts are common ones easily obtainable from most parts jobbers, and the whole thing need cost no more than a few dollars. The return loss worked out at 18 dB which is ample for a simple receive application. The operator can then tell the size category of the leak by how many dB of attenuation he had to put in to silence it.

One manufacturer is considering putting an extra button on his unit and assigning the same values. Since we are not, in this application, trying to get a CLI, it makes no difference what the software says, so long as the data is properly stored and printed out as work orders as very big, medium and small leaks.

A final point that needs reiteration is the question of equipment accuracy. It's bad enough trying to get free-field measurements in an urban environment, sometimes from a moving vehicle, in surroundings that are anything but a free-field, but we have no excuse for inaccurate equipment. A case in point is a system that recently paid for a flyover and failed it rather badly.

On further investigation it was found that the system operators were unaware that the monitoring equipment, while quite accurate on an unmodulated CW carrier, was some 5 dB to 6 dB low when the modulation was applied. This correction was not introduced into the software input, resulting in a false sense of security. Almost all equipment tested thus far requires some correction when operated on a modulated carrier. Most frequently we use channel C for this purpose. There is, therefore, no substitute for benching all leakage detection equipment when it comes in with the standard level of CW carrier to produce the standard deviation—usually 20 μV/m, and then capturing the correction needed when the modulation is applied. This same technique can be used for getting a correction for use on a sync-suppressed channel. The frequency accuracy of the detector plus channel must also be checked and be correct. If these steps are *not* taken, you could be living in a fool's paradise. ■

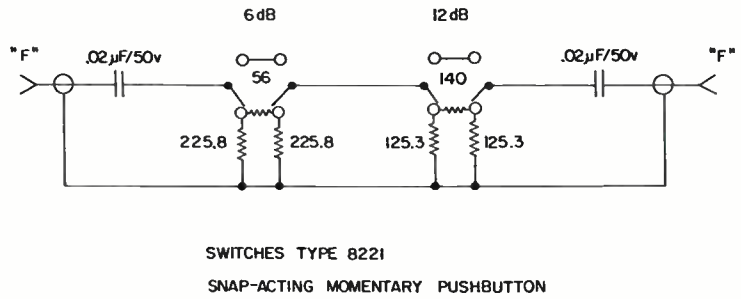
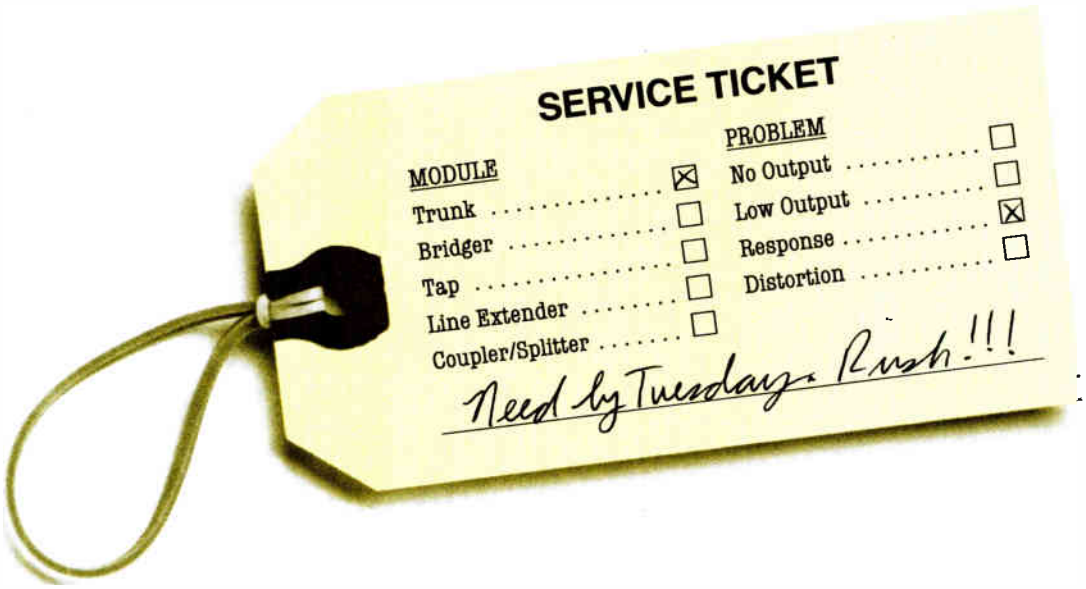



**Figure 5**

**LEAKAGE MANAGEMENT REQUIRES:**

- APPROPRIATE EQUIPMENT (Budget)
- PERMANENT LEAKAGE MANPOWER (Budget)
- ORGANIZATION (a plan)
- PERSERVERANCE!
- LEAKAGE MANAGEMENT IS VITAL
- LEAKAGE MANAGEMENT IS SELF AMORTIZING

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| Name | Operator | Launch Dates | Transponders per Satellite | Bandwidth (MHz) | Uplink (GHz) | G/T (dB/K) @ edge | Downlink (GHz) | eirp (dBW) @ edge | Lifetime (years) | Orbit Location (longitude) |
|---|---|---|---|---|---|---|---|---|---|---|
| Anik C1 to C2 | Telesat Canada | 85,83,82 | 16 | 864 | 14.0-14.5 | +3 | 11.7-12.2 | 47 | 10 | 107.5,110,117.5W |
| Anik D1 to D2 | Telesat Canada | 82,84 | 24 | 864 | 5.925-6.425 | 0 | 3.7-4.2 | 36 | 8-10 | 104.5,111.5W |
| Anik E1 to E2 | Telesat Canada | 90 | 24 | 864 | 5.925-6.425 | 0 | 3.7-4.2 | 40 | 10 | 107.5,110.5W |
| | | | 16 | 864 | 14.0-14.5 | +3 | 11.7-12.2 | 47 | | |
| Aurora I | Alascom, Inc. | 82 | 24 | 864 | 5.925-6.425 | -4 | 3.7-4.2 | 32-38 | 10 | 143W |
| Aurora II | Alascom, Inc. | 91 | 24 | 864 | 5.925-6.425 | -4 | 3.7-4.2 | 34-40 | 12 | 137W |
| ASC 1 & 2 | Contel-ASC | 85,90 | 18 | 864 | 5.925-6.425 | -4 | 3.7-4.2 | 34 & 36 | 8-10 | 129,83W |
| | | | 6 | 432 | 14.0-14.5 | -1 | 11.7-12.2 | 40 | | |
| Contelsat -1, -2, -3 | Contel-ASC | 93,93,Spare | 24 | 864 | 5.925-6.425 | -4 | 3.7-4.2 | 35 | 10 | 101,129W |
| | | | 16 | 864 | 14.0-14.5 | +2 | 11.7-12.2 | 46-49 | | |
| Galaxy I-IV | Hughes Comm. Galaxy, Inc. | 83,83,84,91 | 24 | 864 | 5.925-6.425 | -2 | 3.7-4.2 | 34.5 | 9-12 | 133,74,95,141W |
| Galaxy V-VI | Hughes Comm. Galaxy, Inc. | 93,91 | 24 | 864 | 5.925-6.425 | -2 | 3.7-4.2 | 34.5 | 9-12 | 64,91W |
| Galaxy IR,IIR,IIIR | Hughes Comm. Galaxy, Inc. | 93,94,94 | 24 | 864 | 5.925-6.425 | -2 | 3.7-4.2 | TBD | 10 | 133,74,95W |
| Galaxy A & B | Hughes Comm. Galaxy, Inc. | 93,94 | 24 | 864 | 14.0-14.5 | +2 | 11.7-12.2 | 47-49.5 | 12 | 99,131W |
| Gstar I-IV | GTE Spacenet Corp. | 85,86,88,90 | 16 | 864 | 14.0-14.5 | -2 | 11.7-12.2 | 38-48 | 10[a] | 121,105,125,64W |
| Gstar IR | GTE Spacenet Corp. | 94 | 24 | 864 | 14.0-14.5 | 1 | 11.7-12.2 | 43.8 | 10 | 121W |
| Morelos A & B | Mexico | 85,85 | 18 | 864 | 5.925-6.425 | +2 | 3.7-4.2 | 36-39 | 10 | 113.5,116.5W |
| | | | 4 | 432 | 14.0-14.5 | +0.1 | 11.7-12.2 | 44 | | |
| Satcom IR,IIR | GE Americom | 83,83 | 24 | 864 | 5.925-6.425 | -6 | 3.7-4.2 | 34 | 10 | 139,72W |
| Satcom IIIR & IV | GE Americom | 81,82 | 24 | 864 | 5.925-6.425 | -4 | 3.7-4.2 | 34 & 32 | 11 | 131,81W |
| Satcom C-1[b] | GE Americom | 93 | 24 | 864 | 5.925-6.425 | -4 | 3.7-4.2 | 34 | TBD | 139W |
| Satcom C-3,C-4[c] | GE Americom | 92,93 | 24 | 864 | 5.925-6.425 | -6 | 3.7-4.2 | 34 & 32 | 12 | 130,81W |
| Satcom K1-K2 | GE Americom | 86,85 | 16 | 864 | 14.0-14.5 | 0 | 11.7-12.2 | 43-49 | 10 | 67,81W |
| Satcom K3 | Crimson Associates | 89 | 16 | 864 | 14.0-14.5 | +2 | 11.7-12.2 | 45-49 | 10 | 85W |
| Satcom H-1 | GE Americom | 93 | 24 | 864 | 5.925-6.425 | -2 | 3.7-4.2 | 34 | 10 | 79W |
| | | | 16 | 864 | 14.0-14.5 | +2 | 11.7-12.2 | 42 | | |
| SBS 1-2 | Comsat General | 80,81 | 10 | 430 | 14.0-14.5 | -2 | 11.7-12.2 | 41 | 7[e] | 74W |
| SBS 3 | MCI | 82 | 10 | 430 | 14.0-14.5 | -2 | 11.7-12.2 | 41-43 | 8-9[e] | 95W |
| SBS 4 | IBM/Hughes | 84 | 10 | 430 | 14.0-14.5 | -2 | 11.7-12.2 | 40 | 9 | 91W |
| SBS 5 | IBM/Hughes | 88 | 14 | 870 | 14.0-14.5 | -5 | 11.7-12.2 | 40 | 10 | 123W |
| SBS 6 | IBM/Hughes | 90 | 19 | 817 | 14.0-14.5 | 0 | 11.7-12.2 | 42 | 10 | 72W |
| Spacenet I-IV | GTE Spacenet Corp. | 84,84,88,90 | 18 | 864 | 5.925-6.425 | -4 | 3.7-4.2 | 34 & 36 | 10 | 120,69,87,141W |
| | | | 6 | 432 | 14.0-14.5 | -2 | 11.7-12.2 | 39 | | |
| Spacenet IR,IIR, IIIR | GTE Spacenet Corp. | 93,93, Spare | 24 | 864 | 5.925-6.425 | -2 | 3.7-4.2 | 35 | 10 | 103,69W |
| | | | 24 | 864 | 14.0-14.5 | -1 | 11.7-12.2 | 40.6 | | |
| Spotnet 1, 2, 3 | National Exchange Satellite, Inc. | 93,93, Spare | 24 | 864 | 5.925-6.425 | -5.9 | 3.7-4.2 | 31 | 10 | 135,76W |
| | | | 18 | 3753 | 14.0-14.5 | +5 | 11.7-12.2 | 56-59 | | |
| Telstar 301-303 | AT&T Communications | 83,84,85 | 24 | 864 | 5.925-6.425 | -5 | 3.7-4.2 | 32-36 | 10 | 97,85,123W |
| Telstar 401,402, 403 | AT&T Communications | 92,93 Spare | 24 | 864 | 5.925-6.425 | -2 | 3.7-4.2 | 31-38 | 10 | 97,89W |
| | | | 24 | 864 | 14.0-14.5 | -2 | 11.7-12.2 | 40-47 | | |
| Westar III | Hughes Comm. Galaxy, Inc. | 79 | 12 | 432 | 5.925-6.425 | -7.4 | 3.7-4.2 | 33 | 8 | 91W |
| Westar IV & V | Hughes Comm. Galaxy, Inc. | 82,82 | 24 | 864 | 5.925-6.425 | 0 | 3.7-4.2 | 35-37 | 10 | 99,122.5W |

[a]Except Gstar III, which is 3 years. [b]Will replace Satcom IIIR and IV in 1992 and 1993, respectively.
[c]Will replace Satcom IR in 1993. [d]Lifetime may be extended by using the COMSAT Maneuver.



During the past year, the cable programming community made a decision to purchase or lease approximately 150 transponders of C-band capacity on the various cable birds. This commitment to transponders sent a loud and clear message that, at least for the foreseeable future, C-band technology is going to be the distribution vehicle for cable television programming.

And while this commitment will take the industry past the turn of the century, it still doesn't deal with what is considered to be state-of-the-art in satellite technology—Ku-band. Of the 38 satellites currently orbiting continental North America, 17 are pure Ku or hybrid C- and Ku-band. Within the next decade, all of the Ku-band satellite replacements along with several new hybrids will be launched. This continued commitment by satellite operators and manufacturers does not suggest an obsolete technology. However, for the cable industry, which has decided against the technology as a major distribution vehicle, the question now becomes, "who will use Ku-band and why would it be used?"

### Backhauling driving demand

It was the regulatory arena that decided C-band's fate when the satellites became secondary users of a shared frequency which forbid them to interfere with the terrestrial microwave links using the spectrum. This decision allowed Ku-band, with its higher power levels, to penetrate the microwave transmission problems confronted in metropolitan areas making it the preferred medium for sports/news gathering and backhauling. Backhauling—where an original feed of an event is uplinked to a satellite and back to a studio where it is retransmitted to its intended audience—has seen a tremendous growth in regional, independent broadcast networks and is a primary factor in the demand for Ku-band technology.

This is especially true as the hybrid satellites are launched with their capacity for cross strapping—the ability to transfer signals between C- and Ku-band frequencies aboard the satellites. This would enable mobile news-gathering vehicles equipped with small Ku-band antennas to transmit news stories as they happen to a hybrid satellite. The satellite would then relay the signal to the C-band earth station serving the network for rebroadcast to affiliated stations.

This kind of usage is preferable for Ku-band. However, it's obviously not the only use for the high-powered medium. Ku-band technology is famous for its business video and two-way data transmission—corporations have long used it for educational purposes and meetings. To Ed Horowitz, senior vice president at Viacom International, "any launch of Ku-band (now) is really just to take advantage of the VSAT (very small aperture terminal) business."

Another use of Ku is one very familiar to the cable industry—DBS. Direct broadcast satellite provides programming which can be delivered directly to an antenna at the subscriber's home. Unfortunately, DBS has a rather long and unsuccessful history, as evidenced by the many players who have entered into the precarious business and exited quite abruptly.

### Old news, old rumors

To the credit of DBS, it is a technology that makes sense so it's not surprising there are still attempts by the industry to master the technique. Almost everyone has heard the stories of a consortium of operators, headed by Tele-communications Inc. (TCI), that plans to start a DBS business. This persistent rumor has it that the MSOs

will acquire an entire block of Ku-band transponders for use as auxiliary cable delivery, pay-per-view events, or even possibly for HDTV display delivery.

Although TCI officials refuse to comment on the consortium or its proposed plans, Tom Elliott, director of research and development for TCI, feels there is "probably a marketplace for some sort of DBS program. On the other hand," says Elliott, "it's an extremly risky project so it's not an easy thing to deal with—and maybe the reason no one is aggressively addressing it at the moment."

For Elliott, one of the major reasons to look at DBS is geographical. Most franchises have a population distribution of approximately 80 to 85 percent in areas that are easily wired for cable television. Another 10 percent live in a ring around those cities and generally are higher-income households. These "ring" areas are typically more troublesome to cable systems because their low density makes it expensive to wire. And, unfortunately for the homeowners, strict covenants often prohibit the use of large backyard dishes.

"In an environment like that," says Elliott, "if we could offer a Ku-band alternative, it may well help serve that market, that in many cases, does have access to off-air signals. So there is that marketplace we're struggling with trying to figure out how it makes sense to serve them. If we're worried about if we're going to be an entertainment provider to the world," he continues, "we ought to have a method of largely providing that entertainment."

**New rumors**

The future of Ku-band usage in the cable industry may rest in TCI's hands at the moment. Because the MSO is such a dominant player, and the issue is an industry concern, a cooperative effort such as the proposed consortium could alleviate some of the natural worries about a DBS business. However, a new rumor has twisted itself into the satellite world that if true, would eliminate satellites entirely. Some say that by the time the next generation of video communication satellites (many of which will be launched in 1992-93) reach the end of their lifetimes (10 to 12 years), a fiber optic terrestrial network will replace the highly expensive and risky satellite business.

"We keep hearing that," says Walter Morgan, president and consultant for Communications Center, a telecommunications consultant company located in Clarksburg, Md. "But people who say that are caught up in the 'gee whiz' world and haven't sat down and figured how in the world (they're) going to do that. Cable or broadcast television has got to be taken from, say New York, to thousands of locations across the country. And in the case of the broadcast networks, it's got to be switchable, not only by time zone, but also by interest area, particularly on a Saturday afternoon when you've got (several) football games going on simultaneously."

To others in the satellite industry, the old saying, "the rumor of our demise is greatly exaggerated" fits well. For the cable industry, whether it becomes true is a question for the future. For now, the answer to signal delivery lies in the C-band satellites that have supported the industry for years. As for Ku-band usage, there are some advantages now, but whether it becomes more widely used depends on the players and the business reasons that would compel a move to Ku-band. ■

*—Kathy Berlin*

# An OTDR primer

BACK TO BASICS

*Although much has been said about optical fiber technology and its related attributes, scarcely a whisper has been mentioned about the necessary testing that must occur when problems crop up. In this month's 'Back to Basics,' George Grant of Anritsu America examines the optical time-domain reflectometer, a device which is instrumental in performing correct optical field tests.*

An optical time-domain reflectometer (OTDR) is essentially a one dimensional optical radar which sends light pulses down an optical fiber and measures the reflected and backscattered light as a function of time but displays it on a CRT as a function of distance. Modern OTDRs make use of both Fresnel reflection and Rayleigh backscatter levels to characterize such items as fiber attenuation, splice loss, breaks and fiber length or index of refraction. In the past, OTDRs have been used primarily in the laboratory, but the current proliferation of fiber and future fiber-to-the-home considerations promise to make OTDRs a most important piece of test equipment for the communications industry.

### The importance of fiber

Optical fiber has proven to be a neat solution to problems ordinarily found in communications and transmission systems. Fiber can be used to transmit information at extremely high frequencies over long distances with very little pulse rounding when compared to electrical systems. Optical and fiber optical systems also have the advantage of being immune to crosstalk, EMI and EMP, which makes them ideal for noisy environments where electrical systems tend to be troublesome. And finally, the future prospect of coherent optical communication systems promises to someday make available a communications bandwidth that is somewhere between 1200 GHz and 20,000 GHz. This means that in the coming years the advantages of fiber will make it the transmission medium of choice in a rapidly growing communications market.

The more practical side of fiber optics, like installation and maintenance, is somewhat more problematic. Fibers are not like electrical cables that require no extraordinary preparation for splicing. The ends of optical fibers must be right angle cleaved, precisely aligned and fused or otherwise spliced so that transmission can take place with a minimum of loss and reflection. If connectors are used, all connections must be made in a dirt-free, relatively dry environment to insure proper transmission, as well as preventing damage to optical components.

An OTDR can and has been used for making loss and reflection measurements of fiber and fiber optic components to evaluate fiber transmission systems. In addition to making loss and reflection measurements, OTDRs, in conjunction with automatic switching equipment, can be used to remotely monitor the condition of fiber optic transmission lines. When a fiber fails or degrades sufficiently over time due to a break or more gradual deterioration determined by the OTDR, an automatic switching system can change transmission paths from the failed fiber to a redundant one or just sound an alarm in a distant central office, bringing the problem to the attention of repair crews.

The OTDR not only can determine the loss in a fiber span but can tell the operator exactly where a break has occurred, if there is one. This is especially convenient in the case of breaks that occur in underground fiber spans that are difficult to access for repair. Perhaps the only aspect of an OTDR more interesting than the many fiber characteristics it can determine and problems it can diagnose is how the OTDR actually does all this.

### How the OTDR works

Generally, the OTDR works by transmitting pulses of light down a fiber and then observing the reflected pulses. This is a time based process, but the OTDR is usually input the index of refraction (IOR) of the material by the operator (for glass fiber, usually about 1.5). The IOR is the ratio of the speed of light in a vacuum to the speed of light in the material. Knowing this, the display can be converted from what would otherwise be a time base into distance, as if the OTDR was a one-dimensional optical radar.

Figure 1 shows a typical OTDR trace of relative amplitude as a function of distance. Figure 2 shows a block diagram of a typical OTDR. In Figure 2, a pulse genera-

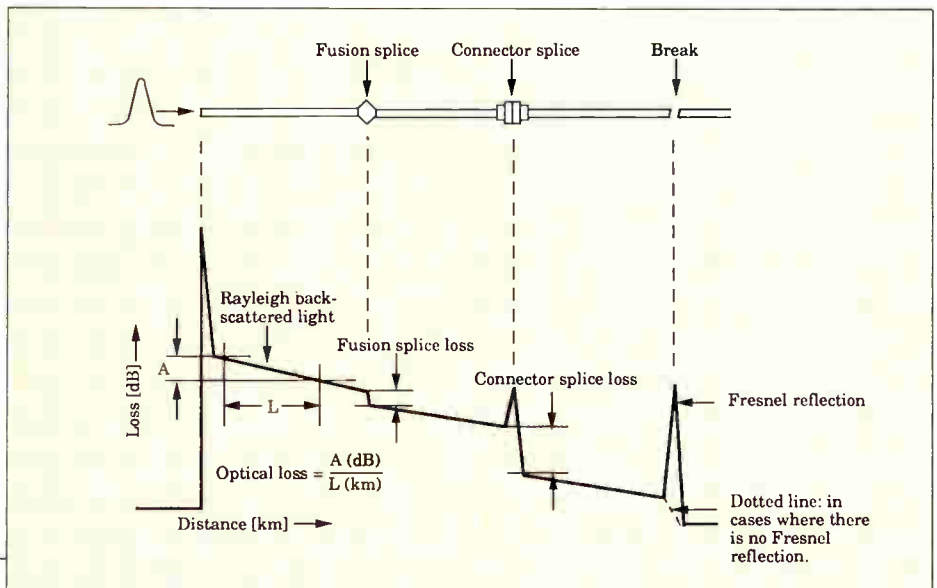


**Figure 1**

**Typical OTDR Trace**

*By George Grant, Anritsu America Inc.*

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tor drives a laser diode which emits optical pulses of a specific pulse width and duty cycle. Wider pulse widths tend to increase dynamic range as they send more light into the fiber, however, narrower pulse widths tend to increase resolution. Like IOR, pulse width is usually settable to some degree by the user depending upon the application.

The light then travels through a coupler or an optical switch that couples it to the fiber. An optical coupler can be much simpler and cheaper to use, but using an optical switch can improve performance, as well as provide the ability to perform optical masking, a key feature. Since the switch is electrically controlled, it can be strategically toggled where an undesireably large reflection has occurred which may hide an important part of the trace.

For example, a relatively small fusion splice may be hidden in the skirt of a large connector pulse. Toggling the switch at the right time can direct the large pulse away from the detector and enable more of the trace to be seen that was previously hidden due mostly to the amplifier's finite recovery time. The reflected light returning from the fiber passes through the optical switch

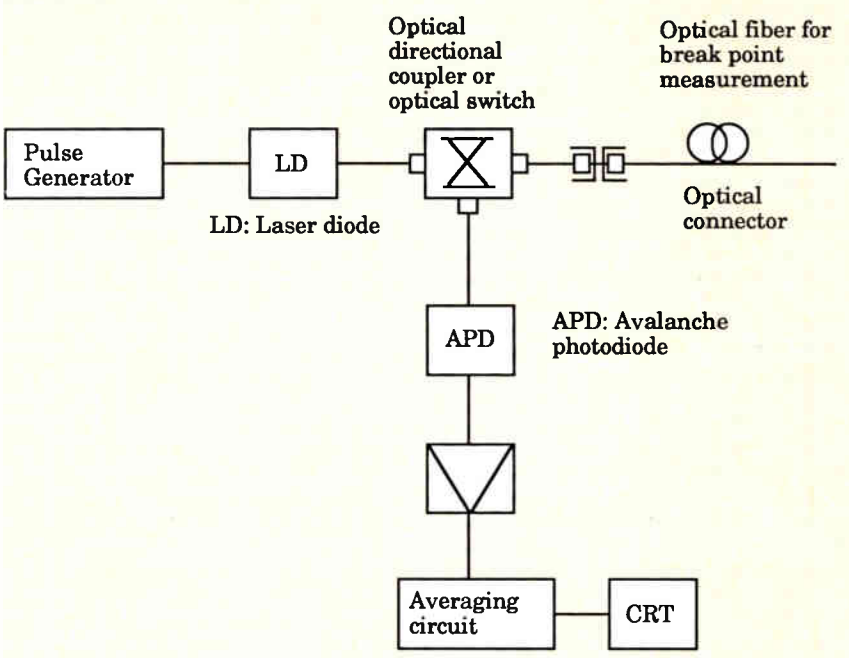


**Figure 2**

**Typical OTDR Block Diagram**

or coupler and is directed to an avalanche photodiode (APD) where it is detected. The now-electrical signal passes through an amplifier, through averaging circuitry and finally on to display processing.

### Some design trade-offs

Some critical design considerations concerning OTDRs depend upon the two major types of phenomena observed during fiber measurement (See Figure 1). The first is known as Rayleigh backscatter. This can be seen on the trace in Figure 1 as the constant slope between connectors indicative of fiber loss. This is caused by light that has been "backscattered" by imperfections in the fiber such as impurities, air bubbles, moisture, etc. This backscattered light is usually of a very low level and is inversely proportional to the wavelength of the light raised to the fourth power. The conclusion can then be drawn that as one travels from 850 nm to 1310 nm to 1550 nm, the backscatter level decreases dramatically.

The second phenomena is known as Fresnel reflection. It can be seen to be occuring at all the connectors because of the glass-air-glass dielectric interface. The level of this reflected light is at an extremely high level of up to 4 percent of the incident light. The Fresnel reflected light level does not change nearly as much as a function of frequency and mode as the Rayleigh backscatter level does. To observe the Rayleigh backscatter level and the Fresnel reflection at 1550 nm would therefore require an amplifier of much larger dynamic range and sensitivity than it would at 850 nm.

Similar difficulties occur with high resolution OTDRs where the pulse width must be very narrow. The backscattered light level becomes very low, but can be compensated for somewhat by using a high powered semiconductor laser. Also, a 50 μm core multimode fiber will have a typical numerical aperture (the fiber's ability to couple light) of about 0.2 while a single mode fiber will have an NA of only about 0.1. This means that a multimode fiber will capture and return more of the backscattered light than the single mode fiber will.

It could be concluded that a long wavelength, single mode, high resolu tion OTDR is generally harder to design and build and therefore much more costly than a short wavelength, multimode, ordinary resolution OTDR for the above reasons.

### Future trends in OTDRs

As fiber continues to be installed in ever increasing amounts, emphasis is being shifted away from laboratory grade test equipment to equipment that is field portable and user friendly. OTDRs are no exception as fiber optic test requirements shift from research and development to installation and maintenance. Future OTDRs will most likely be much smaller, lighter, more rugged, somewhat less functional and more technician oriented.

One might expect to see in addition to the models that exist today specialized hand-held models and stripped down fault locators that will fill out the low end of the OTDR market.

Improvements at the upper end of the market will most likely take the form of improvements in software and firmware for such applications as optical return loss calculations and remote monitoring capabilities. Trends would indicate that the future will see large growth in the OTDR market and possibly even wider diversification. ■

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PERSONNEL: Atlee Jacobson, Sales Support Engineer; T. Takenaka, Applications Engineering Manager
DESCRIPTION: Advantest manufactures instruments for field and R&D applications: Bit Error Rate Testers, Spectrum Analyzers, Optical Power Meters, OTDR's, LED & Laser Sources, Optical Spectrum Analyzers, Spectral Linewidth Test Set, Wavelength Meters, Optical Channel Selector, Optical Attenuator.

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**Anritsu America, Inc. . . .(800) 255-7234**
**FAX . . . . . .(201) 337-1111**
15 Thornton Road
Oakland, NJ 07436
PERSONNEL: Hugh Felger; George Grant
DESCRIPTION: Manufacturer of optical and RF/microwave instrumentation, including OTDRs, spectrum analyzers, power meters, line width analyzers, chromatic dispersion test sets, etc. Other product areas include digital video generators and analyzers, and digital transmission test sets.

### Antel OPTRONICS INC.

**Antel Optronics . . . . . .(416) 335-5507**
**FAX . . . . . .(416) 335-5141**
3325 B Mainway
Burlington, Ontario, Canada L7M 1A6
PERSONNEL: J.D. Brown; J. Wainwright
DESCRIPTION: The Antel LANprobe is a totally new concept in OTDRs for CATV and LAN applications. By incorporating 850 and 1300 nm singlemode/multimode OTDR cards in a popular laptop PC, Antel has achieved a compact, lightweight (21 lb), easily portable, full featured OTDR. The laptop provides powerful computing capability for running the menu-driven OTDR software and storage memory for a virtually unlimited number of waveforms.

### Fiberoptic Transmission Technology Ltd.

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**Technology Ltd.**
**FAX . . . . . .+44 274 730130**
Lister Hills Science Park
20-26 Campus Road
Bradford, England BD7 1HR
PERSONNEL: Alistair Gooch; Mike Phillips
DESCRIPTION: FTT Ltd. designs and manufactures OTDRs for use on-site in tough environments. The products are amongst the easiest to use and most practical of their type. Models giving high resolution performance are available to cover full fiber and system wavelength usage. Tough, user friendly, high performance—put us to the test.

### PK

**Photon Kinetics, Inc. . . . .(503) 644-1960**
**FAX . . . . . .(503) 641-5614**
4900 S.W. Griffith Dr.
Beaverton, OR 97005
PERSONNEL: Jack Morehouse, National Sales Manager, Telecommunications; Tom Moore, Sr. VP, Sales & Marketing
DESCRIPTION: Optical fiber test and measurement instrument manufacturer. Supplies a range of field equipment, including OTDRs, fusion splicers, active fiber detectors. Model 4000 High-Resolution OTDR designed specifically for local loop, LAN and Cable TV applications; Model 3200 Ultra-long range OTDR for trunking applications.

### SIECOR

**Siecor Test . . . . . .(704) 327-5040**
**Equipment Group**
**FAX . . . . . .(704) 327-5042**
489 Siecor Park
Hickory, NC 28603-0489
PERSONNEL: Judy Lavin, Test Equipment Marketing Manager; Todd Hudson, Test Equipment Product Specialist
DESCRIPTION: Siecor's line of fiber optic test equipment includes OTDRs, attenuation test sets, hand-held test kits, return loss test option, talk sets, dispersion test set, and test fiber boxes. Siecor test equipment meets all of your testing needs from pre-installation on-the-reel testing to post-installation acceptance testing, maintenance and troubleshooting.

# Fiber optics: Today and tomorrow

*The following article has been presented at various SCTE chapter and meeting group technical seminars.*

Fiber optics, you have figured out by now, is not frightening. It is a relatively new technology for cable TV. But we have dealt with new technologies in the past.

Satellite communications was once a new technology for cable TV. Without it, half of us would not be here, in this industry, today. We mastered satellite. We molded satellite to our industry's needs. We grew quality nationwide programming services like ESPN, HBO, Showtime, CNN and C-SPAN. We grew happy subscribers. We grew.

We can grow again and grow more. Fiber optics will allow us that. The technology turns out to be easy to understand for cable TV engineers and technicians. After all, key measurements are at RF. What matters is good pictures, better pictures, more pictures and more reliable service.

### Few links today

Today, we use fiber optics almost exclusively for "supertrunks" and "cascade reduction." Supertrunks typically link indoor headends to other indoor headends. Cascade-reduction is a term I picked up from a few operators that explains the limited use of most AM fiber optic links to date. In this application, a few strategically placed fiber optic links intercept the longest trunk amplifier cascades. These cascades, often overextended from original designs due to population growth, are reduced to provide better end-of-line picture quality to outlying subscribers. Today's applications employ few links in each system.

We have used fiber optics to link headends since before 1985. As many MSOs trended toward clustering systems into regions, more headends became suitable for linking together. The relatively expensive, real estate-hungry and high maintenance headend antenna and electronics can be concentrated in one "master" location. A number of lower-cost, lower-maintenance "remote" or "slave" headends can be served via supertrunks.

A problem with today's typical FM supertrunks is their inability to transparently carry scrambled channels. Every remote headend then usually requires scramblers. The full real estate, maintenance and cost benefits of the master-slave headend system are denied.

We have licked this problem in the lab. During 1990, we will ship and install high performance, scrambling-transparent FM fiber optic supertrunk product.

Today's FM fiber optic supertrunk systems typically provide EIA RS-250B medium-haul broadcast specifications (including video S/N >60 dB) with 16 channels per fiber at distances exceeding 25 miles. The 1310 nm wavelength typically is employed. Terminal equipment costs usually are between $4,000 to $5,000 per channel for a point-to-point link.

Tomorrow's supertrunk systems will make more use of the 1550 nm wavelength, digital modulation and/or AM.

Fiber loss at 1550 nm is only 0.40 dB/mile vs. 0.65 dB/mile at 1310 nm. Laser suppliers happen to have less experience with 1550 nm today, so there are fewer components from which to select in volume production. Also, lasers are theoretically approximately 70 percent less efficient at 1550 nm than at 1310 nm.

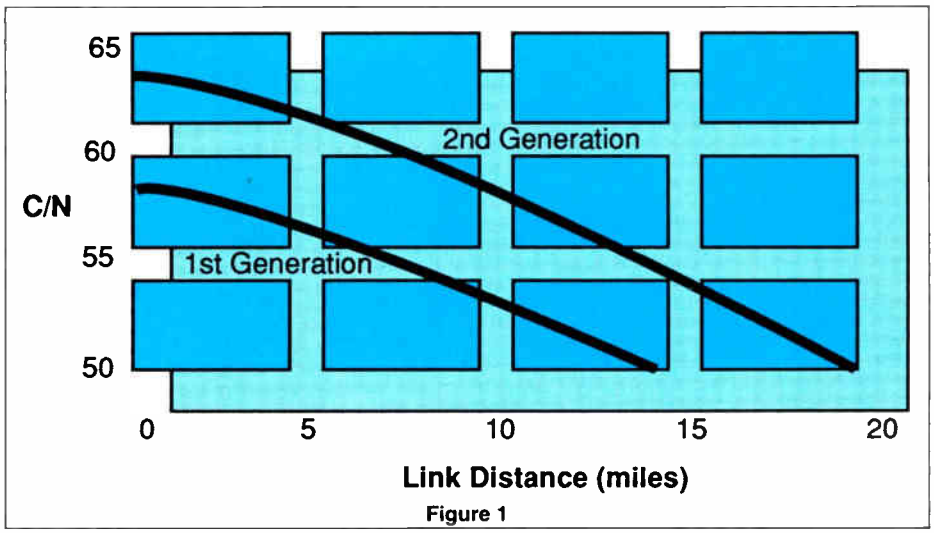

Figure 1

But as laser suppliers become more experienced at 1550 nm, allowing them to drop their prices, expect to see more systems offered at 1550 nm. The lower fiber loss will more than compensate for a less efficient laser for very long links in the near future.

Digital modulation, using repeaters, allows virtually unlimited distances to be covered. But digital is bandwidth-hungry. Each uncompressed NTSC video channel takes over 100 megabits per second (Mbs) of capacity. In an "apples-to-apples" performance comparison, today's digital supertrunk system costs often exceed those of FM by about 50 percent. Five years ago, the cost premium was more like 500 percent. As digital costs continue to decline vs. the more mature FM technology, tomorrow's supertrunk systems could be digital, especially for longer links. Note that "tomorrow" could be two to five years away for most applications.

"Tomorrow" might be even sooner for viable AM supertrunk product. Rapid advances in AM laser performance are being driven by demands for cost-effective fiber optic backbone trunks. In the process, we have stumbled onto lasers that seem suitable for many supertrunk applications. By keeping channel loading to around 10 per

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

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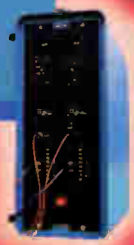

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fiber, systems soon may be available that provide a reach of 15 to 25 miles, with carrier-to-noise (C/N) performance in the 54 dB to 59 dB range and composite triple beat (CTB) and second order distortions (CSO) at -70 dB or better. Terminal equipment costs could be on the order of $2,500 per channel for a point-to-point link.

**Backbone trunks**

By now, you are all familiar with the backbone fiber optic trunk concept. Essentially, a big coax tree-and-branch system breaks into a cellular collection of much smaller coax tree-and-branch systems each linked to a headend via a fiber optic overlay or backbone.

AM is ideal for this application. It is most compatible with the existing distribution electronics and the lowest cost option. Today's AM fiber optics terminal equipment typically costs $500 to $1,000 per channel for one to three fiber systems.

Most often actually designed for digital applications, today's "AM" lasers often are not good enough. There haven't been any 100 fiber optic node backbone systems because laser performance has been inadequate. Today's cascade-reducing AM links typically use one to three fibers to carry 36 to 60 channels an average distance of six to nine miles with C/N in the low 50s (dB), CTB in the low-mid 60s (dB) and CSO at -60 dB measured according to NCTA-recommended practices.

Tomorrow's true AM lasers will allow construction of many fiber optic backbone trunk systems beginning in 1990. Figure 1 compares today's first-generation AM system C/N to tomorrow's second-generation system performance over various link distances. Using two fibers, 80 NTSC video channels can be transmitted 10 miles with C/N at 56 dB. At a 20-mile link distance, C/N of 50 dB can be maintained. CTB and CSO are both -65 dB or better.

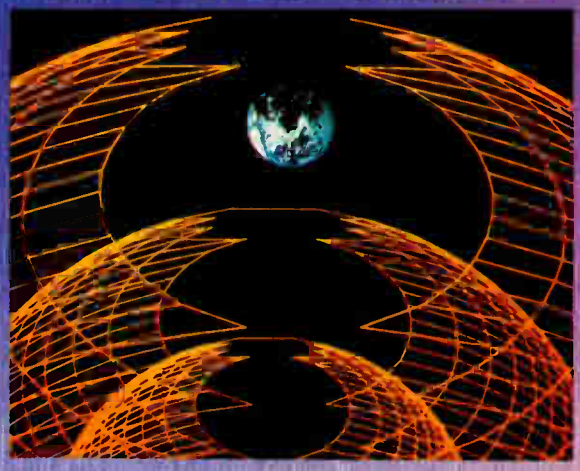
Tomorrow's AM laser's higher output power can also serve multiple optoelectronic nodes by using optical splitters. These splitters work much like RF splitters with a 3 dB to 4 dB loss per two-way device. Using a two-way splitter effectively cuts the laser transmitter cost in half.

This type of backbone system was demonstrated at the December 1989 Western Cable Show, relying on distributed feedback (DFB) lasers designed specifically for AM cable TV. As more laser manufacturers design for our industry's needs, expect this type of performance soon to become the norm. And as production volumes increase, expect costs to decline gradually over time.

There is more to a system than performance and cost. Today's AM fiber optics product serves primarily one-way applications with limited flexibility and features. Fiber optic connectors with both low insertion loss and the high reflection protection (return loss) required for AM applications are sorely lacking today. The excellent performance of fusion splicing satisfies the design engineer who never leaves the laboratory. But that's not good enough. Most of you spend your time in the field where quick connects/disconnects with optical transmitters and receivers would make things more productive. Expect suitable connectors tomorrow as components suppliers learn what it takes to make AM cable TV work best.

Tomorrow's transmitters and receivers will have modular designs allowing easy upgrades and changes. Some of the leading system suppliers already offer sockets in their trunk amplifier stations allowing for optoelectronic op-

# OFF-AIR, ON-LINE, WORLD-WIDE



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To find out more, write Mike Dowling at 1248 Clairmont Road, Suite 3D-231, Atlanta, Georgia 30030 or call **404-633-2867** and receive the 1990 Lindsay Products Catalog.

Lindsay

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tions. The leading suppliers also have features like data and/or video fiber-return-path, coax redundancy and optical status monitoring in various states of new product introduction.

Further out, expect AM fiber optics system bandwidth capacity to grow in tandem with advancing electronics beyond 600 MHz toward 1 GHz. The 1550 nm wavelength may also be adopted. Even higher transmitter output power, perhaps with a laboratory scheme known as "external modulation," could even be commercialized later in the 1990s.

### Distribution's tomorrow

Fiber optics may move beyond the bridger amplifier into distribution and perhaps all the way to the tap during the later 1990s. This will be a gradual, evolutionary process. Fiber is unlikely to extend beyond the tap in this century. Large cost penalties would result with little usable bandwidth advantage over the existing coax drop cable.

Tomorrow's fiber optic cable TV distribution system will be a "broadcast" or point-to-multipoint architecture similar to today's tree-and-branch. Some, unfamiliar with the realities of cable TV consumer demand, technology and economics, might disagree. A switched-star, broadband integrated services digital network (B-ISDN) has been proposed by some in the telephone industry for many years. B-ISDN simply does not make sense for large volume residential deployment in the 1990s.

For example, Jerrold has modeled a switched-star fiber optic architecture known as "System K." It would provide the high-quality, high-capacity needs of cable consumers in the mid-to late-1990s at less than half the projected costs of the switched B-ISDN fiber-to-the-home alternative analyzed. We constructed a lab prototype of the system, which works great. We have measured 57 dB video S/N at the TV after eight miles of fiber distribution, for example. But it is projected to cost twice today's hybrid fiber/coax tree-and-branch cable TV systems. Like all switched-star systems, it has some consumer friendliness issues, too.

You would not buy System K in volume nor would your co-workers or bosses. And we are not in business to do just trials. The switched-star mesh architecture is best for telephone and real-time interactive narrowband data services requiring the universal coverage of the telco network. It is a poor fit for cable TV delivery.

Digital modulation may be possible, but much more highly compressed than in the B-ISDN scheme (perhaps 10-to-1 instead of 2-to-1 or 3-to-1). More likely, continued advances in AM technology will yield sufficiently low costs in an evolutionary consumer-friendly fashion.

Once fiber is into distribution, telephony carriage will be easy as far as technology goes. Long distance telephone carriers spend more money per year for charges to access local subscribers than all of cable TV's current revenues. Ancillary revenue from providing long distance carriers alternative access to subscribers could become significant.

Many cost-cutting breakthroughs must occur to realize tomorrow's fiber optic cable TV distribution system. Among the technologies and components that may be involved are optical amplifiers, optical heterodyne tuners (coherent systems), external modulators, advanced laser structures and compounds, wavelength division multiplexers and optical taps. ■

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# Hot dip galvanizing

Requirements of CATV line construction hardware include quality assurance, manufacturing integrity, production experience and service life durability. Sometimes these factors are underestimated and can lead to expensive emergency repairs, unscheduled maintenance or construction rebuilds. Systems are built to provide reliable service for a maximum period of time. Hot dip galvanized hardware which is produced by reputable, experienced manufacturers provides maximum service life to your system.

But, just what is hot dip galvanized hardware and how does it provide trouble-free years of service when properly manufactured? First, let us examine the excellent corrosion protection qualities of hot dip galvanizing—focusing on its composition, method of process and protection features.

Although steel to produce hardware has many attractive properties, it will corrode if left unprotected in our environment. Corrosion will ultimately result in loss of mechanical properties. Hot dip galvanizing of steel hardware is a time proven effective method in which corrosion of the steel is controlled.

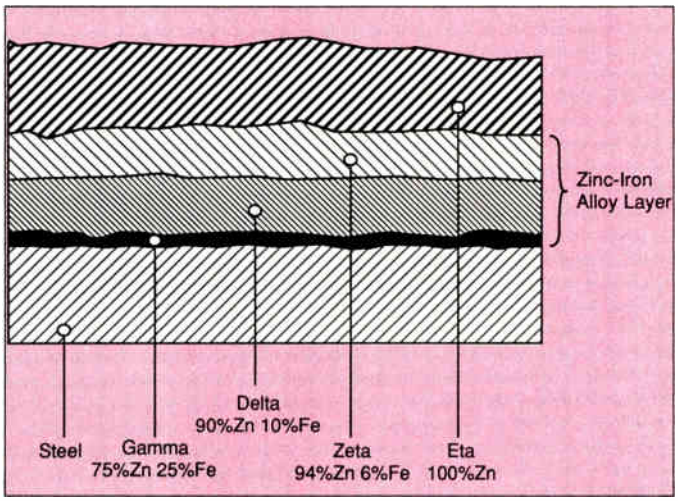
Hot dip galvanizing (HDG) is a process which metallurgically interlocks zinc to steel, forming an impervious barrier between the steel and the corrosive environment. The HDG method applies molten zinc to the steel, resulting in a series of zinc and zinc-iron alloy layers (See Figure 1). These alloy layers are unequaled in other methods of applying zinc to steel, including plating and mechanical depositing methods. Zinc and zinc-iron alloy layers of HDG develop excellent adhesion of the protective coating. Hot dip galvanizing does not flake or blister. Nor does it lose any of its zinc deposit in handling. Zinc is the most economically effective coating material for hardware, offering both barrier and sacrificial protection. HDG is the most time proven method of utilizing the protective properties of zinc.

*By Tom Niemiera, Marketing Manager, Hardware, Joslyn Mfg. Co. and Lawrence White, Product Mgr., Anixter Cable TV*

How is HDG applied to line construction hardware? The following are the six fundamental steps of the process of HDG machine bolts:

1. *Surface cleaning:* The bolts are placed in a tank containing a hot alkaline cleaner to remove all shop oil and grease used in bolt fabrication.

2. *Chemical surface preparation pickling:* The bolts are submerged into an acid bath solution for removal of scale and surface rust. Pickling provides a chemically clean metallic surface.




3. *Prefluxing:* The bolts are next immersed in a liquid flux solution to dissolve oxides that may begin to form after the pickling operation.

4. *Hot dip galvanizing:* The machine bolts are immersed into a kettle of molten zinc which is maintained at a temperature of approximately 850 degrees Fahrenheit (455 degrees Centigrade). In this procedure, the formation of zinc and zinc-iron alloy layers is accomplished to metallurgically bond the coating to the steel bolts.

5. *Finishing:* After the bolts are removed from the molten zinc, they are immediately placed in a centrifuge in which excess zinc is spun off. The now HDG bolts are cooled by quenching them in water.

6. *Inspection:* The HDG process is complete as the bolts are inspected for coating thickness, uniformity and surface conditions.

How does hot dip galvanizing protect CATV line construction hardware? In two ways. First, because of the metallurgical interlock of zinc, zinc-iron alloy and steel, an impervious coating is formed to shield the steel from corrosive elements. And second, the zinc and zinc-iron alloy layers furnish galvanic protection by sacrificing themselves ever so slowly when exposed to corrosive environment.

This sacrificial protection is a continuing effect even when moderately sized areas of bare steel may be exposed to the atmosphere because zinc is more electro-chemically active than steel. Thus, the corrosion protection of hot dip galvanizing is unique because of its dual qualities of shielding and sacrificial protection. Most protective coatings act merely as a barrier between the atmosphere and the steel. When exposure of steel occurs, shield type coatings offer no protection and rapid corrosion commences to attack the steel.

Other types of zinc coating such as plating and mechanical depositing do not develop the metallurgical layers of zinc and zinc-iron alloy as is achieved in hot dip galvanizing. The shielding and sacrificially protective qualities of zinc as measured in length of protection are a function of coating thickness, adherence and surface coverage—all excellent qualities of HDG.

Hot dip galvanizing is not the only factor involved in providing reliability and service life. Proper steel selection and manufacturing experience are equally important. CATV line construction hardware is designed for applications which may require specific ductility, tensile, compression or torsional properties. Stronger may not be better. A hardware product made from a higher tensile steel may actually be undesirable as the product application may require ductility. Additionally, improperly manufactured or heat-treated high-carbon, high-strength steels can develop a strain-age embrittlement, which over time can cause abrupt failures.

CATV line construction is, therefore, dependent to some degree on the quality, experience and integrity of the hardware manufacturer. ■

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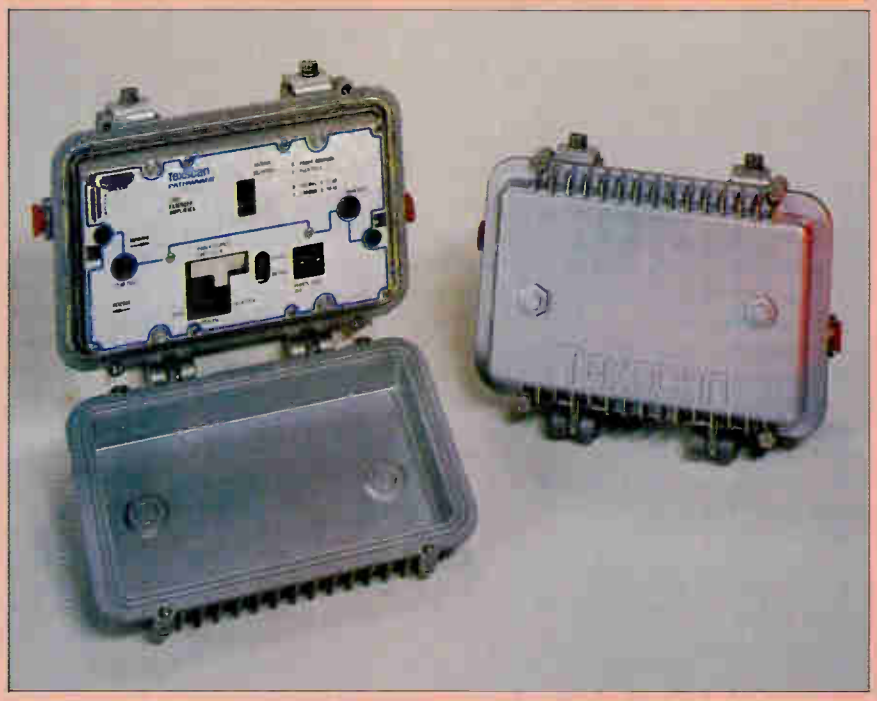

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## CONSTRUCTION CALLBOOK

*The following companies have paid a fee to have their listing appear in the Construction Callbook.*

**Bigham Cable Construction, Inc.**

**Bigham Cable . . . .(904) 932-6869**
**Construction Inc.**
P.O. Box 903
Gulf Breeze, FL 32562
PERSONNEL: Harold Bigham, President
DESCRIPTION: Bigham offers aerial construction, splicing, balancing and installs. We also specialize in rebuilds.

**CATV SERVICES**

**CATV Services Inc. . .(415) 651-4331**
**WATS (National) . . . .(800) 227-1200**
**WATS (State) . . . . .(800) 223-3152**
2211 Warm Springs Court
Fremont, CA 94539
PERSONNEL: Richard Richmond, President
DESCRIPTION: The only authorized West Coast Wavetek sales, service and repair facility. Full line distributor of CATV products: specializing in buying, rebuilding and selling equipment for the industry, upgrade/rebuilds. Active equipment carries 90 day unconditional warranty.

**ELECTRONIC METAL PRODUCTS, INC.**

**Electronic Metal . . .(303) 375-8000**
**Products, Inc.**
**FAX . . . . . .(303) 375-8015**
21000 E. 32nd Parkway
Aurora, CO 80011
PERSONNEL: Howard J. Hofferman, Vice President; Russell Udelhofen, Vice President
DESCRIPTION: Manufacturers of the MAX™ and ECONO-MAX™ line of maximum security enclosures and apartment boxes. MAX™ enclosures are used by the largest MSO's in their demanding urban area builds. Also available: pre-drilled plates, DeMark Plates with/without F-fittings, choice of recessed security locks.

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**Excalibur Cable . . .(800) 462-3811**
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**FAX . . . . . .(407) 368-4385**
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DESCRIPTION: Florida Cable Works is a full service construction and installation contractor operating throughout the southeast. We offer aerial and underground new build, rebuild and installation services from planning and mapping through final testing and activation. In addition, Florida Cable Works is capable of providing all material and equipment on a turnkey basis.

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**NaCom . . . . . .(614) 895-1313**
**WATS (National) . . . .(800) 669-8765**
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Columbus, OH 43229
PERSONNEL: Jerry Evans, VP-Const. & Engineering Div; Bob Gemignani, VP-Mktg. & Corporate Development
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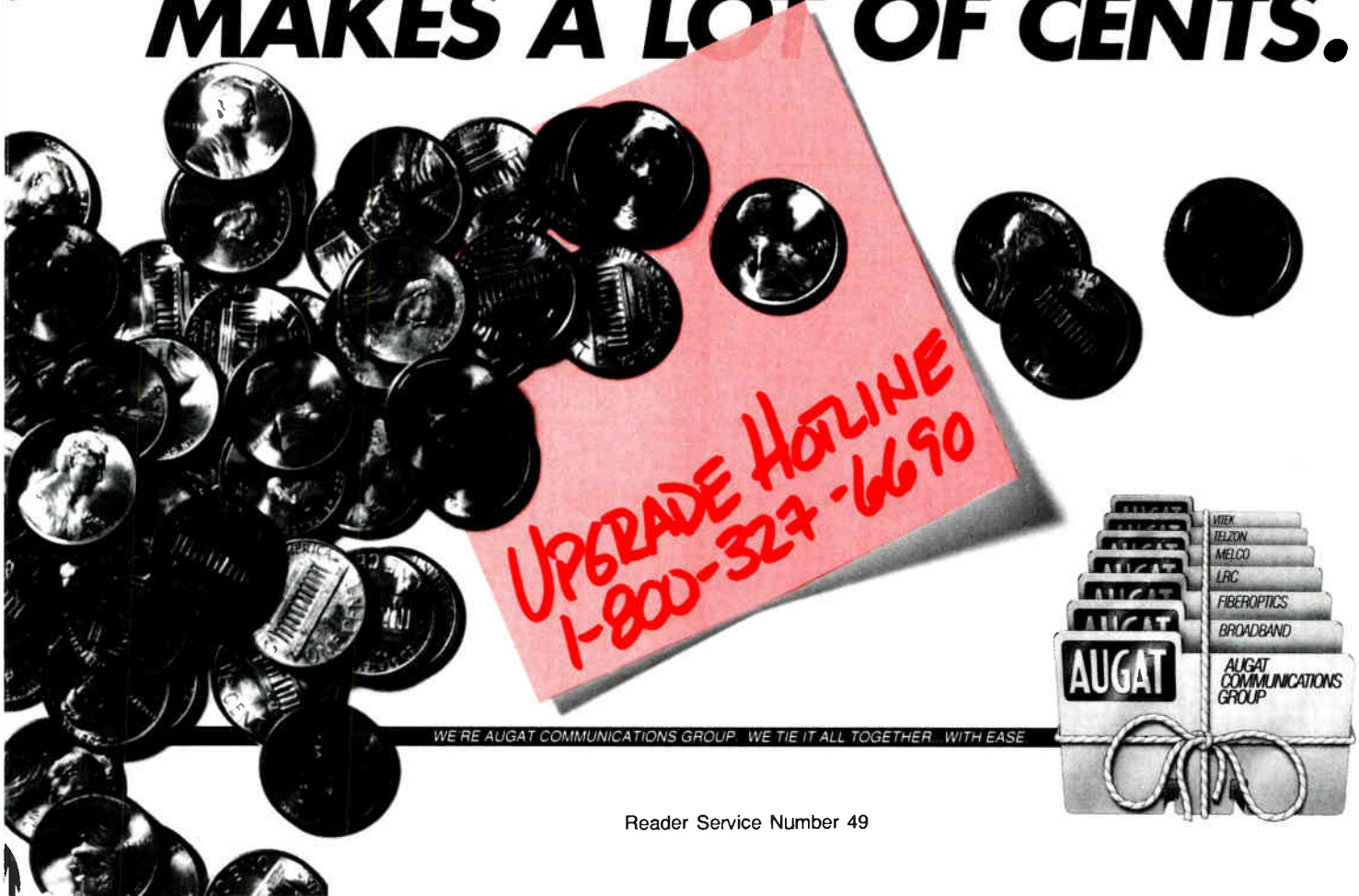


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# WHAT'S AHEAD

## SCTE

*Following is a list of SCTE technical seminars with contact name. If known, location and seminar topic are listed.*

**February 13** *Greater Chicago Chapter* (Tentative) BCT/E testing to be administered. Contact Joe Thomas, (312) 362-6110.

**February 16** *Miss-Lou Chapter* Biloxi, Miss. Contact Save Matthews, (504) 923-0256.

**February 21** *New England Chapter* "CLI: A Fresh Approach" at the Sheraton in Roxborough, Mass. Contact Bill Riley, (508) 588-6895.

**Februàry 21** *Great Plains Meeting Group* BCT/E examinations to be administered in Categories II, III, V and VII at the Crown Court Restaurant in Bellevue, Neb. Contact Jennifer Hays, (402) 333-6484.

**February 21-22** *Dakota Territories Meeting Group* "Microwave Distribution" to be held Feb. 21 at the Ramkota Inn in Pierre, S.D., and Feb. 22 at the Kirkwood Inn in Bismark, N.D. Contact A.J. VandeKamp, (605) 339-3339.

**February 28** *North Country Chapter* "BCT/E Category IV, Distribution Systems, and Category VII, Engineering Management and Professionalism" at the Sheraton Midway, St. Paul, Minn. Contact Douglas Ceballos, (612) 522-5200, ext. 705.

**March 7** *Sierra Meeting Group* "Trunk Sweeping, Standby Power and System Preventive Maintenance" with presentations by Calan, Wavetek, Alpha Technologies, Viacom and Tektronix at the Oxford Suites Hotel, Roseville, Calif. Contact Steve Allen, (916) 786-2469.

**March 8** *Big Country Meeting Group* Abilene, Texas. Contact Albert Scarborough, (915) 698-3585.

**March 13** *Central Illinois Chapter* "CLI Last Chance" at the Sheraton Normal Hotel in Normal, Ill. Contact Ralph Duff, (217) 424-8478.

**March 14** *North Country Chapter* BCT/E testing to be administered in Categories I, IV, V and VII at the Edina Community Center, Edina, Minn. Contact Douglas Ceballos, (612) 522-5200, ext. 705.

**March 21** *Greater Chicago Chapter* "Safety." Contact John Grothendick, (312) 438-4200

**March 21** *Dixie Chapter* in Montgomery, Ala. Contact Greg Harden, (205) 582-6333.

## C-COR ELECTRONICS INC

C-COR Electronics "state of the art" seminars are three-day events designed to instruct relatively new technicians in basic theory, installation and maintenance of cable TV systems. Attendance is limited to a maximum of three persons from one system. The fee is $195. Call Teresa Harshbarger, (800) 233-2267, ext. 326 to register or for additional info on any of the following 1990 seminars.

**February 13-15**
Charlottesville, Va.
**March 20-22**
Atlanta, Ga.
**April 24-26**
Albany, N.Y.
**May 22-24**
Allentown, Pa.
**June 19-21**
Indianapolis, Ind.
**September 18-20**
Dallas, Texas

## MAGNAVOX CATV SYSTEMS CO.

The Magnavox CATV Systems mobile training center is a fully-equipped laboratory on wheels for cable training. The fee is $300. Call Amy Costello Haube at (800) 448-5171 (in N.Y., (800) 522-7464) for information and reservations.

**March 6-8**
Chicago, Ill.
**March 13-15**
Lincoln, Neb.
**March 20-22**
Spokane, Wash.
**March 27-29**
Portland, Ore.

## FC²

Fiberoptic Communications Corp. offers 5-day fiberoptic splicing and termination workshops. All workshops are held at its training facility in Sturbridge, Mass. For details or registration call, (508) 347-7133.

February 26-March 2
March 19-23
April 23-27
May 21-25
June 25-29

## Scientific Atlanta

Scientific-Atlanta offers technical training for subscriber products for customers as well as advanced training for the industry. The following seminars will be held in Atlanta, Ga. Contact Patti Kitchens at (800) 722-2009 to register or for additional information.

**Febuary 13-14**
QuickScan Training

**February 15-16** System Manager III for Generic PCs

**February 21-22** 8570/90 System Manager Training

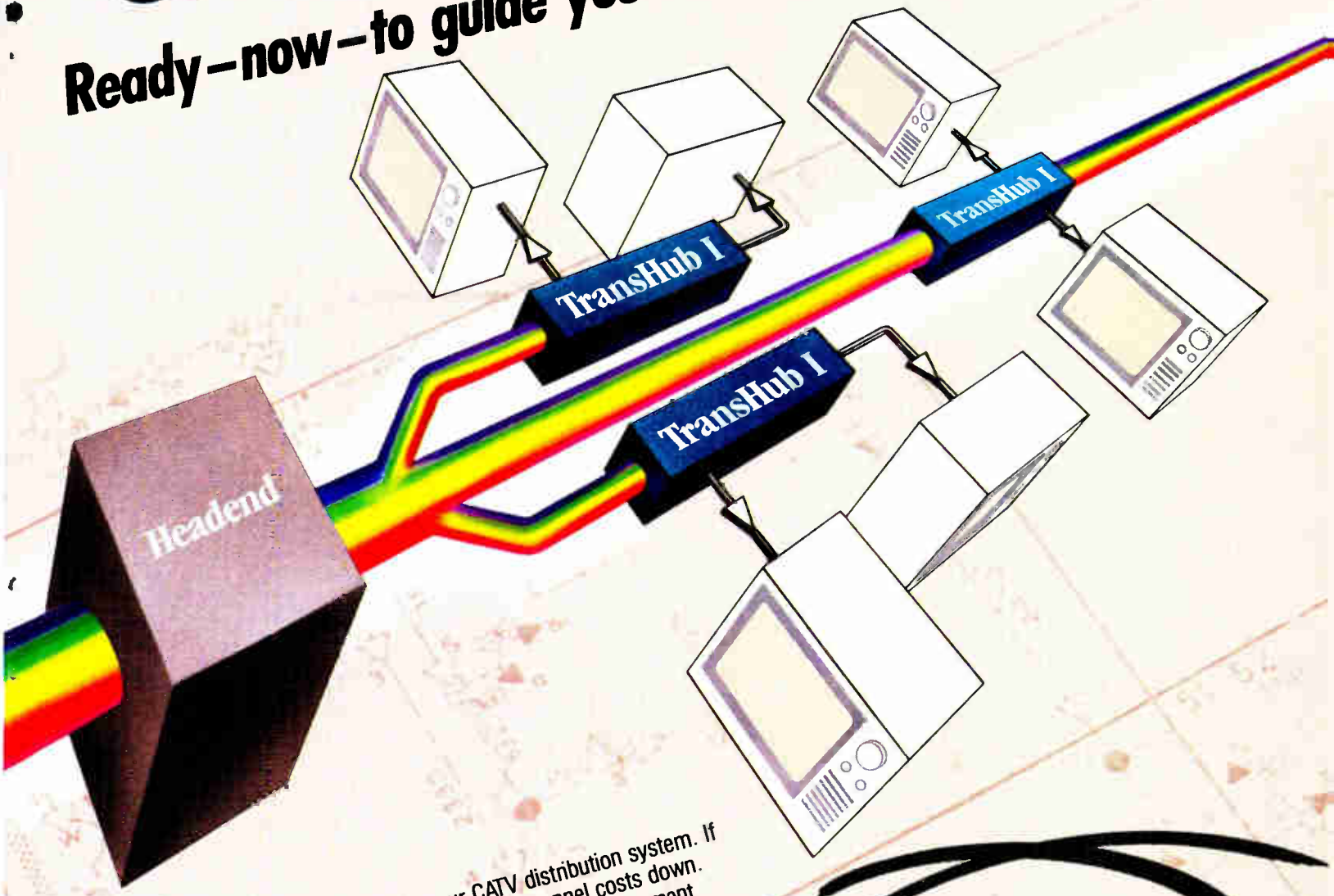
February 27-28 8580 System Manager Training

## Etcetera

**March 26-29, 1990** The *North Central Cable Television Association* annual trade show and convention will be held at the Hyatt Regency, Minneapolis, Minn. For information call Mike Martin, (612) 641-0268.

# CATEL

## Ready–now–to guide you into the fiber optics future.




It's inevitable—fiber optics in your CATV distribution system. If you're to compete in signal quality. Keep per-channel costs down. Expand smoothly. The real questions are how best to implement fiber optics and how far into the network you'll ultimately go.

Catel's family of FM and AM backbone fiber optics equipment answers the first question. And poises you for any answer to the second—by paving a clean fiber migration path. Right to that "last mile" and—when you're ready—right to the subscriber.

Our TransHub I, for example, gives you RS-250B headend quality video signals at the hub. Handles both clear and scrambled channels. Converts your FM-on-fiber to VSB-AM for use on cable or on AM fiber—taking those quality signals "deeper" into your distribution system.

TransHub I reflects two decades of CATV technology leadership. And like our entire AM and FM fiber optics product family, it's ready for delivery. Send for more information. And take a major stride toward a system superior in quality, flexibility and cost-effectiveness.

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The CABLE POLL

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# How much do you know about Cable Labs? If you're a large operator, probably a lot

About a year after it set up shop in Boulder, Colo., the industry's R&D consortium, CableLabs, has made progress on several fronts. It has assembled a large, capable staff, launched several research projects and has established a firm financial footing with a $6.5 million budget approved for the coming year.

But according to data from the Cable Poll, general knowledge of CableLabs and its activities remains quite low throughout the industry, especially at smaller systems. On the other hand, at larger systems and among the Top 25 MSOs, knowledge of CableLabs is much higher. For example, barely a quarter of those surveyed at cable systems with fewer than 10,000 subscribers said they had heard or read "a lot" or "some" about CableLabs. But at systems with more than 50,000 subscribers, more than half said they were generally aware of the consortium's activities, according to an analysis of the responses from nearly 400 system management personnel, mainly general managers, system managers and vice presidents of operations and engineering.

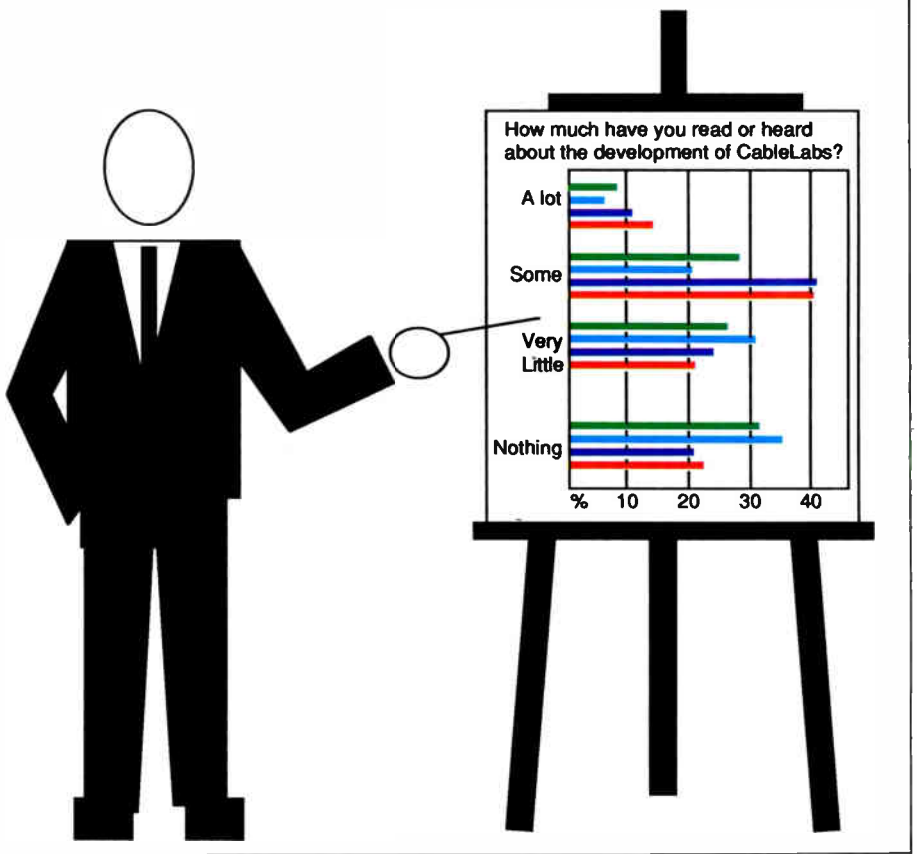
And 60 percent of all respondents said they had heard or read "very little" or "nothing" about CableLabs. That lack of general knowledge about the consortium rises at smaller systems to 69 percent but declines among larger systems to 45 percent.

The broader knowledge of CableLabs among the larger systems, which typically are owned by the larger MSOs, apparently is because it is the top MSOs which are financial backers of the consortium. Among CableLabs' early backers were Tele-Communications Inc., ATC, Comcast, Cox, Jones and other larger companies.

Dick Green, president of CableLabs, noted in commenting on the data that the results generally tracked results of internal surveys he has seen, but he pointed out that the poll was taken at a time when CableLabs was still in its "administrative stage of development" and before the consortium made several announcements late in the year.

"Last year was our first full year of operation," Green said, "and August was sort of a mid-point because we had just moved to Boulder and we had assembled a staff, but they had just moved to Colorado. In a lot of ways that was the beginning of our year.

"What we have seen is sort of the same things as in the (Cable Poll), that the knowledge of CableLabs has been gradually increasing over the last year. We have had an explosion in the last part of the year." Those events, he



noted, included announcements of two joint ventures—a test process with Jerrold's Applied Media Labs on NTSC picture quality and cooperation with Scientific-Atlanta on future headend systems development. Last month CableLabs also said it would take an equity position in Eidak Corp., developer of the Copyguard system to deter unauthorized taping of pay-per-view events. All three developments attracted significant public notice.

"So the first part of last year was administrative for us, which didn't attract a lot of attention," Green added. "But our public exposure, the contributions we have made to the industry, has increased since then."

Green said he was somewhat concerned about the apparent low level of knowledge about CableLabs among smaller operations, who he said "are very important to us. This tells me that we need to do more to reach out to them." But he said that a major program already is in development that should be of interest to smaller systems. "In our program fund for 1990, we have a program called Optimize System Operations, which is one of our major programs, and it focuses not only on the immediate need of operations at all levels, but the small systems as well. (It will focus on) what's happening with F-connectors, power supplies, the day-to-day operational concerns. As we begin to implement that program, which impacts day-to-day operations, I hope that will be addressing the needs of the smaller operators." He also noted that CableLabs hopes to enlist technical people at smaller systems to serve on the consortium's Technical Advisory Committee.

Another clear distinction between smaller and larger operators appears when they are asked what, in their opinion, CableLabs should concentrate on. The Cable Poll asked respondents if they believed that the primary focus of CableLabs should be on new technology, such as fiber optics and advanced television, or on improving existing coaxial-based technology.

Among systems with fewer than 10,000 subscribers, the edge fell to existing technology over new technology by a narrow margin, 41 percent to 35 percent. But at systems with more than 50,000 subscribers, that was reversed by a wide margin. There, system management personnel favored a focus on new technology by 55 percent to 27 percent. Generally, about 20 percent of respondents expressed no preference in all sample categories.

That pattern holds almost exactly when considering responses according to the size of MSO ownership, with companies outside the Top 100 favoring a focus on existing technology and the Top 25 MSOs favoring new technology.

"I'm not surprised by that data," Green commented. "Our own surveys show the same thing."

He emphasized that research programs planned for the next year or two "are structured to focus on both." The Optimized System Operations program mentioned above "focuses on solving the big problems in current architectures," Green said, with an eye toward overcoming limitations on standard tree-and-branch architecture.

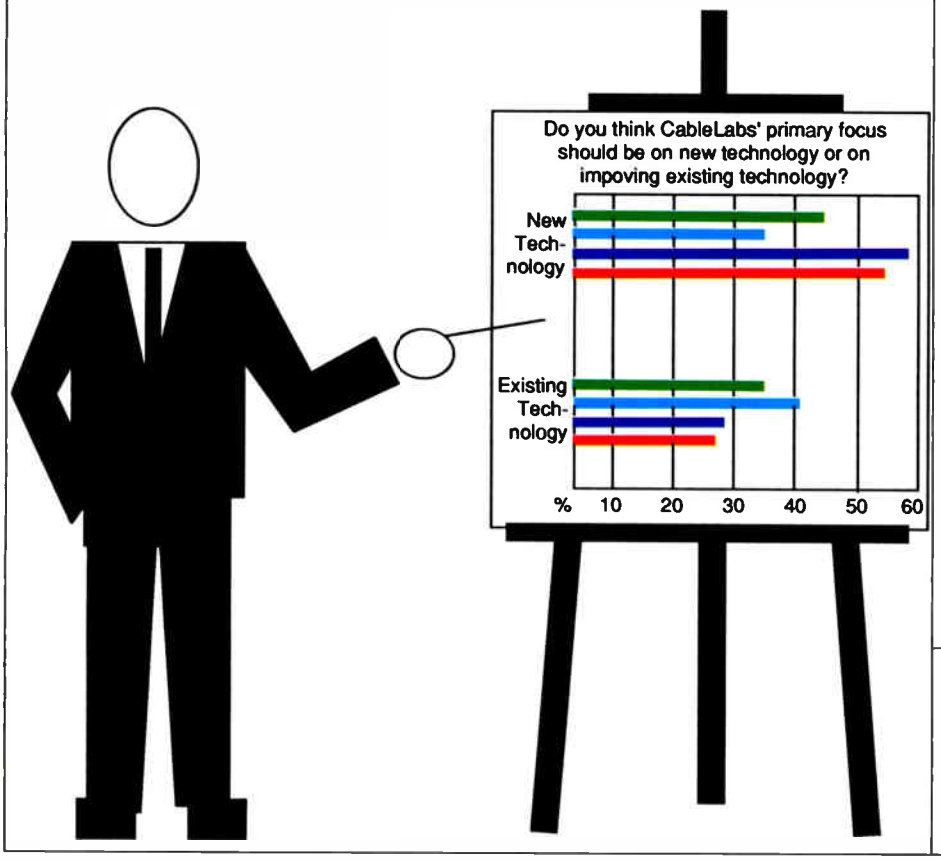
To explore new technology, CableLabs has launched another research program called Advanced Network Development, which Green termed "a longer-term look at networks of the future."

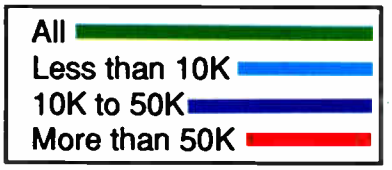
Green said these two programs—one to improve existing technology and the other to explore new technology—"are parallel" and are supported by roughly equal funding with roughly equal staffing commitments. "We found the same thing in talking to our members, that they were interested in both."

As CableLabs enters 1990, Green said the consortium is "particularly interested in how the industry sees the future, where they think things are headed, what they think long-term strategy should be" so that CableLabs can provide research to fill those needs.

As one example of an effort to further inform the industry of CableLabs' activities, Green pointed out that its house organ, *Specs*, is being sent out to a far wider readership. "Last year, typically only one person in each company received it. Now we are expanding that to get down to the system level."

And he expressed satisfaction about the support CableLabs is receiving from the industry, pointing out that the cable companies who are members of the consortium now represent 85 percent of all subscribers. ■



# New syndex switch announced

**Trilithic Inc.** has announced several new products including an Interlink Model 7RS Syndex/Headend Reconfiguration Switch. The Interlink 7RS features a modular design using plug-in cards for flexibility. Functions available include A/B switching for baseband video; composite video with 4.5 MHz audio; IF; RF to 650 MHz, 1000 MHz or 950 MHz to 1450 MHz; SPDT contact closures; satellite receiver tuning; and 12 bit A to D converter. Functions can be performed by RS232C, GPIB or manual front-panel control.

*Trilithic's SP-170D*

Also for syndex applications is a performance upgrade to Trilithic's Searcher leakage detector. The enhancements affect the receiver's post-detection circuitry and its ability to reject false signals, without loss of sensitivity. The modifications are currently being installed in all Searchers shipped from Trilithic.

A new addition to Trilithic's tunable filter product line is the VF-3 which consists of three 75 ohm cavity filters covering a frequency of 55 MHz to 440 MHz. Each individual filter tunes an octave bandwidth, has five section selectivity, and a bandwidth specifically designed for standard CATV channels. An all metal field case allows customers to transport and use up to three tunable filters at any remote location.

In a final announcement, Trilithic has introduced the SP 1700 Digital Signal Level Meter. The SP 1700 features 5 MHz to 600 MHz frequency range, keyboard or spinknob digital tuning by channel or frequency and electro-mechanical attentuators. Testing features include C/N and 60 Hz and 120 Hz active carrier hum testing. Other features include multiple channel plans, user definable front panel presets, water resistant construction and a two year warranty. For information on any Trilithic products call, (800) 344-2412 or (317) 895-3600.

**Coinview Corp.** has introduced a coin operated pay TV unit for hotel, motel and hospital applications. The Coinview HM-2000 can be used on a pay-per-view (PPV) or pay-per-day basis. It is field programmable for elapsed time, number of coins and channel or groups of channels controlled. Features include CATV compatibility using existing positive or negative traps and the ability to be used in any system regardless of wiring scheme or design. For details call, (805) 658-0721.

*The Coinview Pay TV System*

**Lindsay Specialty Products** has announced the availability of Alpha Technologies ACL Amp Clamp surge suppressor devices in Lindsay LPD-100 Power Delays and LPI-100 Power Inserters. Power Delay and Power Inserter units in the field can be retrofited with the Amp Clamp module. The Amp Clamp shunts surge current to ground when the trigger point (104 volts to 115 volts) is reached, protecting the distribution electronics from overvoltage conditions. The Amp Clamp

operates at a steady state of 35 amps and can withstand single cycle (8 ms) pulse ratings of 500 amps. For more info call, (404) 633-2867.

Available from **Microwave Filter Company, Inc.** are the hyperband traps 5KV (customer option, channel #) for its FASTRAP line of negative, positive and tiering filters for 54 MHz to 300 MHz. The 5KV is fully weatherized with type F male/female connectors for 75 ohm impedance. Channels available are AA (300 MHz to 306 MHz) to NN (378 MHz to 384 MHz) and bandwidth is up to 550 MHz. One upper adjacent and two lower adjacent channels are sacrificed using the trap. For additional info call, (800) 448-1666 or collect (315) 437-3953 New York, Hawaii and Alaska residents.

**Pico Products Inc.** has introduced the "Perfect Trap" (PT) product line using parallel capacitor circuitry (patent pending) for the CATV security industry. The PT traps are welded on both ends for moisture proofing and RF shielding effectiveness. The line includes notch filters, decoding filters and tier traps. For details call, (800) 822-7420; in New York (315) 451-7700.

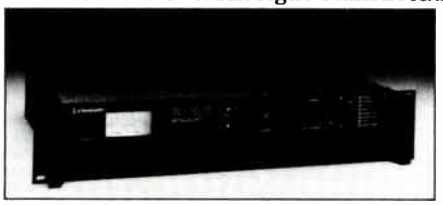
**CT Systems Inc.**, a Wavetek company, has announced the Model 1405 Sweep Generator for manufacturing and repair of CATV converters. The Model 1405 features alignment of specific channel passbands, IF response, second local oscillator frequency, trap rejection, VSWR, gain and first oscillator frequency. Up to eight programs of 99 channels can be programmed for a maximum of 240 frequencies ranging from 1 MHz to 500 MHz.

Also from CT Systems is the Model 1470 Satellite Receiver Test Set. The programmable test set is designed to simulate satellite television transmissions for testing satellite receivers. The Model 1470 operates as an IF sweep generator to troubleshoot and fault-isolate receiver operation. Other features include a precision 45 MHz to 95 MHz, 0 dBm to -79 dBm IF sweep with up to five crystal controlled frequency markers. For details on either product call, (800) 245-6355, ext. 13.

**Nemal Electronics International** has introduced a series of new precision video and audio cables for broadcast, video and RF applications. Both cables comply with the new National Electrical Code requirements, and carry the "CL2" rating. Nemal part 1570 is a precision video coax, similar in size to RG59/U, offering shielding, low loss (0.7 dB per 100 feet at 10 MHz) and is priced at $235 per 1000 feet. The part 2201A is a one pair 22 ga cable with foil shielding and drain wire featuring reduced diameter (0.135 inches) and single strip removal of both jacket and foil. The price for part 2201A is $79 per 1000 feet. For additional info call, (914) 359-3333.

### Satellite technology

A new broadcast quality satellite receiver is available from **Standard Communications**. The Agile Omni Broadcast is a television rebroadcast satellite receiver available with RS250B proof of performance broadcast package. Features include PLL RF center and audio subcarrier tuning; front panel indications of satellite format, channel number, with upper/center/lower transponder indication plus antenna polarity; audio subcarrier frequency; and six IF bandwidths. For more info call, (213) 532-5300.



*Standard's Agile Omni Broadcast System*

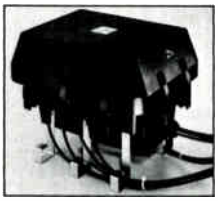
**Comtech Antennas Systems Inc.** has introduced a 2.4 meter VSAT (very small aperture terminal) satellite antenna system. The antenna uses a three-piece composite reflector that is manufactured in one-piece and then cut for ease of shipping and installation. The 2.4 meter employs an offset feed system with transmit/receive and receive only feeds available. An optional interface HPA bracket for compatibility with other manufacturers products is also available. For details call, (407) 892-6111.

A new ku-band low noise block downconverter (LNB) is available from **R.L. Drake Company**. The Model 2864 is a broadcast-quality LNB designed for commercial downlink applications such as CATV, SMATV, broadcast, hotel or teleconferencing. The compact LNB has a frequency range of 11.7 GHz to 12.2 GHz and converts ku-band signals to the intermediate frequency range of 950 MHz to 1450 MHz. The Model 2864 measures 4 inches high by 2¼ inches wide by 1½ inches deep. For more info call, (513) 866-2421.

**Engineering Consulting** has announced several Syndex applicable prod-

ucts. The first is a special program using the Commodore 64 and 64C/128 computers to provide video page generators. The video screens provide multiple or single channel insertion. The video page generator program is provided on autoboot EPROM cartridge (model VIDG) which plugs directly into the C64C cartridge port of the computer. Also available are 75 ohm coaxial relays, model RL4 (4 per board) which provide >65 dB RF isolation between D.C. and 600 MHz. At 100 MHz and below, the isolation is >80 dB. A final product is the Model DVM digital voice recorder for providing an audio message for pre-empted channels. Messages of 32 or 64 seconds will be automatically repeated. For info on any products call, (714) 671-2009.

**Reliable Electric** has announced the Universal Enclosure for fiber optics (UEFO) designed to house and protect fiber optic splices and terminations within various environments including underground, inside pedestals, and aerial applications. The UEFO can be used for fiber service drop points, fiber splicing (144 fibers max.), cable restoration and cross-connecting (24-ports). Units are available for most connector styles including ST, BICONIC, SMA, D4 and FC. Call (312) 455-8010 for details.



*Reliable's Universal Enclosure*

Available from **Gould Inc.** is a fused wavelength division multiplexer (WDM) designed for use with fiber amplifiers. In this application, the WDM multiplexes the 1480 nm pump laser wavelength used to stimulate fiber lasing with the 1550 nm signal to be amplified in a section of rare earth doped fiber. For additional info call, (301) 787-8311.

**Optics for Research** has introduced fiber optic pigtailed collimators and related products. These feature both single-mode and multi-mode pigtailed collimators, as well as large core diameter silica fiber collimators for high power applications. OFR also has a 4-page, full-color brochure entitled "Fiber Optics and Laser Diode Products" available on request. For info call, (201) 228-4480.

**Zenith Electronics Corp.** has introduced a new commercial-quality front-projection monitor which uses a "Delta-Brite" projection lens system with peak light output of 600 lumens and enhanced phosphors. Features of the Model PRO840X include: variable size picture images from 5- to 10-foot diagonal; convergence circuitry for accurate color registration; multi-brand remote control that can be programmed to operate most popular brands of TVs, VCRs and cable converters; digital chassis and digital comb filter; auxiliary jack panels for audio/video component connection; S-VHS capability; automatic picture brightness control; and world system teletext capability. For additional info call, (708) 391-8181.

### People on the move

**Continental Cablevision** of Ohio's Miami Valley District has announced

*Randy Midkif*

the certification of District Field Engineer **Randy Midkiff** to the Engineer-

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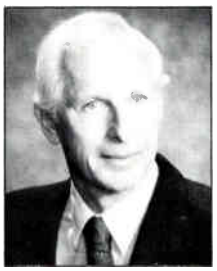
ing level of the Broadband Communication Technician/Engineer (BCT/E) organized through the Society of Cable Television Engineers (SCTE). Less than 30 people, of the 1,500 enrolled, have passed all seven parts in both testing programs to become BCT/E certified at the engineering level, according to SCTE spokesmen.

Midkiff began testing at the technician level in early 1988 and completed the engineering level testing in September, 1989. Midkiff is currently the only employee of Continental Cablevision of Ohio certified at the engineering level.

**Laser Precision Corp.** has announced three new members to its management team. **Robert Johnson** has been named vice president of fiber optic engineering; **Hal Halpern** as vice president of sales and marketing; and **James Nerschook** as sales administration and technical support manager. Johnson is responsible for overseeing all internal technical operations and the development of strategic technical relationships with other participants in the industry. Halpern is responsible for business and strategic planning; key account management; sales plan development; forecasting; and profit analysis. Nerschook will be responsible for all administrative activities in sales support as well as managing the applications engineering group.

**Pioneer Communications of America Inc.** has appointed **Mark Hutchison** as software engineer in the Cable Television Engineering Department in Columbus, Ohio. Hutchison was formerly a software engineer for Fuller Weighing Systems and a programmer analyst for John E. Foster and Associates.



*Glenn F. Higgins*

**Glenn F. Higgins** has been named President of **Comtech Antenna Systems Inc.** Higgins assumes overall management control of the St. Cloud, Florida Antenna Corp. Formerly Vice President and General Manager, Higgins was one of the founders of the antenna company in 1964.

**Midwest** CATV, a division of Midwest Corp., has announced the appointments of two sales representatives in the Los Angeles area. **Mary Rose Shearer**, formerly with Hudson Supply, will have primary responsibility for local area networks in southern California. **Glen Schrader**, also formerly of Hudson Supply, began his CATV career with Western CATV where he was involved with sales and distribution, along with a major role in purchasing.

### Bits of News

**SecaGraphics International Inc.** has announced an initial contract totalling over U.S. $1.3 million that has been signed with Hong Kong Cable Communications Limited (HKCC). The contract includes installation of a six workstation Magic™ System—a computer aided design and drafting (CADD) system for automated drafting of geographic information, cable TV network design and analysis, inventory control, project and facilities management. Entry of over 700 Hong Kong maps into the Magic System database has already begun in Denver. SecaGraphics will also provide consulting and extensive cable TV training classes for approximately 15 HKCC personnel. For more details call, (303) 279-SECA. ■

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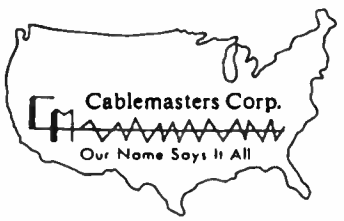


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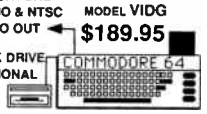


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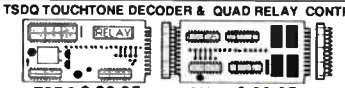


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# Threats from NTSC's deficiencies

I'd like to devote this and next month's columns to a look at one of the fundamental constraints on video quality in cable systems, the NTSC technical standard. I want to explore how competition can arise from entities not subject to some of cable's limitations. Understanding this may help us plan competitive strategies for the future.

### The fission of the NTSC standard

The current televison standard we use in the United States is called NTSC after the National Television Systems Committee which created it in 1941. This black-and-white television standard was modified in 1953 to provide color information to color television receivers and again in 1984 to add stereo sound. These two compatible upgrades are truly marvels of the engineering art of compromise. Additional information for color and for stereo sound was squeezed into a crowded signal in a manner that has served us well for decades.

In some respects, we are finding the limits imposed by these compromises. From the subscribers' perspective, this standard has been a single unit with all of its component parts tightly locked inside for most of its history. Only recently has the consumer gained access to the inner workings of NTSC. It's been like the fission of the atom, unattainable for most of its history. But once split open, access to the inner workings of the NTSC standard has become a part of everyday life for many of our subscribers.

NTSC has been split into two parts, a baseband part and a modulated or radio frequency (RF) part. The consumer has access to baseband video from the video outputs of VCRs and video disk machines.

### NTSC deficiencies

For most of its history, the NTSC television standard has been able to deliver more video quality than the TV receiver could display. About five or so years ago, the situation changed dramatically. Consumer electronics products had evolved to the point where they could provide more video quality than the NTSC standard could deliver. As these products continue to evolve, the disparity will increase. We need to look at the NTSC deficiencies in two parts, the baseband component and the transmission element.

As a baseband signal, NTSC has limited luminance bandwidth and even more limited chroma (color information channel) bandwidth. Large areas of the picture flicker. Line structure is visible on big screens. And, most importantly, the luminance and the chroma channels leak into one another. This latter deficiency causes the luminance channel to have crawling dots on image edges and the chroma channel to have spurious rainbows on picture details.

Both terrestrial broadcast and cable television modulate the baseband signal onto carriers for transmission over an appropriate medium to the subscriber. This modulation and transmission add new problems that are even more severe. The worst damage is done by the modulation and demodulation process. In order to save valuable spectrum space, the creators of the NTSC standard cut off part of one of the two sidebands resulting from amplitude modulation. They would have preferred to have eliminated one entire sideband, since the information in the second sideband is fully redundant.

However, vacuum tube circuitry could not cost effectively deal with single sideband transmission. It was recognized that business growth demanded affordable receivers. Practical filters in the TV receiver dictated how much of the second sideband could be removed. The result is called vestigial sideband amplitude modulation (VSB/AM). This signal is complex in the mathematical sense in that it has an in-phase and a quadrature component. This signal can be analyzed as if it were two signals modulated on separate carriers. The carriers are phase shifted by 90 degrees. They are said to be in quadrature with each other. This causes severe problems when the signal passes through non-linearities. The two components cross modulate each other and the mess is almost impossible to untangle.

### Transmission path problems

Another problem with NTSC is its rather unsophisticated amplitude modulated signal processing. Today, we know a lot more about how to treat signals to reduce their susceptibility to noise. Unfortunately, the creators of NTSC didn't have this knowledge at their disposal. Also, circuit technology couldn't affordably implement these techniques. We are stuck with a rather vulnerable modulation approach. It places an upper limit on just how noise-free a cable signal can be.

The transmission path introduces random noise, impulse noise, cross modulation of signals and carriers yielding multiple pictures per channel and disturbing bars and herringbone patterns, and reflections.

Non-linearities cause the mixing of desired and undesired signal components. The principal source of these non-linearities are the amplifiers of cable systems. First on the hit list are the amplifiers in the distribution part of the cable plant. Since they are operated at relatively high levels, the signals reach into the slightly non-linear areas of the amplifier's operating characteristic. Second on the hit list are the long cascades of amplifiers in the feeder part of the plant. Even though the signal levels are relatively low, the very slight non-linearities accumulate. The set-top converter is yet another source of slight non-linearity and noise. Finally, the TV receiver and VCR themselves contribute to the problems. A major additional culprit is the in-home amplifier installed by the subscriber to support multiple signal splits.

Next month we'll look at reflection problems with NTSC as well as some of the techniques for dealing with NTSC's deficiencies. We'll concentrate on how these deficiencies create a potential technical advantage for competitive video media. ■

*By Walter Ciciora, Vice President of Technology, American Television and Communications*

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