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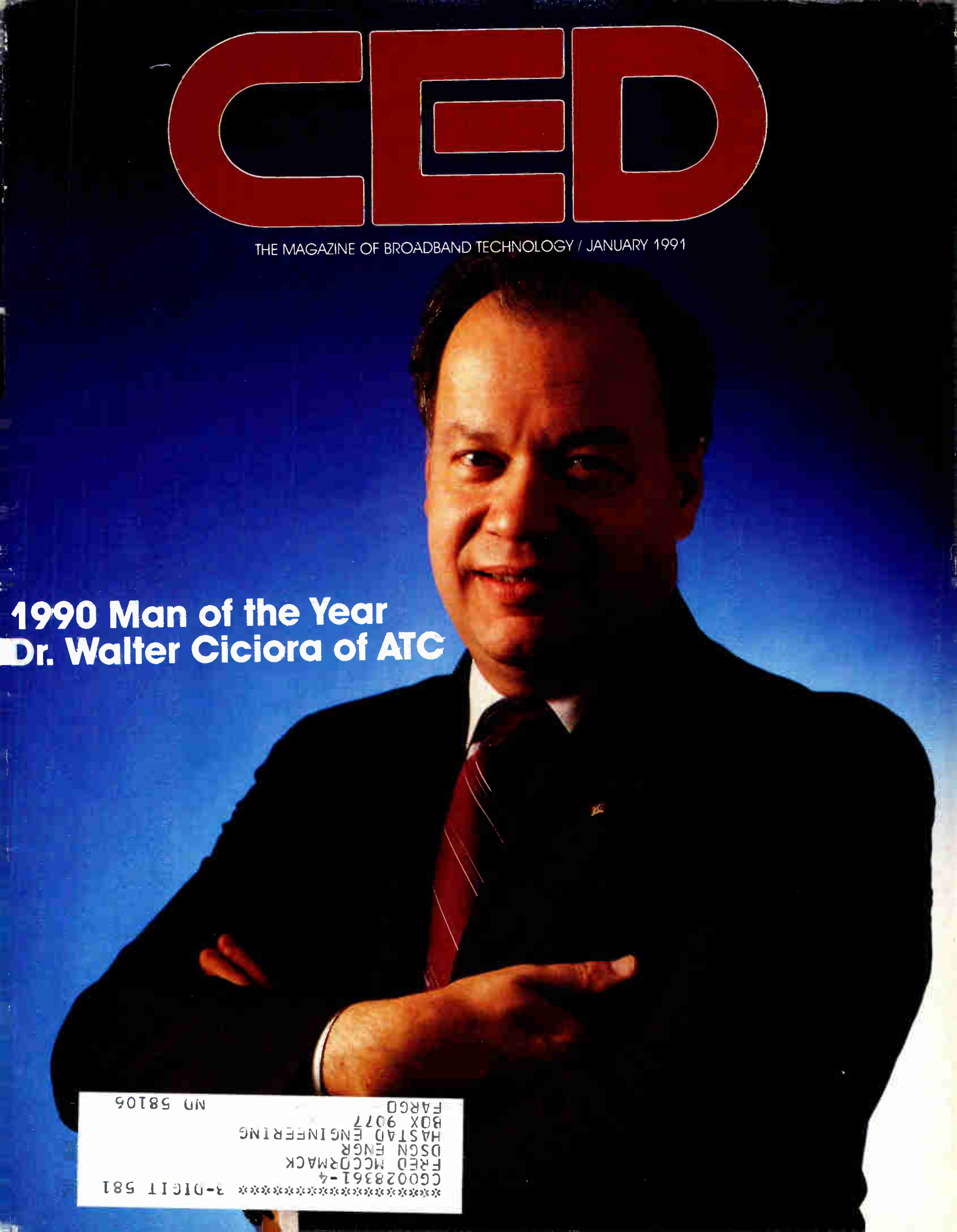

1990 Man of the Year
Dr. Walter Ciciora of ATC

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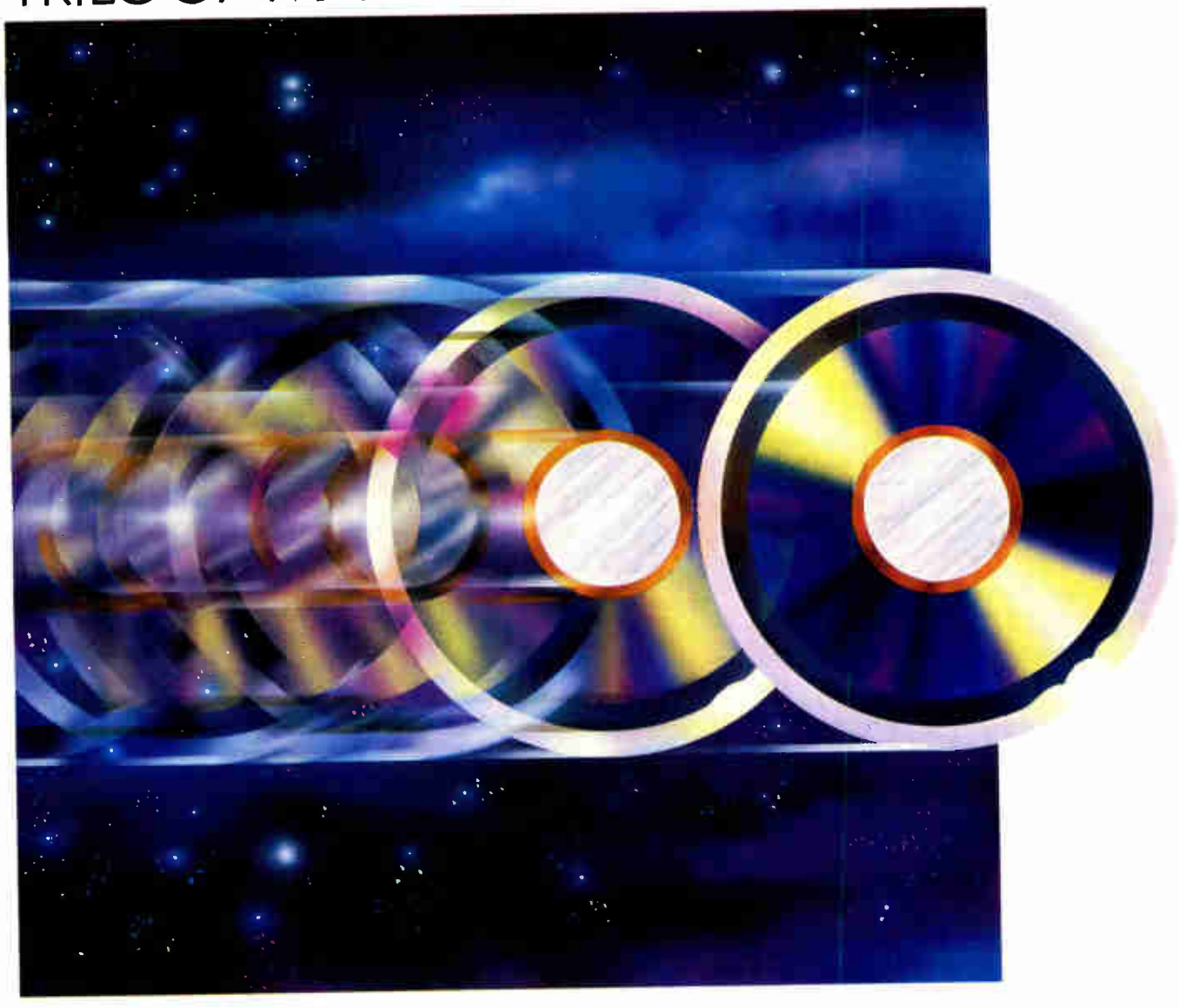
Reader Service Number 1

TRILOGY MAKES THE RIGHT MOVES



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January 1991

CED

Volume 17, Number 1

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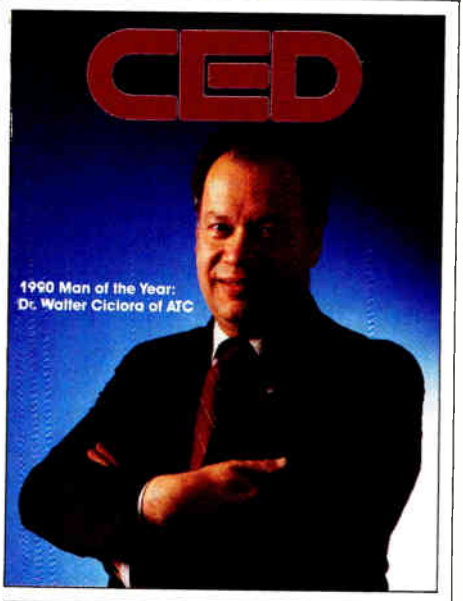

About the Cover:
ATC's Dr. Walt Ciciora is heralded as the 1990 Man of the Year. Photo by Don Riley.

DEPARTMENTS

Headend Performance to Drive AM Fiber

Increased subscriber expectations and advanced television formats are creating new standards in RF performance. Conventional headend technology is becoming a weak link in advanced fiber distribution systems. That's why Nexus' engineers created the Series 2000 — to dramatically improve headend signal quality, reliability, maintainability and flexibility, to 1 GHz and beyond. See how you can maximize the potential of AM optical distribution — test drive the Nexus Series 2000 Headend System.

- +67 dB weighted SNR at 150 channels
- complete input signal format flexibility (including combined video and 4.5 MHz BTSC subcarrier)
- remote status monitoring
- computer controlled agile standby modulators
- fully redundant powering to each unit
- upgradable to all advanced television standards
- covered by the famous Nexus 5 year warranty

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ENGINEERING CORP.

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Fax: (604) 420-5941

Bellevue, WA
Tel: (206) 644-2371

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Walt Ciciora and the FCC?

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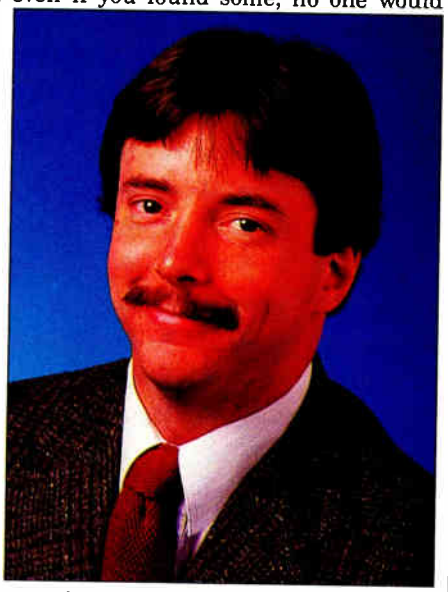

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Reader Service Number 3

CONTEST RULES: No purchase is necessary. Entries accepted from authorized personnel faxing their name, title and phone number, and the phrase "Please enter us in the Midwest CATV Steamboat Springs Contest" on company letterhead to 1 303 643-4797. Contest entry is limited to cable television systems companies only. The prize will be awarded in the company name; the winning company will determine the individual to be given the prize. Midwest CATV, its suppliers, parent companies, subsidiaries and ad agency are not eligible. This contest is void where prohibited by law. Only one entry per company is permitted. The odds of winning will be determined by the number of entries received. No contest entries will be accepted if received by Midwest CATV after January 31, 1991. Total value of the prize is $1,169. No cash or prize substitutions. For more information contact Midwest CATV at 1800 MID-CATV or write: Midwest CATV Sweepstakes, Fairways II at Inverness, 94 Inverness Terrace East, Suite 310, Englewood, CO 80112.

Ski free!
Midwest CATV wants to have you heading to the high country.

How? It's simple. Starting this month, we're introducing the Midwest CATV Customer Incentive Contest. It's our way of bringing more to our customers throughout the United States.

Here's how it works. You can enter the contest in two ways. First, you can place an order for Jerrold Cableoptics during the month of January and automatically be entered in the contest. Second, you can send us on company letterhead, via fax machine, the name, title and telephone number, of the company's authorized representative, and the phrase "Please enter us in the Midwest CATV Steamboat Springs Contest," and your company will be entered in the drawing. It's that easy!

Only one prize will be awarded. The winning company will receive a free ski vacation to Steamboat Springs, CO. The trip includes roundtrip airfare for two, three nights lodging at The Inn, ground transportation and lift tickets for 2 days unlimited skiing.

The winning company will be selected by February 15, 1991 and the name of the winner may be obtained by writing Midwest CATV after February 20, 1991.

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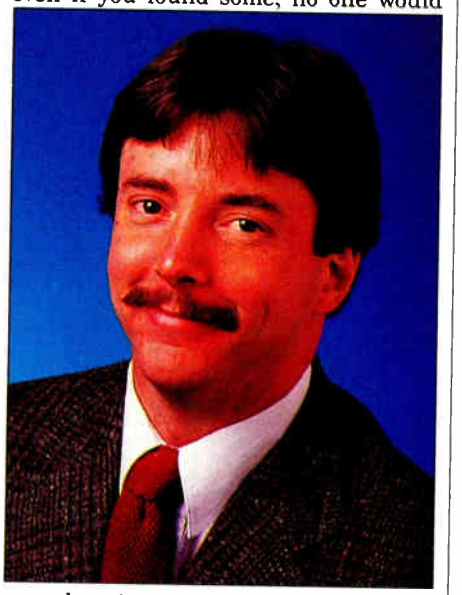

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Wavetek offers the clearest choices in signal level meters.

From the smallest to the largest CATV system, Wavetek has a complete family of field strength meters.

Beginning with MICRO SAM, Wavetek provides an easy to use installer meter with the versatility of auto-ranging and programmable channel plans. SAM JR is a proven field strength meter combining full amplitude and frequency range.

For more advanced trouble shooting, SAM 1000 ventures one step further with quick keyboard tuning and improved measurement accuracy. Complete system maintenance becomes a snap with the SAM 2000, Wavetek's trunk and headend meter. The SAM 2000 incorporates automated test functions that simplify system measurements.

The premier FIBER SAM rounds out the complete SAM line with all the simplicity of the SAM 2000 and incorporates an optical power meter.

For all their sophistication and effectiveness, Wavetek's SAM signal level meters are remarkably easy to use, so your technicians can spend more time testing.

Digital technology provides precise tuning at the push of a button, accurate amplitude measurement throughout the frequency range, and long service life through the use of electronic attenuators rather than conventional mechanical types.

Also, Wavetek signal analysis meters (SAM'S) are built tough—to take bouncing around in a truck or swinging from a pole—in any weather!

Give your subscribers the best cable performance by using the best signal analysis meters. To see how Wavetek offers more in "SAM" technology, contact your nearest representative or distributor for a demonstration.

Reader Service Number 5

WAVETEK®

Advanced TV testing slated for April

Barring any further delays, testing of advanced television systems by the FCC Advisory Committee on Advanced Television Service is slated to finally begin in about 90 days. With the news that a format converter, being constructed by Tektronix, was successfully demonstrated, it appears that the test bed at the Advanced Television Test Center for both broadcast and cable delivery is ready to go and a new testing schedule has been adopted (see schedule).

The format converter permits several different, incompatible forms of TV signals to be recorded in real time on videotape for later viewing and comparison by government officials and industry decisionmakers. The device converts the 1050/59.94, 2:1 and 787-5/59.94, 1:1 and 525/59.94, 1:1 formats into the 1126/60, 2:1 format which the Sony HDD-1000 recorder can use.

Although the number of proponents has steadily dwindled since interest in advanced TV reached a high-water mark about two years ago, the issue of what North American standard will emerge is still far from clear. Faroudja pulled his SuperNTSC system out of the process, choosing to go straight to the marketplace, and General Instrument upped the ante by proposing an all-digital delivery system. And now, both Zenith and the ATRC consortium say they'll likely test digital systems as well (see related story).

According to a letter sent to each proponent from Richard Wiley, chairman of the committee, any proponent that "intends to present a system for testing that is substantially different from that which has been precertified must apply for re-precertification" with a new system description due by December 31, 1990 and detailed system materials by February 28, 1991. Wiley added that he plans to have a meeting sometime early in 1991 to discuss test procedures and field tests.

The goal of the committee is to complete all testing by the middle of 1992 so a standard can be adopted by the FCC by the end of 1993. Many experts, however, say it will be a long time after that before all the expected litigation will be settled and true high-definition television will become a reality.

FCC Advisory Committee on Advanced Television Service
TEST SEQUENCE & CALENDAR

ATV SYSTEM ACCESS PERIOD	Move In 10 working days before: INTERFACE CHECK	LABORATORY TEST PERIOD START TESTING	LABORATORY TEST PERIOD END TESTING	Move Out 5 working days after:	ATV SYSTEM/ PROPONENT	SCANNING FORMAT
	1991					
1	April 8	April 12	June 12		ACTV: Advanced Compatible Television David Sarnoff Research Center	525/59.94, 1:1
2	June 13	June 19	Aug 12		Narrow MUSE NHK/Japan Broadcasting Corporation	1125/60, 2:1
3	Aug 27	Sept 3	Oct 24		DigiCipher General Instrument Corporation	1050/59.94, 2:1
4	Oct 25	Oct 31	Dec 27		SC-HDTV: Spectrum Compatible HDTV Zenith Electronics Corporation	787.5/59.94, 1:1
	1992					
5	Dec 30	Jan 8	March 3		Analog Simulcast HDTV N.A. Philips Consumer Electronics Co.	1050/59.94, 2:1
6	March 4	March 10	April 30		Channel Compatible HDTV Massachusetts Institute of Technology	787.5/59.94, 1:1

Notes:
- MOVE IN: Proponent permitted to begin moving certified ATV system's equipment into ATTC facility and setting up 10 working days prior to beginning INTERFACE CHECK; ATTC'S electric power and HVAC systems will be in operation.
- INTERFACE CHECK: From this date, ATTC prepared to supply video, audio, and other specified signals to ATV system as previously agreed; each system permitted up to four working days prior to test start for proponent and ATTC/CableLabs to verify signal interface parameters.
- MOVE OUT: Proponent permitted up to five working days after end of testing to remove all of its equipment and belongings from ATTC facility.

ATRC group to go digital

The Advanced Television Research Consortium has decided to concentrate on an all-digital simulcast approach. According to a press release, the consortium believes it can offer a "Practical digital solution for HDTV that preserves existing NTSC channel allocations" yet ensures that high-definition television images will be available through terrestrial transmission means.

The ATRC consortium consists of NBC, the David Sarnoff Research Center, Philips Consumer Electronics Co. and Thomson Consumer Electronics Inc.

ATRC is basing its efforts on two recent developments: An "NTSC-friendly" digital modulation technique and an efficient digital data compression approach for encoding HDTV. The modulation scheme uses low power levels to avoid interfering with existing NTSC stations while the compression method allows the bandwidth-hungry HDTV images to be squeezed into the existing 6-MHz channel frequencies.

Zenith to get $1 million for R&D

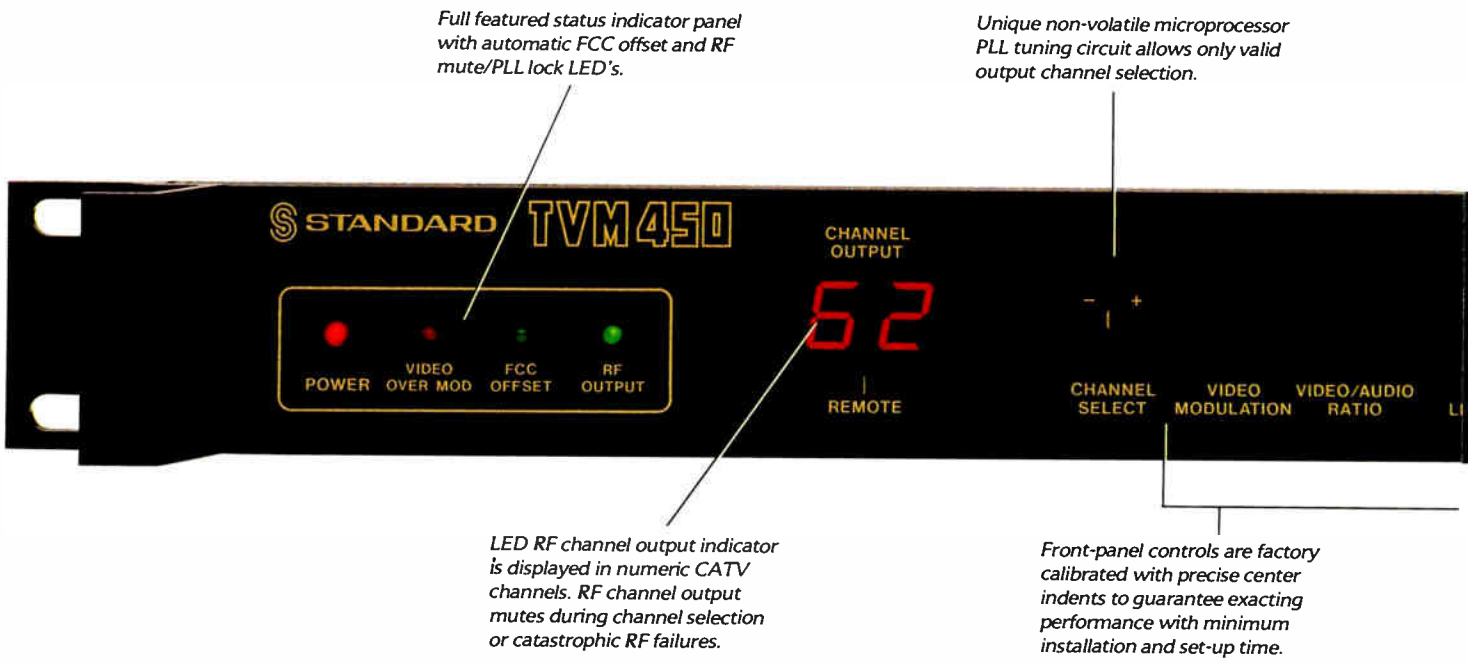
The state of Illinois has awarded Zenith Electronics Corp. a $1 million grant to develop new manufacturing processes for high-definition color displays. The color picture tubes will be used initially for computer monitors and eventually for HDTV receivers as well as conventional television sets.

Specifically, the money will be used to help fund the two-year development of a new process for applying phosphors to picture tube screens.

According to Zenith officials, the project represents a major part of the company's effort to develop new production processes for large-screen versions of its patented "flat tension mask" picture tubes.

The funding is aimed at helping keep Illinois near the forefront of picture tube development. Recently, Zenith competitors have built six new large-screen picture tube plants in other states.

The TVM450...



No noise. No filters. No problems. No kidding.

Forget everything you've ever known about frequency agile modulators. You see, the TVM450 from Standard Communications is not a modulator. It's a revolution.

The TVM450 is the first 450 MHz frequency-agile modulator to challenge the RF performance of fixed channel modulators. The technically advanced PLL synthesized tuning process takes full advantage of Standard's High-Level Mixing (HLM). With six levels of filtering, and extremely stable RF circuitry, we can offer the industry out-of-band noise floor and spurious free performance previously available only with fixed frequency modulators.

The result?

Listen carefully. The final RF output signal meets all recommended NTC7 noise and spurious specifications for a 450 MHz CATV distribution system, and external bandpass filters are not required.

If you're thinking of rebuilding or upgrading your headend, this is one revolution you'll want to join.

On air. Off air. No error anywhere.

Inside the TVM450 is a non-volatile microprocessor tuning circuit which allows the utilization of a standard set-top converter channel format, while the optional PROM permits the installation of a custom set-top converter channel format. The TVM450 is frequency agile through Low VHF (2-6, Mid VHF (A-1), High VHF (7-13, Superband (J-W) and Hyperband (AA-ZZ). The front panel LED display indicates your real-life channel number, eliminating the need for look-up charts.

When the optional OAP450 off-air processor is added, the TVM450 becomes a internally phased-locked frequency agile off-air processor meeting all FCC offset and stability requirements.

It's a revolution.

Expansion slot allows options such as:
CSG60 integrated BTSC stereo generator module
OAP450 Off-Air I.F. processor module
CMA60 Monoral audio module
Internal space is provided for optional CRC450 RS232C remote control module

RF output purity, stability and video quality can be monitored with front panel video and RF output test ports.

FCC offsets are automatically selected via an internal microprocessor or custom programmed PROM. A rear panel switch is also provided for manual selection of required FCC offsets.

Left. Right. Mono. In Stereo.

The TVM450 Mono audio processing module features a 7-segment calibrated audio deviation meter, pre-calibrated front panel audio deviation control and an external BTSC input indicator.

With the unique integration of the GSG60 BTSC stereo encoder the TVM450 is the first agile modulator that puts stereo in its place.

Inside the Modulator!

This proven stereo unit will save you countless hours of tedious integration and set-up. The front-panel level controls are factory calibrated with precise center indents to guarantee exacting performance with minimum installation and set-up time.

For one unit, an entire headend or a complete network Standard's addressable Remote Alignment Control (RAC) option gives you multi-station access and status monitoring capability.

All of these powerful features are masterfully incorporated into one impressive piece of cabinetry. The front panel offers clear, precise control of all functions and direct reading of channel output.

When it's time to automate your headend, when it's time to rebuild or upgrade your headend there is no other choice.

The TVM450 is downright revolutionary.

Raise your standards.

Standard Communications

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ONI offers fiber awareness kit

Optical Networks International, the sister company of Anixter Cable TV which concentrates on fiber technology, has created a "Handbook on Community Awareness" to help cable operators who have installed fiber optic systems educate the public about what lightwave technology can do.

Designed as a "cookbook and catalog" of ideas for marketing and public relations personnel, the handbook covers four areas: promotional materials like bill stuffers, 30-second spot ads, print ads, etc.; operational issues like launch plans and CSR question-and-answer sheets; public relations; and tips on involving local leaders and lawmakers.

The promotional material is aimed to counter the information given to subscribers, the local consumer press and legislators by telephone companies that claim only they can provide state-of-the-art telecommunication networks, says Shellie Rosser, Anixter vice president of corporate marketing. "This (handbook) is seen as a way to have fiber better understood by grassroots legislators and officials who are being barraged by the phone companies" with misinformation, she says.

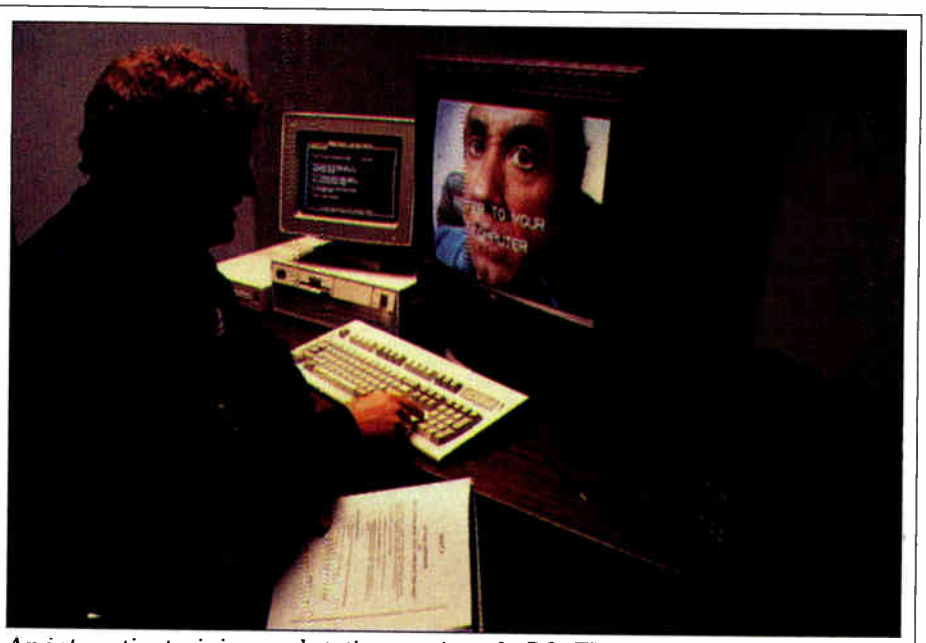
The handbook will be distributed free of charge to all ONI customers, Rosser says.

Interactive tech training debuts

As the cable industry evolves from its construction-oriented focus to a marketing and customer service intensive business, its workforce, which will likewise undergo changes, will have to be efficiently and adequately trained to ensure that customers are pleased with the service they receive and employees follow safety guidelines.

The Mind Extension Institute, a subsidiary of the Jones Education Network, has produced two laserdisc-based interactive video training courses, one aimed at training installers and the other geared toward on-the-job safety.

"An investment in training will result in great returns to the industry," predicts Gregory Liptak, president of Jones International. Some return will come in the form of prevented accidents, which, in 1988 alone, cost U.S. industries $40 billion, according to Jones officials.



An interactive training workstation consists of a PC, TV or monitor, laser videodisc player and course materials.

Further returns will come from reduced service calls and workman's compensation claims, which cost the cable industry $1 million per day and $200,000 per day, respectively.

Bob Luff, Jones' vice president of engineering and technology, says strong preliminary data shows that proper training will have "significant" impact on those costs.

For example, in the first year Jones' Qualified Installer Program was in effect, service calls were reduced 20 percent as a result of performing installs properly the first time. Luff says interactive video training could improve those results.

The two new discs, titled "Installer Training" and "General Safety" are a step toward providing industrywide installation and safety standards. Nearly 40 cable operating companies participated in the development of the courses and a dozen hardware suppliers contributed over $600,000 to fund production of the videos, which used SCTE recommended practices and NEC and OSHA regulations as the basis of the training courses.

The high-quality, easy-to-understand courses make it easy for employees to learn at their own pace. Groups can also learn new skills or brush up on training with the new courses. General information is given and students are motivated to learn by interacting with the video being played.

The General Safety course features 10 important safety issues: personal safety; equipment; ladders; power awareness; vehicle safety; physical safety; substance abuse; working environments; and when to back off. The program is structured to present the rules while demonstrating healthy attitudes about safety. It is projected to be approximately 12 hours of training.

"The course provides a year's worth of recommendations for follow-up campaigns to keep the material fresh in employees' minds," said Connie Buffalo, director of educational product development for the Mind Extension Institute. "Through research we found it was not necessarily the new installer who made safety mistakes, but the installer with years of experience."

The Installer Training course covers an introduction to cable; service; tools and materials; basic theory and cable prep; aerial and underground drop installation; ground blocks and splitters; wiring; connection to customer equipment; finishing the install; and pole climbing guidelines. In addition, users can customize the program to address fittings, drop clearances, splitter loss, signal strength and grounding procedures. It represents approximately 20 hours of training.

"This is by no means the whole (training) solution—it's 80 percent of the solution," says Buffalo. "The other 20 percent must be filled in by the system. This is just a tool." In fact, the system-level culture must support the training for the courses to be completely successful. ■

—Roger Brown

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Reader Service Number 8

Let's get busy

For those who attended the Western Cable Show, I think you'll agree it was abuzz with activity. There seemed to be plenty of people on the floor looking at products, and the programmers seemed to be talking to a lot of potential customers. The overall mood and attitude seemed to be quite upbeat, and I was happy to see that. But a couple of messages conveyed in the general sessions were of great interest to those of us in the engineering fields.

In the opening general session, TCI CEO Dr. John Malone stated in no uncertain terms that fiber and its potential use was no longer a future project, but had reached an economic point where it was a viable tool for expanding channel capacity. He stated that it is now his belief that DBS is a short-term tool and not of long-term use to the cable operator, because the economics of fiber would allow it to help cable operators bring increased channel capacity into the American home immediately.

It is always gratifying to see the work engineers have done being appreciated by someone like Dr. Malone. Because of his engineering background, of course, Malone's been quick to see the benefits of this technology. But he's also been pragmatic about fiber optics, again an attribute of his engineering training. He has engaged not in wishful thinking, but instead has encouraged the people who work on this project to get the job done as quickly and as economically as possible. As a result, this business professional now has a new tool to use.

By Wendell Bailey, Vice President Science & Technology, NCTA

The other comment I found to be interesting was made by Jim Mooney, the president and CEO of the NCTA, who stated in his luncheon address that the cable industry will be doing some experimenting with PCS (Personal Communications Services). He did not say we would be utilizing or engaging in the businesses in this area, but that operators will be looking at the potential for this technology to interface with the infrastructure that the cable industry has built over many years. There are so many questions to be asked about PCS that one hardly knows where to begin.

First, of course, what is it? A simple answer is that it includes services that have been around for about a year and a half now under different names, such as PCN (Personal Communication Network), Cellular Telephone II, Cellular Telephone III and Telepoint. How these services could be used with the cable infrastructure is clearly an interesting technical puzzle. In the next weeks and months it seems clear that the cable industry will begin experimenting and tinkering with what is and isn't possible.

There are, however, myriad other issues surrounding this activity and the FCC is working on a Notice of Inquiry to determine where PCS activities can take place in the frequency spectrum. But that's only one of the problems it must deal with. Other problems include who will get licensing in any geographic market, what services will be allowed, what technology and modulation schemes will be used.

Too many suitors

All of these are relatively thorny issues. For instance, with regard to frequency spectrum allocations, there is literally no piece of the spectrum that does not have several entities seeking entrance to its use, and which also do not have embedded users fighting to preserve their primary rights to interference-free use of the spectrum. It seems that every single spot on the old radio dial has many suitors—and nobody is willing to move aside to let a new service get in line ahead of anyone else pressing for access.

Certainly, we cannot expect the incumbent users to roll over and let a new entrant march in to use their frequencies. Having said all that, it is also true the Commission recognizes there are some frequency spectrum allocations that are underutilized, even though they are heavily licensed. Even though that's the case, the incumbent licensees will claim that their use is "valid and growing," and that they have new ideas for improving the way their services are used, which will increase the activity on the lightly used bands—and on, and on, and on.

It has always been this way and will be so in the future. If you look at another side of this issue—that of spectrum sharing—you quickly stumble upon the issue that the Commission will most likely have to deal with quite seriously. The FCC is and always has been committed to the efficient maximization of the radio frequency spectrum. Because of the aforementioned problem of multiple claimants and multiple potential users, sharing has been the preferred technique when at all possible. The Commission has always opted for sharing where it can be technically accomplished, which in turn has greatly increased the efficiency of the bands.

But while sharing was easy in decades past, it gets harder with every new day. This in turn leads to the issue of which modulation schemes should be adopted, because various claimants point out that the modulation techniques they propose will allow greater or lesser sharing than alternative proposed methods.

However, once the spectrum allocation and modulation technique issues are resolved, yet another issue remains: How will the FCC deal with the multiplicity of potential licensees, and under what sort of preference will it grant licenses? The complexity of this puzzle demands that the cable engineering community once again roll up its sleeves and begin thinking of ways that the infrastructure can be utilized to further enhance the potential of this undefined service. Thinking is also necessary to determine ways in which we, as business operators, can utilize the potential services offered under these scenarios.

If the comments and discussions heard in Anaheim are any indication, the next year or so will be quite an interesting time for the technologist. Once again, our expertise in creative thinking and our efforts to reshape our networks for the future will create opportunities to experiment with exciting new services. ■

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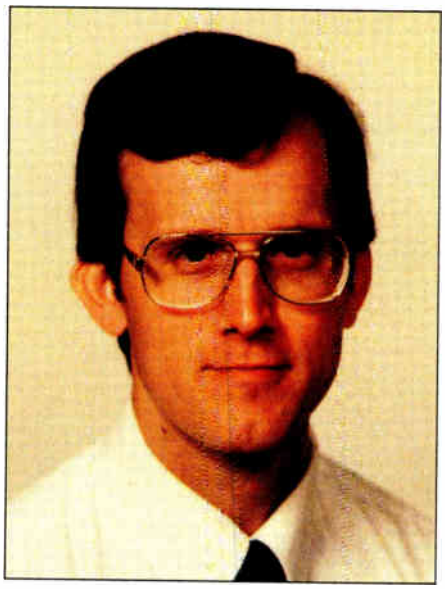

Propagation primer (Part 1)

In the world of cable television, one could argue that an understanding of the atmospheric propagation of radio and television waves isn't necessary. After all, the signals we deal with are confined to coax and fiber for the most part, with an occasional point-to-point AML system thrown in. Careful review of the requirements for the SCTE exams on signal processing centers however, will reveal a different story. You'll have to know a little about atmospheric propagation via the ionosphere and its potential affects on television signals, if you want to ace the exam.

With that in mind, lets get started. After all, it might help explain why co-channel interference is only an occasional or seasonal problem. This month we'll concentrate on a description of the ionosphere, and next month we'll tackle the affects of the ionosphere on propagation and how these affects vary with frequency.

The earth's atmosphere

The earth's atmosphere, which is a body of air surrounding the earth's surface, in effect extends for many thousands of miles. But in practical reality, more that 99 percent of the earth's atmosphere is confined in a layer about 50 miles thick around the surface of the planet, and is our lifeblood, containing the chemical elements that sustain life as we know it. Beyond that distance of about 50 miles, the air is so thin that it becomes a vacuum with a scarcity of atoms or molecules.

The ionosphere consists of a series of layers of charged particles, or ions, in the atmosphere surrounding the earth's surface. It is these layers that can affect the propagation of transmitted signals so greatly. But before we dig into a description of the ionosphere, perhaps we should define an ion. For purposes of this discussion, and in simplified terms, an ion is simply an atom which has temporarily lost an electron from its outer or "valence" shell. In such a state, an ion assumes a positive charge until such time that it can recombine with another "wandering" electron to again assume its neutral charge. Ionization of an atom can occur when the atom absorbs enough energy (radiant energy from the sun for example) to, in effect, "bounce" the electron from its orbit around the atom.

The sun, and its radiant energy, is the primary contributor to the ionization of the atmosphere. In the far reaches of the atmosphere, where atoms are relatively scarce compared to the lower regions of the atmosphere, the radiant energy from the sun keeps the atmosphere in a relatively constant state of ionization. This is true because while there are relatively few atoms at these altitudes, once one is ionized, it may be a long time before an electron makes its way back to de-ionize the ion.

As a result, the outer reaches of the ionosphere, while thin and variable, are relatively constant when compared to lower ionospheric layers. Closer to the earth's surface, on the other hand, where atoms are plentiful, the ionosphere is in a constant state of flux, variable by day vs. night and by season. Here, during daylight hours when the sun's energy is intense, the ionosphere can reach to low altitudes and become dense—where it can wreak havoc with radio communication.

This layer of the ionosphere is commonly referred to as the "D" layer, and can extend down to altitudes very close to the earth's surface. At night, however, when the sun's rays have moved to other parts of the globe, the ionized particles in the atmosphere recombine with the plentiful free electrons that have been roaming around, forming neutral atoms, and the D-layer disappears. Depending upon the density and intensity of the D-layer, the de-ionization process may take a few hours, or it may take all night.

As mentioned earlier, at higher altitudes, where there are fewer ions and fewer free electrons, the recombination process never fully recovers, and as a result, the ionization has a tendency to remain throughout the day and night. One layer, known as the "E" layer, tends to form about 50 miles above the surface of the earth, while another, known as the "F" layer, forms at altitudes from 100 to 250 miles above the surface.

In addition, the altitude of the F layer has a tendency to be somewhat variable with time, lending rise to what has been called the F1 and F2 layers. This layering affect has been attributed to the differing kinds and amounts of gas atoms that are present at different altitudes in the atmosphere, the variable absorption of the sun's energy at different altitudes, and with the variable intensity of the sun's rays with changes in the seasons.

So far, it's fairly obvious that the density and intensity of each layer of the ionosphere are totally dependent upon the energy radiated from the sun. Seasonal, as well as day-to-night variation of the ionosphere, are therefore a somewhat obvious result of this dependency. There is another not-so-obvious affect that the sun has on the ionosphere on an even longer cyclic basis due to the so-called "sunspot cycle."

The 11-year flare cycle

While scientists don't yet know all the reasons, the sun seems to be in an 11-year cycle of varying solar-flare activity. During periods of high solar flare activity, the additional energy created by these solar flares and other magnetic storms on the surface of the sun results in additional energy reaching the earth and thereby causing significant increases in the ionization of the atmosphere. These types of solar activity have been known to effectively shut-down long-distance RF communications at certain frequencies for extended periods of time.

Next month we'll examine the effect that the ionosphere has on wave propagation, and why certain frequencies are more useful than others when trying to communicate over specific distances at certain times of the day. ■

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

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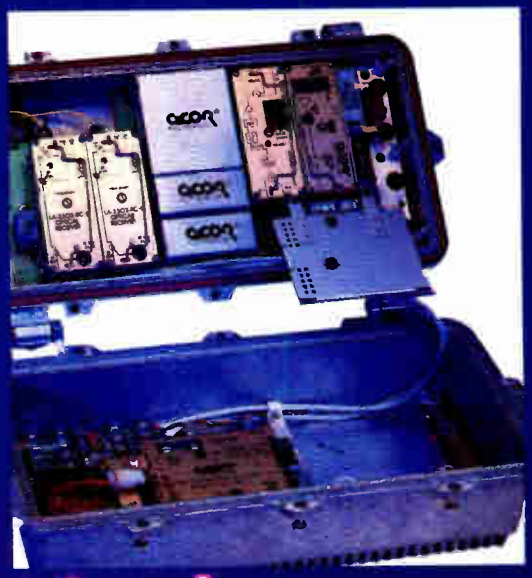

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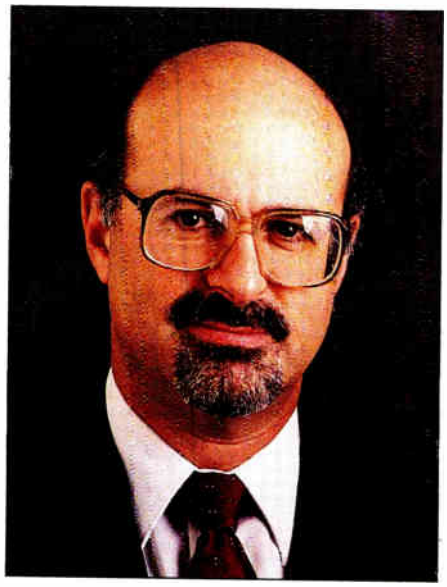

The year ahead in Washington

It's crystal ball time—time to look at the issues affecting cable TV technology that are likely to be hot in Washington during 1991. Who would've guessed: it's many of the same issues that came up in 1990. But we won't let that stop us. These, then, are my predictions for 1991.

Legislation, competition & re-tiering

It started as constituent complaints to Congress in 1989 about cable TV rate increases and poor customer service, but later evolved into a fight over access to cable's name-brand programming. A legislative compromise was reached on the access issue, but the 1990 cable legislation died when the Bush Administration decided to oppose the re-regulation of cable rates. Cable legislation will be re-introduced in 1991, and it will again cover rate regulation, customer service and access to programming.

Meanwhile, the FCC is expected to make a decision by late spring or summer on the new definition of "effective competition." Local municipalities are permitted to regulate the basic rates of cable systems that are not subject to effective competition. Under existing FCC rules, cable systems are subject to effective competition if there are at least three local TV signals, but this is likely to change.

While this FCC decision or new legislation may not have a direct effect on cable technology, there might be an indirect effect because only the basic tier would be regulated. A number of MSOs began making plans to re-tier in 1990, and that trend may continue. To implement re-tiering, some systems may need to consider major changes in their technology.

By Jeffrey Krauss, Independent Telecommunications Policy Consultant and President of Telecommunications and Technology Policy of Rockville, Md.

Telephone industry legislation

Under the Modified Final Judgement (MFJ) in the AT&T antitrust case, the Bell Operating Companies are prohibited from manufacturing telephone equipment, from providing long distance services and from providing information services. Cable TV is one type of prohibited information service.

There will be a legislative effort to overturn parts of the MFJ in 1991. In the House, Rick Boucher is the leading supporter of legislation that would allow telephone companies into the cable TV business. In the Senate, Conrad Burns is the leader.

The FCC, led by Chairman Al Sikes, will probably decide on a position that allows telephone companies into cable TV, but subject to certain safeguards against cross-subsidization. And the FCC could recommend that cable companies be allowed into the local exchange telephone business.

But this is an area where Congress, not the FCC, must make the decision, and there will major lobbying efforts against the legislation in 1991.

Spectrum issues

Even though cable TV is theoretically a "closed system" that doesn't use the radio spectrum, we all know that theory and practice don't always coincide. The FCC Field Operations Bureau will step up its enforcement of cable leakage regulations, and will assess some big "forfeitures" (the FCC term for fines) against some major systems.

The FCC will continue its inquiry into wireless personal communications networks (PCNs), and Cox, Cablevision Systems and other MSOs will participate in experiments that show how cable systems can participate in this major new technology area.

The FCC will also continue its inquiry into digital radio broadcasting services. But this potential new broadcast service will be slowed because of opposition from existing radio broadcasters, because of the cost of implementing a satellite-based system, and because of the need to test competing formats before adopting a standard.

HDTV will pick up steam, as the Advanced Television Test Center spends most of 1991 testing the proposed formats. But a final FCC decision still won't be made before mid-1993. Meanwhile, several different formats for compressed digital NTSC video will emerge in hardware form, and the testing of these formats on both satellite and on cable systems will start.

Multipoint Multichannel Distribution Service (MMDS) will continue to limp along as an ineffective competitor to cable TV. As a result, there will be some effort to reallocate some of the MMDS spectrum for mobile radio or PCN services.

High power DBS broadcasting will continue to be the service whose time has not yet come. As a result, the FCC will begin an inquiry into home video delivery over C-band satellites, hoping to stimulate that into becoming an effective competitor to cable TV. The FCC will look at increasing the orbital spacing of satellites and other technical measures for reducing the size of home dishes.

With the increase in regional cable news services, the FCC will start to look at some changes in the microwave rules needed to give these operators access to the same frequencies as broadcasters and cable operators. Microwave is needed both to get the live feeds back to the studio from the scene of news events, and to distribute the news programming to all of the cable systems in the region. Under existing FCC rules, only national news services (e.g., CNN) have access to the microwave frequencies they need, but regional services do not.

Finally, Congress will get into the spectrum action, by again bringing up the bill to reallocate 200 MHz of spectrum from Federal Government use to non-government use. This bill was passed by the House in 1990, but never made it through the Senate. This bill has a good chance of passing in 1991. However, the cumbersome procedures spelled out in the bill for identifying what spectrum to reallocate, and what new services the spectrum should be used for, will take years to implement. ■

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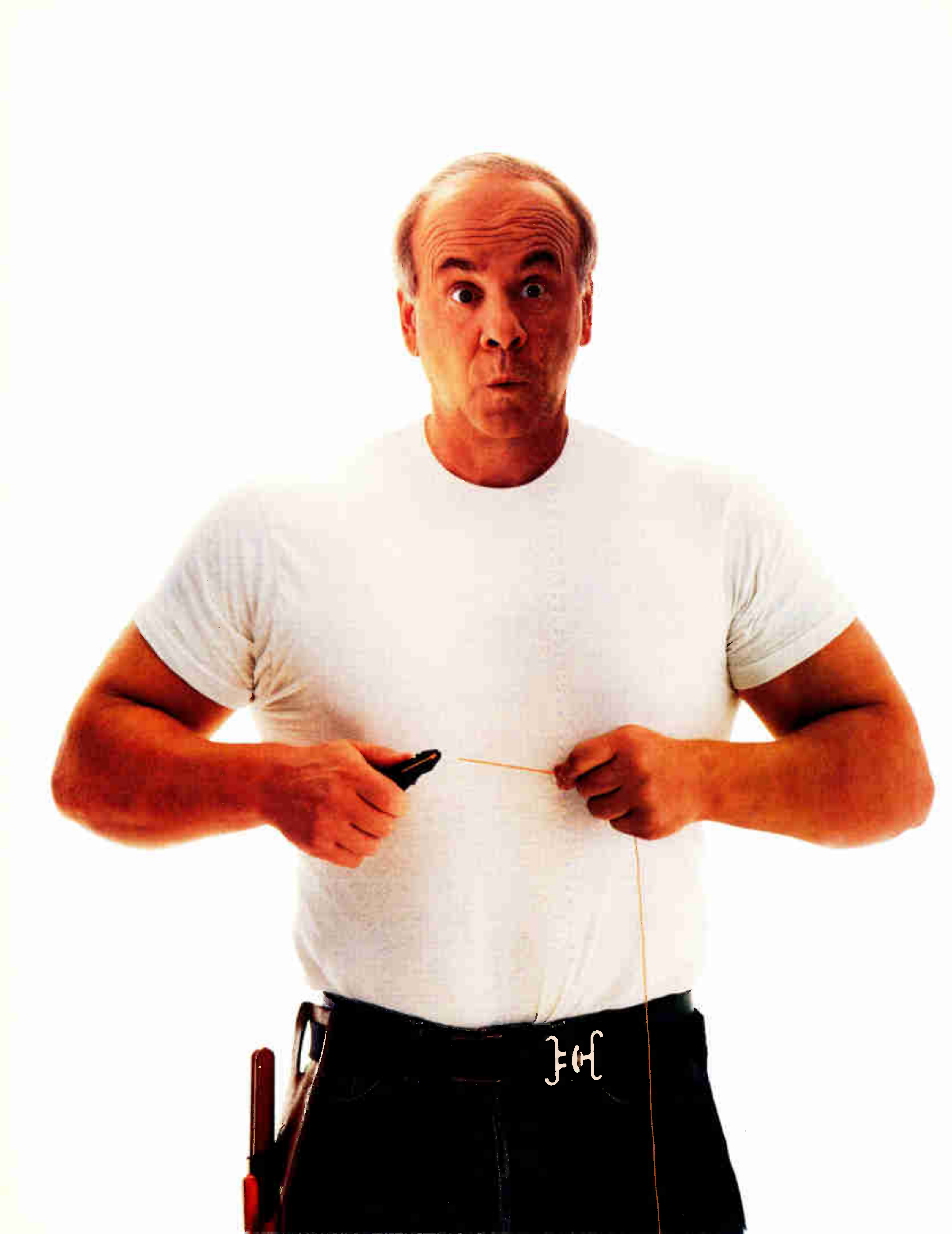

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Reader Service Number 12

Microcellular telephones

There are 26 million cordless telephones out there; 5 million cellular telephones; 9 million pagers; and a bunch of CBs (Citizens Band). That represents a lot of consumer interest in the ability to communicate freely, without Ma Bell's ubiquitous umbilical cord; and the numbers are growing.

Sales of cordless telephones to dealers exceed 10 million annually. By the mid-1990s, there will be more than 15 million cellular users. Pager growth in 1990 is 1.3 million subscribers. (Source: The Market for CT-2: The U.K. Experience and Market Potential in the U.S.; Economic Management Consultants International Inc., [EMCI], a Malarkey-Taylor company).

Yet, the cordless telephone is limited to a range of less than a few hundred feet, and can only be used with its own base station. Mobile cellular telephones require relatively high power (up to 3 watts) with heavy, bulky batteries, for communication with base stations 10 miles or more away. Pagers are one-way signalling devices and CB is strictly simplex (switch-to-talk).

Cutting the tether

Bellcore's Donald C. Cox believes that the popularity of these wireless services "...points strongly to the inevitability of widespread tetherless portable radio communications." The public has clearly demonstrated with its purchases the need for a full-featured wireless service drop connected to the Public Switched Telephone Network (PSTN).

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

UK allocations

The United Kingdom has allocated spectrum for an advanced digital cordless telephone technology, CT-2; and a similar Digital European Cordless Telephone (DECT) standard is being developed in Europe. CT-2 and DECT could be used within range of any microcell base station in the home, at the office, or at telepoints in public places, comparable to pay telephones.

As presently conceived, digital cordless telephones could originate calls within a limited range (several hundred feet) of any base station, but could not receive incoming calls. However, CT-2 could evolve into a full-fledged Personal Communications Network (PCN) of portable telephones capable of receiving, as well as placing, calls from and to microcellular base stations. This would require additional hardware and software to search for the base station closest to the particular portable unit.

The technology for digital mobile cellular telephones is at hand. By reducing the size of the cells from tens of miles down to hundreds of feet, power requirements could be reduced from watts to milliwatts. This would make it possible to rely on lightweight, disposable dry-cells for power. The consequent reduction in size, weight and cost would make it possible to fantasize about mobile cellular telephones that could fit in a shirt pocket or even a Dick Tracy wristphone.

Such microcells, as they are called, would be too close together for a practical vehicular service, however. There just is not enough time for the handoff from one microcell to the next. But they would be ideal for a pedestrian service, with hand-held units moving at speeds no more than a few miles per hour. It is already beginning to evolve, even before CT-2 or DECT take root in the U.K. and Europe.

Experiments coming

On June 28, 1990, FCC issued a Notice of Inquiry (NOI) seeking guidance on spectrum allocations and technical standards for advanced digital cordless telephones (CT-2) and for Personal Communications Network (PCN) type equipment. A dozen or more experimental operations have already been authorized.

In September 1990, Cablevision Systems and Cox Enterprises, cable TV multiple system operators (MSOs), applied for experimental authority related to PCN developments utilizing existing cable TV networks in several communities.

There is believed in the cable TV industry to be a striking synergy between microcell PCN and two-way cable TV networks. Base stations, in weatherproof housings comparable to line extenders, might be attached to the cable TV strand, connected to the coaxial cable by means of a directional coupler.

The Cablevision Systems proposal calls for assigning 18 MHz of spectrum, both upstream and downstream, for duplex voice and data linkage to the Mobile Telephone Switching Office (MTSO) at the headend.

A viable Personal Communication Service (PCS), whether CT-2 or PCN, must have access to the public switched telephone network (PSTN). Thus, the telephone industry sits astride the gateway to a profitable, competitive PCN service, while vigorously seeking entry in the cable TV business which it expects to dominate.

Watch the experiments

The mobile cellular telephone provides a strong precedent for a competitive wireless portable personal communication service with access to the PSTN. Although many of the licenses designated for non-wireline companies have been acquired by wireline companies, they are still competitive, although not entirely at arm's length. It is not at all clear that the cost of access to the PSTN will, in the final reckoning, be prohibitive. However, obtaining access at reasonable cost is not likely to be easy. There is much lobbying to be done, at FCC and Congress. A grassroots case for competition needs to be made. Litigation is inevitable.

Experimental projects like those of Cablevision Systems, Cox Enterprises and the new architecture for PCN soon to be unveiled by TCI, are right on target. They can be expected to demonstrate both the capability and the serious intent of the cable TV industry to take its proper place in the portable PCN telephone business. ■

Man of the Year: Dr. Walt Ciciora

ATC engineer honored for his efforts for the industry

Dr. Walter Ciciora has the kind of job most cable television engineers only dream about. As American Television and Communications' vice president of technology, Walt (as he prefers to be referred to) is on the cutting edge of video technology—from compression and advanced television to the consumer electronics interface and electronic program guides. He's ATC's high-tech eyes and ears; learning about emerging technology, understanding how it might impact cable-TV and then determining ATC's response.

But he's more than that. He's cable TV's bridge to other industries, such as the consumer electronics business. He's cable's humble diplomat, if it has one. Many people don't even associate Walt with ATC, they just consider him *as* cable television's technology expert. Wendell Bailey of the NCTA may be CATV's political engineer, but Walt is the cable community's technology engineer.

One way to say thank-you

It is for his unselfish devotion to the industry, his wide-ranging technical knowledge and utter professionalism that Ciciora was chosen as *CED* magazine's Man of the Year for 1990. He was selected by acclamation by a committee consisting of: Nick Hamilton-Piercy, last year's *CED* Man of the Year and Rogers Cable TV's vice president of engineering and technical services; Ted Hartson, vice president of engineering at Post-Newsweek Cable; and Robert V.C. Dickinson, president of Dovetail Systems.

"Walt has helped lead the industry to a higher level of professionalism through his own brilliance," says Hamilton-Piercy. "No one has ever really said thanks to Walt for all his work. This is a great way to do it."

Hartson echoed those thoughts, calling Ciciora "an engineer's engineer. He could build a TV and know why it works. If a person likes science, you have to like Walt."

"He's been so visible and so instrumental in so many things," Dickinson notes. "It seems to me he gets paid to help cure the industry's ills. The industry is in debt to companies like ATC for letting people like Walt do this kind of work."

To say Ciciora is a man on the go would be a gross understatement. Over the past year, he's logged more than 100,000 miles on airplanes and can recall only one occasion this year when he could be found in his Stamford, Conn. office for a full week. Instead, Walt travels in the real world, in pursuit of knowledge and ideas.

The definition of an engineer is someone who applies science to make a profit.

He is often whisked from his Connecticut home or office to some little-known spot on the map and shown the latest whiz-bang gadget. Or he's attending a seemingly endless series of meetings of industry leaders and asked for his guidance. Ciciora is so busy, one wonders if the man ever sleeps.

In fact, tracking Walt down for this extended interview was a difficult exercise. Over a month's time, there were only four days in which he wasn't scheduled to be elsewhere, including Europe. "His own dog probably barks at him when he comes home, he's on the road so much," remarks Hartson.

The job demands a lot of time and energy, but Walt welcomes the challenges it delivers. "This is the best job I could imagine," he says. "I'm very pleased with what I'm doing. I am extremely grateful to ATC (for the fact it) feels this is a reasonable thing for me to do. I hope it lasts indefinitely."

Making R&D pay off

Ciciora has been successful in the past at making research and development pay off in tangible ways; an important key to longevity in uncertain economic times. The skill was honed while Walt worked at Zenith, where he combined engineering and business knowhow to build products that could be successfully marketed.

Walt was attracted to technology at an early age. He'd often watch while his father, a Western Electric veteran of more than 40 years, fixed appliances, radios and other electronic devices. In high school, Ciciora excelled in science and math courses, which led to his decision to pursue a radio or television career.

The Chicago-area native chose to attend the nearby Illinois Institute of Technology, in part because he could still work part-time and commute to class. In 1964, he received his bachelor's degree in electrical engineering from IIT. While there, he also met and married his wife Jeanette.

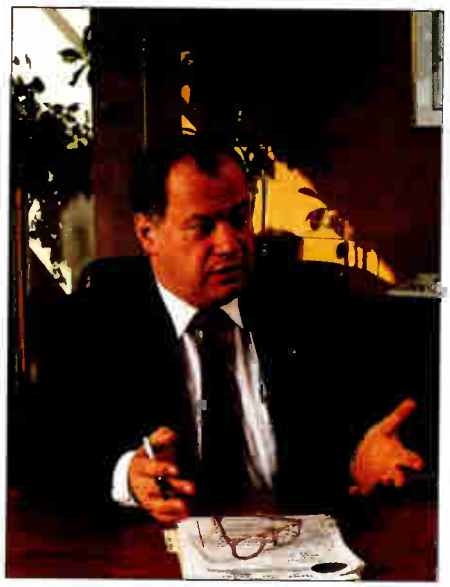
At that time, the federal government was still generous to educational programs and Walt was awarded a National Science Foundation fellowship and went on to graduate school. He also took a teaching assistantship to support his family, which was growing at the rate of one every year. "I like to joke that (Jeanette and I) figured out that graduate school causes kids, because when I stopped going to graduate school we stopped having children."

In 1969, Ciciora emerged from IIT with master's and doctorate degrees in electrical engineering. He went to work at nearby Zenith, where he had been working during the summer months between classes.

Walt's first project consisted of digital encryption for Phonevision, Zenith's over-the-air subscription TV service that was operating in Hartford, Conn. The system was a technical success, but died a political death because it got caught in a political crossfire. It was a lesson he would not soon forget.

Walt progressed through the research-and-development hierarchy, spending a lot of time working on digital television and teletext systems. While at Zenith, Walt would ultimately be issued nine patents for various inventions. He also taught part-time at IIT and became quite comfortable with public speaking and extemporaneous thought.

In 1977, realizing that he was approaching the occupational limits of the R&D department, Ciciora began a two-year MBA program at the University of Chicago to learn more about the business side of science. Though many consider engineers and businessmen an incongruous couple, Walt believes that's an unfortunate result of the space race.



I think we now have the right (R&D) solution, with CableLabs.

Engineers and scientists

"The definition of an engineer, in the Thomas Edison sense, is someone who applies science to make a profit," says Ciciora. "That's what Edison and other engineers did—all the way up until Sputnik. Then we changed the emphasis to science and these people running around calling themselves engineers were really trying to be scientists. I've always felt an engineer should apply science for a profit, therefore, I was interested in how people make profits and how businesses run."

Consequently, Ciciora approached his Zenith R&D efforts from a business point of view. "Bill Thomas (with whom Walt worked on teletext) and I decided an excellent strategy would be

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SALUTES

WALT CICIORA

CED's MAN OF THE YEAR

Walt Ciciora's global perspective has helped to assure that the cable TV industry is on the cutting edge of technological advancements. With his leadership and dedication, Walt has challenged us all to develop new and better ways to more effectively serve our subscribers.

Anixter Cable TV extends its warmest congratulations to Walt Ciciora on his selection as cable television's "Man of the Year."

John Egan
President & CEO
Anixter Cable TV

to make products we could sell in small volume and bring in enough money to support ourselves."

The idea worked. Zenith built headend and set-top teletext products to support a large experiment being conducted by Group W. But more importantly, the effort kept Ciciora and Thomas employed. "We continued to have a job when others were being laid off because we were bringing in revenue and supporting our research," Ciciora recalls.

Another early research project which has major implications today was ghost cancelling. In fact, Thomas and Ciciora authored a paper on ghost cancelling that is still often cited as the tutorial on the subject. "Ghosts are probably the single most irritating picture impairment," Ciciora says. "Noise and lack of color resolution are tolerable (which is why videotape is generally considered to offer an acceptable picture). That teaches us what we need to concentrate on when we try to improve the picture on cable."

One of Ciciora's last R&D projects at Zenith was a ghost cancelling system. However, because of the complexity of the interference, ghost cancellers were found to be simply too expensive—often three or four times the cost of the television receiver itself. "We concluded it was just too complicated technologically to be affordable," reports Walt. "The other thing we concluded was that cable was going to grow in penetration and ghost cancelling would be done at the headend instead of in the television."

After he received his MBA, Ciciora joined the newly formed Zenith cable group as director of sales and marketing. At about the same time, ATC began selling subscription TV and needed a new secure scrambling method to transmit the signal. Jack Thompson designed the equipment, and Zenith was licensed to manufacture the decoders, which became known as the Z-Tac.

When Walt came on board, Z-Tac had just one buyer: Nick Hamilton-Piercy of Rogers. Ciciora made Joe Van Loan and Viacom Zenith's second customer. But the third, and largest, Z-Tac customer became TeleCable, even though Walt originally tried to sell them teletext decoders for a project the MSOwas planning with The Weather Channel.

Moving on to ATC

In late 1982, Bob Rast was putting together an R&D department at ATC

Ciciora is no stranger to Zenith's Z-Tac.

and approached Walt. "I didn't want to leave Zenith because I really liked it there," recalls Ciciora. But Walt was faced with four kids approaching college age and economic hard times at Zenith. "Bob made the kind of offer that you'd have to be insane to turn down." So Walt, although nervous about his future, uprooted his family, moved to Colorado and joined ATC as vice president of research and development.

"I was very dubious of the rationale of having an R&D department in a company that doesn't manufacture products. It's one of those expenses that's hard to justify."

The first project—off-presmise addressability—was already well under way when Walt joined ATC. In this project, Walt applied his knowledge of consumer electronics and large-scale manufacturing. The huge project focused on the converter-on-the-pole approach vs. interdiction because of cost considerations, but finding a test bed was difficult. Consumer friendliness had become a big issue with TV dealers, who were afraid cable subscribers would bypass high-end, feature-filled sets because converters made those features useless anyway.

ATC soon learned the approach simply wouldn't fly because of the large up-front capital cost and the consumer electronic interface issues. The project's focus shifted to a technological experiment and was quietly folded sometime later.

Ciciora says the Darwinian approach to R&D that focuses on strong relationships with vendors simply works better in CATV. The industry is very good at taking good ideas and copying them, and there aren't problems with patents, royalty payments and pride of invention, he says.

CableLabs Involvement

"We learned the hard way that the industry needed R&D but doing it at MSOs is probably not the right way. Doing it through a consortium is the best way and working with vendors is almost as good a way. I think we now have the right solution, with CableLabs as a consortium and active participation by the vendors," says Ciciora.

Walt was highly active in the formation of Cable Television Laboratories. In fact, he remains one of its driving forces as chairman of the Technical Advisory Committee. "CableLabs will be successful if the vendors don't feel threatened. Some of them thought CableLabs would set itself up as a manufacturer but that is likely never to happen.

"CableLabs is a success story as far as I'm concerned" because it builds industry consensus—which is important to industry vendors and federal lawmakers, says Ciciora. "One of the real challenges we had at Zenith was finding out what the industry wanted. You would get a different answer from each and every company you visited, which is why we had so many different flavors of Z-Tac."

Chairing CableLabs' TAC has been rewarding and ranks right up there with the NCTA Engineering Committee as Walt's favorite endeavors. Chairing the latter organization for an unprecedented four years (from 1986 to 1990) was gratifying, says Walt. "It's the only organization I've been involved with that works that well involving a large number of people over an extended period of time. Working with Wendell Bailey andhis staff has been a real pleasure."

During his tenure as NCTA Engineering Committee chairman, Walt saw attendance rise from the 20s in 1986 to the high 60s, which he finds mysterious, given its location (Washington, D.C.), the size of the room, etc. "The meetings sometimes drag on and

some of the topics are pretty prosaic, but for each topic there's a small cluster of people that gets excited. If you're patient, attentive and you listen, it seems you learn something every time."

Another favorite is the IEEE Consumer Electronics Society, of which Walt is presently president. In fact, Ciciora is very proud of his efforts to build bridges between consumer electronics manufacturers and cable equipment suppliers. Yet he says there's much more work to be done. "There are some strong bridges at the engineering level, but there is essentially no contact at the marketing level," he says. "We've got to find a way to do that."

Ciciora is also an SCTE senior member and director; chairman of the Electronic Industries Association/ NCTA Joint Engineering Committee; and executive committee member of the Montreux Television Symposium. He is a past chairman of the IEEE International Conference on Consumer Electronics, an IEEE and SMPTE Fellow and holds memberships with Tau Beta Pi, Eta Kappa Nu and Beta Gamma Sigma. In 1987 he received NCTA's Vanguard Award for Science and Technology.

How—and more importantly why—does Walt give of himself so much? "I try to leverage these different organizations for ATC's and the cable industry's benefit," he says. "I don't manipulate anything, because you have to work for the general good of the organization. But where there's a particular ATC need or emphasis, I apply a little more effort. In many cases, it means volunteering to do it."

Finding reward

"Committee work is simultaneously rewarding and very, very frustrating," Ciciora says. "The rewarding part is when bright people with ideas work together in a common direction." But patience is important because things often happen slowly. "Committees are challenging and frustrating, but I always seem to learn something."

And that is the essence of Walt Ciciora. His intense professional curiosity often leads him to places one would never suspect. He and Hartson recently visited the New Mexico nuclear test site; and just last month, Walt attended a Grateful Dead concert with one of his sons.

This "open mind" approach enables Walt to wade through piles of paperwork, latch on to a few good ideas and follow up on them. But it isn't easy: literally boxes of mail arrive at ATC headquarters addressed to Walt every week. Notes made on his laptop computer help him make sense of it all.

One of Walt's strongest personal traits is his ability to filter incoming knowledge, break it down into its simplest form and explain its importance to others. This ability helps Walt (and ATC) respond to technical and political changes and plan for the future. Issues like advanced television, compression and competitive threats are in Walt's mind every day as he focuses on ways to capitalize on cable's competitive advantages.

"It's important to think about where we'll be five years from now and imagine what the competitive situation will be," admonishes Ciciora. "Telcos may be providing video in some places (and) DBS will be in some

places. But cable has an important strategic advantage over those guys in that we can provide a broadband feed that connects to every TV and VCR in the home. If we do it right, we can be customer friendly. Those other guys can't."

At some point in the near future, as competition truly heats up, cable will be forced to remove the converter box from the home because that will give CATV the upper hand. DBS is FM and the telcos insist on digital modulation. Those transmission methods require a converter to provide AM signals—the type of signal TVs and VCRs require.

Taking on the telcos

"What I keep telling (cable executives) is that yes, phasing out additional outlet and remote control revenues is a problem, but maybe not having a customer is a bigger problem," Walt advises.

So, will the cable industry be more agressive with implementing off-premise technology, the ultimate in consumer-friendly signal delivery? Perhaps, says Walt, if the new iterations are more cost effective and reliable than their predecessors and if operational savings can be documented. "Many decisions have been made (in the past) in anticipation of operational savings only to find that there were additional operational costs that wiped out the savings."

Phasing out additional revenues is a problem, but not having a customer is a bigger problem.

Ciciora truly believes cable can beat the telcos when it comes to fiber-based video delivery and even looks forward to the challenge. "Telcos will be a fascinating threat. But if we do it right, we're going to win. We've got the right technology and the right culture. The only problem is, will we recognize it as the serious threat that it is and will we take advantage of our strategic opportunities—particularly with the consumer interface?"

It is this consumer interface issue that most concerns the 48-year-old Ciciora. Already, a lengthy investment in time and energy has been expended on the subject in the form of MultiPort (a baseband interface designed to re-st re the functionality to TV and VCR remote controls), which is a technical success but a market failure. "MultiPort has been the biggest disappointment," Ciciora confirms, "from a 'marshaling the forces' perspective. It's not dead yet, there's still hope, but its breathing is labored."

These days, in addition to compression Ciciora is highly interested in the

development of an electronic program guide, a concept he remembers from his Zenith days.

Walt envisions a system where the viewer will simply select the program he wants to tape and strike a button. The TV/VCR will do the rest, making sure the proper channel is recorded at the correct time. "That's the way it should be. There's no technical reason why it can't happen. What's necessary is an agreement on how we do it." The committee work is already underway and, sure enough, Walt's in the thick of it.

Coming up short

While Walt certainly has hit home runs, he's struck out a few times, too. "There's no end to the dumb things I've done," he laughs. One in particular was the "learning" remote concept. He'd been thinking about that—even wrote a few ideas down—but then GE came out with the product before he could do much else. "Scratch that one," he says. "There's a long list of those...but every engineer has that experience."

But does he have any serious regrets? Not really, except that he wishes he had more time for his family. There's Karen, the 24-year-old mechanical engineer; Steve, 23, an electrical engineer interested in computers; 22-year-old Paul, the chef; and Susan, 21, the psychology major. But the glue who holds it all together is Jeannette, the one who forces Walt to spend time riding horses, skiing down the slopes or building something in the downstairs wood shop. "My life would be all technology if it wasn't for her," Walt admits.

"Kids grow up too quickly and are gone. Spending time with kids is like MultiPort: It's something we can do next week or next year. Then we run out of next years and the opportunity is lost and gone forever." He's grateful his wife and kids understand that his job takes all his time, but concedes there's no way to compensate for it. "Life always brings too much of one thing; too much work or none at all. There aren't any in-betweeners anymore," he laments.

Yet Ciciora remains optimistic to the core. "I consider myself to be extremely fortunate. I've always been in positions where I've been able to do interesting work that has been, hopefully, useful to those who are supporting it. ATC is a tremendous company to work for."

Few of Walt's peers have as much corporate support and freedom to pursue subjects which interest them. Even fewer realize how important it is to have someone performing the role for the industry at large. But no one can think of a nicer person to have doing it.

"Because I'm from ATC I get a hearing (at companies developing state-of-the-art equipment). People tell me things they normally wouldn't tell others.

The work has always been interesting and challenging. And now, technology is making changes I never would have expected," adds Walt. "I have never been a person with a plan; I have never charted my future because every year has been a surprise in a totally unexpected way. It is very difficult to say this (job) is fine and I'd be happy doing it for the rest of my life. But the truth is, after lots of thinking, that's the way it is."

We're glad you feel that way, Walt. ■

—Roger Brown

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MAN OF THE YEAR

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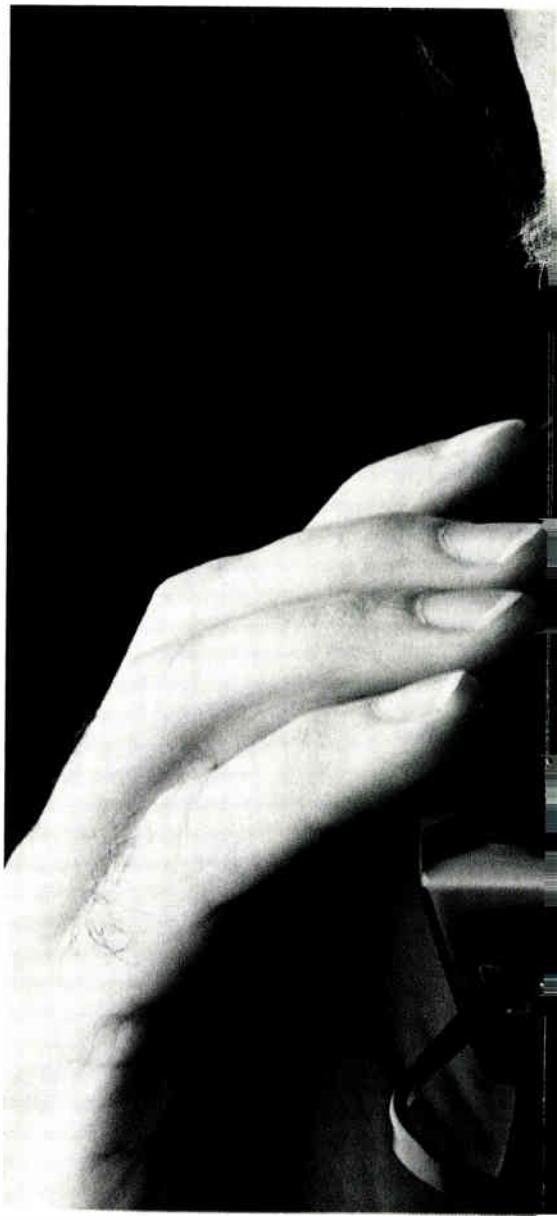

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Western Show upbeat despite financial woes

Fiber embraced by TCI; Interdiction comes of age

Unwittingly or not, Telecommunications Inc.'s Dr. John Malone set the tone of the 1990 Western Cable Show during the opening general session, in which he was one of the participants.

As widely reported in the trade press, Malone unequivocally slapped his stamp of approval on fiber optics technology as the method to upgrade cable systems into an infrastructure that can deliver a wide range of programming options. At the same time, Malone defined DBS as a short-term or "temporary solution."

Malone's ringing endorsement of fiber and his prediction that the bandwidth it makes available will spur the "explosion" of pay-per-view and the number of channel choices will come as little surprise to those operators who have already installed fiber. But the ramifications on industry policy could be huge as the nation's largest cable operator throws its weight behind lightwave technology.

However, as the general session was nearing its end, Malone graphically spelled out what ails the industry as 1990 came to a close—the financial community. He predicted the fallout from the savings and loan debacle would continue to have widespread impact in 1991 (and perhaps longer) but that improved technology and deployment of fiber would, in the long run, lead CATV out of the woods.

Clearly, this "things aren't so hot now but the future looks good" attitude was widespread throughout Anaheim, where the show may have been short on product innovation but was long on price and performance gains and general optimism.

If nothing else, this Western Show may be remembered as the point in time when the cost of fiber paralleled coax. Catel Telecommunications came promising a new family of AM fiber equipment priced at $10,000 per transmitter/receiver pair. C-Cor Electronics discussed economic models in which it showed fiber to the feeder can be implemented with practically no cost penalty. And Optical Networks International confidently predicted it would deploy 4,300 fiber links by the end of 1992.

At the same time, interdiction attracted more attention as Jerrold Communications demonstrated its Agile Jammer and promised to give rival Scientific-Atlanta a run for its money. Jerrold has positioned its system as a "tap adjunct" so operators can install the devices without rebuilding plant (or redesigning the power grid because the devices are powered from the home). By aggressively pricing the device at $135, Jerrold was also able to clear up the price-per-subscriber issue, a move which will likely place pressure on S-A.

Meanwhile, S-A and CableData announced the release of a new DDP software module that supports Scientific-Atlanta's System Manager IV and V interdiction systems. The module will be tested beginning in mid-December at an undisclosed site. The software will also be tested in Warner's Williamsburg, Va. system beginning in February.

The software is unusual in that it tracks addressable equipment by permanent physical locations such as a street address. In the past, the software tracked units solely by converter serial number and its physical location.

With the addition of the software, S-A's interdiction technology is now a true "system" said Gary Trimm, president of S-A's subscriber systems division. He added that the four-port interdiction unit is now entering mass production.

Other product introductions were plentiful at the Show. What follows is a listing:

All Cable

The company announced its agreement with Champion Metal Products to sell and market Champion pedestals throughout North America and the Caribbean. All Cable currently represents Tamaqua Cable Products and CableTek Center Products.

For info, call (203) 235-0883

Audio Rider 2000

Several enhancement announcements were made regarding the Audio Rider product, scheduled to be released in January of 1991. The Audio Rider, an audio level management device, now includes stereo and mono monitoring capabilities, a shortened decision time on audio reference changes, and an upgradeable format.

The Audio Rider is a rack mountable device that resides between an audio source and the modulator, designed to preven over-deviation of audio through rapid gain reduction of audio peaks. The device, coined "IGC" for Intelligent Gain Control, monitors the audio output of the modulator in a closed loop through the IGC, thus solving the problem of varying audio levels and audio shifts from channel to channel. The Audio Rider scans all channels and automatically adjusts each channel based on feedback loop information. Up to 814 mono audio channels and 84 stereo channels can be monitored in one unit. The intelligent gain control costs $350. The host computer, a souped-up personal computer, is priced at $7,500. For more information, contact Audio Rider 2000 at (602) 838-5038.

Augat

Cable operators can reduce connector inventory and simplify installation procedures by using the new Augat Multi-Fit F connector. The same connector can be used for both 59 and 6 series cable and uses a .360 hex crimp to ensure retention, enhanced signal quality and fewer service calls, company officials said.

For information, call (607) 739-3844.

CableData

A marketing alliance between MIS vendor CableData and mapping and graphics specialists SecaGraphics International was announced at the Western Show. The two will offer the industry the first integrated outage detection and vehicle locator (OVL) package sometime late in 1991.

Not All Cable Is Created Equal.

It's a simple fact: a cable TV system is only as good as the fiber optic cable it's built with. And any sacrifice in quality can mean compromising durability, signal quality and consistency of performance. Which is why it's so important to specify Siecor cable instead of accepting just any cable or packaged system. Because our loose tube design insulates the fibers from the stresses of installation and the rigorous aerial environment. Aramid yarn strength members make the cable extremely light and flexible. Our cable doesn't require metallic strength members which can corrode or be damaged by lightning. And we can provide cable that's all dielectric or armored where additional protection is required.

What's more, Siecor offers cables utilizing Corning's new Titan™ fiber which is more fatigue and abrasion resistant than other standard silica fibers. With Corning's third generation single-mode fiber and our leading cable design, you get a durable cable that's craft-friendly. Of course, our cable meets or exceeds all Bellcore, REA and EIA standards. And we offer a complete line of products and service including hardware, splice equipment, test equipment, training, consultation and splicing.

So get exactly what you need for your system with the knowledge you're getting the best. Call us at 800 762-2002, Ext. 5992. Or write Siecor Corporation, 489 Siecor Park, Hickory, NC 28603-0489.

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Reader Service Number 15

The package will consist of four integrated programs that interface with CableData's DDP/SQL system. The system will show, via computer graphics, service area, trouble and service calls; analyze outstanding trouble calls for possible causes; track and locate service vehicles; and provide dispatchers information about the plant and vehicles.

CaLan

In what could be the most significant breakthrough in signal leakage detection technology in years, CaLan showed a prototype of its ALAN (Auto Leak and Navigation) system.

The system consists of a vehicle navigation module which uses computerized maps to generate location information, a proprietary antenna which mounts on the roof of the vehicle, and an electronics unit, which controls signal leakage measurement and data acquisition and records the information on floppy disks.

The system allows any employee—even non-technicians—to ride out the cable system at legal street speeds and monitor leakage. The information is recorded by the computer and the floppy is later transferred to an in-house personal computer which show leakage locations and strengths graphically. System sensitivity is said to be better than 1 microvolt at the receiver input. Measurement frequency is selectable and the unit is internally calibrated.

A variety of reports, including estimate of cumulative leakage indices, work order generation, summary of leak amplitudes and location and historical trend analysis can be generated by the system. Testing was slated to begin in January. The units are scheduled to be available in mid-1991 and will cost between $15,000 and $20,000.

Also, CaLan showed its new Star 2010 signal level measurement system, which integrates field measurement and data management in the same device. This allows service personnel to better schedule, collect and analyze field test data, said CaLan officials.

The unit is essentially a portable signal level meter with PC-based software and related analysis hardware built-in. The software can be tied in to the operator's install and maintenance schedule to organize and schedule field testing, conduct testing via the field meter and archive the data for later analysis. The unit is priced at $2,595.

For details, call CaLan, (717) 828-2356.

Catel Telecommunications

As alluded to earlier, Catel announced a new family of fiber-to-the-feeder products that delivers 60 channels over a single fiber for under $10,000. Dubbed FyberNode, the product line is aimed at new- and rebuild markets and features enhanced composite second order performance using high-yield DFB lasers.

The product line consists of a transmitter, a PIN photodetector receiver (available in two strand-mount configurations) and a trunk station/repeater. Catel is quoting 49.5 dB C/N, -64 dBc composite triple beat and -60 dBc CSO for a 7 dB optical link. An outdoor optical repeater enables the link to span a 13 dB optical path.

For information, call (415) 659-8988.

C-Cor Electronics

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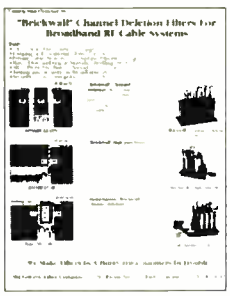

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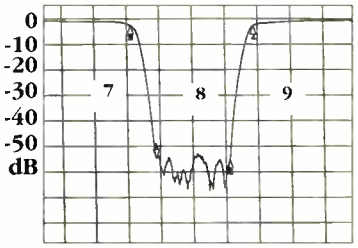
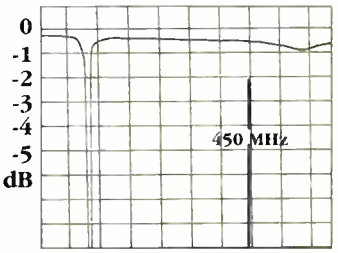
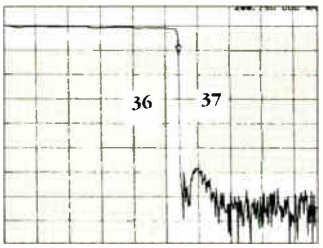


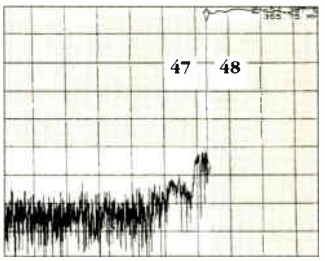
Single Channel 50 dB Notch, Leaves Adjacents In Service 3271ABH-8



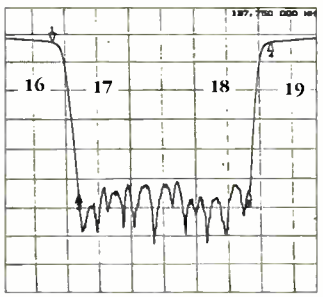
Low Off Notch Attenuation To At Least 450 MHz Type3271ABH-8



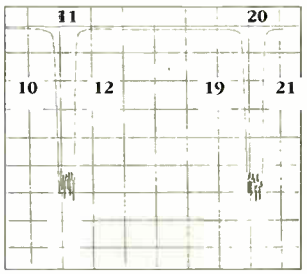
Brickwall LPF 6211LP-36/37 Passes Channel 36 Down, 50 dB Channel 37 Up



Brickwall HPF 6211HP-47/48 Passes Channel 80 Up, 50 dB Channel 47 Down



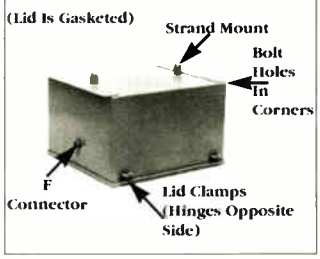
Contiguous Multichannel Type 7964-17/18



Scattered, Multichannel Type 6971-(2)(11,20)(450)

Single Channel Hyperband 3271ABY-FF

Weatherized Box (Example)



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ward and power doubling (PhD) minitrunk amplifiers. The minitrunks provide trunk amplifier performance in a smaller line extender housing. Both the feedforward and PhD amplifiers feature automatic level control and three output ports for signal splitting, eliminating the need for external splitters. C-Cor also exhibited its 32 dB (feedforward) and 34 dB (PhD) versions at the show along with its strand mounted AM receiver for fiber trunk and feeder (FTF) applications. C-Cor also announced the availability of its FTF Design Guide which covers such topics as general issues, system cost analysis and specific uses for RF and fiber optic products in FTF usage.

C-Cor also released information on its tentative agreement with Continental Cablevision to supply C-Cor's 16-channel per fiber digital fiber optic equipment. The agreement between Cardinal Communications and C-Cor to install C-Cor AM fiber links in its New Albany, Indiana system rounded out C-Cor's show announcements.

Richard Perry, president and CEO of C-Cor, was highly optimistic about the future of cable television even though the industry is seen to be "bottomed out" at this point. "I feel it was financing, not re-regulation, that caused the 'bottom out,' " says Perry. "It will come to a head and business will move forward. That's the way we're positioning ourselves. The next calendar year should start picking up and by 1992 it should be outstanding," concluded Perry. For more info on C-Cor products, call (814) 238-2461.

Cable Security

A Cable Converter Bracket targeted for hotel/motel use was introduced. The bracket, designed for Continental Cablevision, has a double sided, industrial strength tape (or it can be screwed onto the device) that secures to almost any major brand of converter and keeps it firmly in place. Priced in the $15 range, the Converter Bracket can be used anywhere converter theft is experienced, says Curt Cope, CEO of Cable Security Systems. For information call (800) 288-1506 or (205) 742-0050.

Contec International Inc.

Contec, which recently announced a management restructuring (the company changed its name from BradPTS) officially announced its new management team. "We now have the management team to match our financial backing," says Danny Cuchuela, chairman of Contec. Barry M. Pressman has been named vice president, sales and marketing and Jim Guzewich has been named vice president, finance and administration.

Pressman, formerly a Jerrold executive, has seven years experience in both the hardware and programming areas of the cable television business. He will be responsible for developing the strategic direction for the distribution and marketing of all product lines and services for both the OEM and system divisions.

Guzewich has financial experience in manufacturing, commercial and retail entities. Guzewich began his career at Ernst & Whinney before joining Bioquest International in 1987, creating accounting and financial procedures for the start-up venture. He later served as vice president of finance for TMS Inc., where he designed a microcomputer based accounting system.

Contec also announced a national MSO service agreement based on volume and penetration which offers multilevel sales, service and repair contracts for operators. Under the agreement, major MSOs will receive a price discount relative to actual expenditures of their service agreement. Large MSOs can receive up to 30 percent off the rate card. Small- to medium-sized MSOs will receive up to a 15 percent discount based on the volume of business. For more info on Contec, call (800) 382-2723 or (518) 382-8000.

Eidak

The final results of a six month market test was released by Eidak Corp. The test, which took place in Warner's Medford, Mass. cable system, was designed to analyze the effect of copy-protected earlier pay-per-view (PPV) film release windows on cable PPV buy rates, consumer taping behavior and home video rental activity.

Major studios participated by providing hit titles released simultaneously with home video. The 21 movies studied were copy protected with the Eidak Copyguard System. The test was designed and the cable research conducted by Temple, Barker & Sloane of Lexington, Mass.; the home video analysis was developed by Alexander & Associates of New York.

Results from the test showed the following information: average per title buy rates increased by 55 percent; individual title buy rates averaged more than 5 percentage points—two films achieved buy rates in excess of 12 percentage points; 85 percent of the buy rate came in the earlier copy protected mode; and there was no impact on overall home video rental activity.

Dan O'Brien, Warner Cable's vice president of new product development, stated: "There were absolutely no complaints from subscribers on the inability to record when given the option of an earlier release." For additional info call (617) 876-9000.

FM Systems

Available from FM Systems is the CSPM-1 Cable Stereo Performance Meter which measures BTSC stereo separation and pilot deviation on TV stereo channels. The CSPM-1 is capable of measuring at the 4.5 MHz TV stereo modulator output, the 41.25 MHz/45.75 MHz TV modulator I.F. and the TV channel 3 output of the set-top converter. This enables the technician to isolate the equipment responsible for any degradation of stereo separation. "It's the first instrument capable of measuring the *stereo content* of a program," says Frank McClatchie, president of FM Systems.

Because the stereo content is being measured, all measurements can be performed without taking the TV channel out of service. Stereo separation is measured in decibels and pilot deviation is measured in kilohertz. The CSPM-1 also detects stereo polarity inversion. The CSPM-1 is battery powered and portable for use at the headend or in the field at a subscriber location. For additional info call (714) 979-3355.

Hughes Communications

A new high-power AML system was announced. The new HIBT-118 80-channel broadband system uses four five-watt field effect transistors to achieve performance equal to 200-watt systems, according to Hughes officials. The system carries a pricetag of about $160,000. The transmitter requires FCC approval before it will be available for shipment.

Jerrold Communications

Jerrold actually brought few new products to Anaheim, but continued to demonstrate enhancements to its subscriber equipment line (including on-screen graphics generated by the converter and an integrated TV remote/telephone). In addition, for the first

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Hughes AML is more than hardware.

HUGHES

time at a cable show, a working optical amplifier was demonstrated, which pushed FM video signals out past 100 km.

The new Starline JLX line extender, a direct replacement of the JLC and JLP LEs, was introduced. The new device was being characterized as "evolutionary" by Jerrold officials. It offers a highly efficient switch mode power supply, backward compatibility with all Starline J series line extender housings and compatibility with future 1 GHz bandwidth electronics.

Finally, Jerrold and ESPN announced that ESPN will utilize a new integrated receiver/descrambler to help the programmer eliminate switching problems encountered with its Major League Baseball television contract. The new box will be implemented next August and will enable ESPN to switch feeds directly from its Connecticut headquarters. Systems will encounter a one-time $1,650 charge for the equipment.

Magnavox CATV Systems

New taps, line passives and a new bridger were featured by Magnavox. The 9000 Series taps and passives were designed to perform from 5 MHz to 750 MHz and feature a 90-degree rotatable seizure mechanism, RF and weather-seal gaskets, environmental coating and brass F-ports. The taps are available in two-, four- and eight-way models made from one interchangeable housing.

A new dual output bridger was also debuted. It features two independent output hybrids and features 6 dB better performance for fixed station output levels and up to 14 dB more system reach for fixed performance levels.

Nexus Corp.

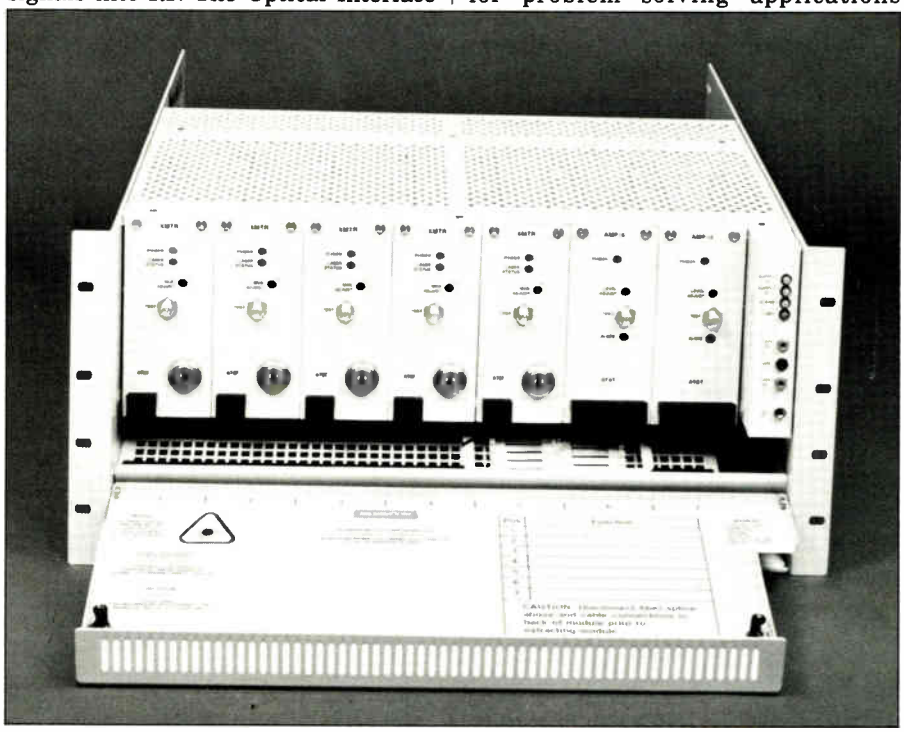
The company introduced the Nexus Series 2000 Headend System, designed to eliminate the "headend as the weakest part of the signal," says Dr. Basil Peters, chairman and CEO of Nexus. The headend boasts a signal-to-noise ratio of 67 dB at 150 channels; complete input signal format flexibility—including combined video and 4.5 MHz BTSC subcarrier; remote status monitoring; computer controlled agile standby modulators; and fully redundant powering to each unit. The Series 2000 is covered by the Nexus 5 year warranty.

"The headend," says Peters, "is capable of handling anything that comes along in the next five years—including HDTV, whether it's analog or digital."

Although currently being installed in Canada by Rogers Cablesystems, the Series 2000 has "several breakthroughs in R&D that still have patents pending before final production," said Peters. For more info on the Series 2000 Headend System call (604) 420-5322.

Optical Networks International

ONI made several new product and system announcements. The first was the introduction of a low cost optical receiver designed to translate optical signals into RF. The Optical Interface Unit (OIU) features a universal package for both European and domestic applications. DC powering is compatible with the external power supplies available in each country. The system has full bandwidth capabilities up to 1 GHz, bi-directional operation, and allows for migration to emerging technologies.



ONI Laser Link II European system

Also developed and manufactured by ONI and AT&T, Anixter Cable TV International announced the introduction of the ONI Laser Link II European system. The Laser Link II transmitter package has a modular design which optimizes flexibility for cable operators. The product features seven universal plug-in slots for laser transmitters, RF amplifiers, receivers and advanced network management modules, all housed in a 8 3/4-inch by 19-inch shelf. The transmitter's design allows a six foot rack to accommodate up to eight shelves and 56 plug-in modules.

ONI also introduced AT&T's CSL LightSplice system, designed to provide a quick and easy method of splicing singlemode and multimode fiber. The CSL system includes a field assembled cleave and mechanical splice designed primarily for restoration splicing. Splicing time, including fiber preparation and cleaving, averages two to three minutes per splice. The system does not require polishing or adhesives.

"With fiber optics being looked at for problem solving applications (headend elimination, reduction of cascade, replacement of microwave links), economics are driving the situation," says Andy Paff, president of ONI. "System design and dropping of electronics will drive the curve of new installations. A system looking at doing a rebuild and not considering fiber optics is obsolete. Almost everyone is looking at fiber optics. This industry, when it sees an opportunity, goes for it."

For more info on ONI products and announcements call (800) *FIBER-ME* or (303) 694-9220.

Panasonic

A new series of non-addressable converters was shown by Panasonic.

The TZ-PC145 and TZ-PC175 feature new AGC circuitry required to meet FCC Part 15 output level requirements. The converters offer 550 MHz bandwidth (85 channels) and will not come with an increase in cost over the TZ-PC150 and TZ-PC170 models.

Panasonic also announced that Tim Roberti has been appointed national sales manager for Panasonic's video communications division, which includes CATV products. Roberti comes to Panasonic from General Instrument.

Also, a new distributor and six sales representatives were named by Panasonic. The new distributor is Toner Cable Equipment and the new reps are: dB Communications; Microsat; Mega Hertz Sales; R. Alan Communications; Communications Supply Group; and Cable Equipment Specialists.

Pioneer Communications of America

Pioneer reintroduced its Laserdisc Autochanger as the latest generation of hardware for interactive music video systems. The Pioneer CableJuke system is a music video ordering system which uses a laser videodisc as the video source. The system originated from the Pioneer Laserdisc Universal System. The announcement allows Pioneer to accommodate the music video market as well as the home video market through the use of laser videodisc technology.

The Autochanger contains up to 72 laser videodiscs, providing 700 to 900 different music videos. Random access within and between discs—a minimum access time of three seconds and a maximum of 35 seconds—allows for quick playback of videos to subscribers. CableJuke is available for immediate installation. Call (201) 327-6400 for additional information.

Reliance Comm/Tec

Reliance Comm/Tec announced its Utility Products Access 360 line of cable pedestals. The line offers three different sizes, a choice of galvanized steel or PVC plastic construction, and a wide selection of locking alternatives—including Diversified (Starlock), Innertite's Barrel Lock, or any form of padlock. The pedestals are rectangular in shape with lift-off covers that provide 360-degree access to internal equipment. Flow through louvers lessen condensation and heat build-up, while a pre-assembled stake and bracket and 8-inch ground base both reduce installation time and provide for stable installation. For more information on the Access 360 line, call (708) 455-8010.

Scientific-Atlanta

Scientific-Atlanta's tradition of bringing several new products to Anaheim continued this year as the company debuted a new series of fiber optic products, a new amp module and other headend equipment.

A new Series 60 family of fiber products (the 6460 transmitter, 6960 receiver, 6961 combiner and 6461 switch controller) were shown. The products share a common chassis and each offer front and rear test points as well as front-panel LED and digital display diagnostics. Each module has its own power supply and status monitoring capability.

The transmitter features a DFB laser, an integrated pre-amplifier, AGC and APC. The indoor rack-mount receiver contains up to two optical receivers as well as AGC that has a 6 dB optical range. The combiner can oper-

Panasonic's Model TZ-PC175 cable converter

ate as an RF A/B switch or as a combiner to provide two-, three- or four-receiver configuration. Control logic circuitry allows operators to custom configure the unit to perform specific functions. And the switch controller controls up to four optical and/or RF switches.

The Series 60 equipment was installed in Rogers Cablesystems in Toronto and will be generally available for shipping in January.

Two additions to the fiber line include the Model 6451 Headend Driver Amplifier, an indoor feedforward amp which drives the fiber equipment, and the Model 6901 outdoor Optoelectronic Bridging Amp, which features an advanced receiver available for either short or long distances. The Headend Driver has a minimum RF gain of 21 dB and a forward equalizer and adjustable pad slot are available as accessories.

Also, a new 32 dB 550 MHz dual parallel hybrid bridger was shown. It uses two output hybrids to provide 3 to 4 dB higher output than a single bridger module and is equivalent to feedforward performance but has a higher compression point. This means fewer line extenders are required. The bridger is designed for "broad applications" such as increasing bandwidth from 330 MHz to 550 MHz. This unit will be available in February.

Finally, stereo audio can be added to cable systems without taking additional rack space by making use of S-A's Integrated Stereo Encoder Module. The module slides into S-A's 6350 modulator chassis. It can also be used with other modulators in a rack-mount "four pack" configuration. These device will be available in January and February, respectively.

Sumitomo Electric

Three announcements were made by Sumitomo's Larry Corsello, VP of sales and marketing.

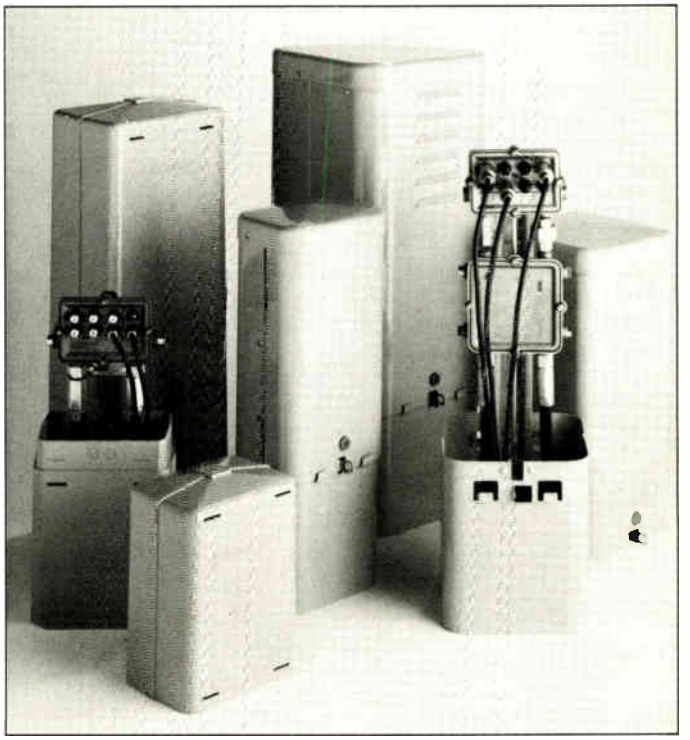
The first was the availability of the LitePipe fiber bundle loose tube cable, which offers "more than a 10 percent savings over its tube counterpart,"

Corsello said. Unlike conventional loose tube cable, the Sumitomo LitePipe cable consists of two to 12 fibers loosely placed in one gel-filled, central thermoplastic tuber—instead of the fibers being segregated within a number of loose tubes. The single tube is enclosed wihin a corrugated copolymer-coated steel/polyethylene outer sheath for rodent protection. LitePipe cable's outside diameter is 0.45 inches and weighs 90 pounds per 1,000 feet, making it "ideal for aerial installation as well as pulling through duct and direct burial applications."

Secondly, Sumitomo unveiled its new fiber-to-the-line extender architecture analog VSB/AM secondary node receiver. The architecture eliminates the need for RF trunk amplifiers. The system was recently tested by Cablevision Industries' Hillsborough, N.C. system (please see related case study, *CED*, December, 1990, p.46.) In the FTLE architecture, a strand-mount optical repeater serves as a "mini-headend", feeding the video signal to "relatively low cost" optical receiver nodes. Each node outputs RF directly to one or more feeder lines.

In a final announcement, Sumitomo introduced a digital system for cable television that transmits 24 channels at 1310 nm on a single fiber, or 48 channels using 1310/1510 nm wavelength multiplexing—without compression. Video and audio are baseband in and out, and operators can choose left and right or BTSC-compatible audio. "MSOs and single system operators have waited for products that fulfill the promise of digital transmission," commented Corsello. "Our new digital system provides high transmission capacity plus high quality pictures and sound, at competitive cost."

For more info on these products, call (919) 541-8100.



Reliance Comm/Tec's Access 360 line of pedestals

Telecommunication Products Corp.

New from TPC is an upgrade module

to the company's ADministrator traffic and billing software. Tagged as Version 3.1, the new software includes enhanced accounting functions, a wide variety of industry analysis reports, and a quickened automatic scheduling function . "The main advantage of the enhancements is speed," said Rick Montgomery, applications engineer. "We've quickened the scheduling and billing process dramatically." Also included in the upgrade is Cable Advertising Bureau (CAB) compatible formats and a new macro function, where repetitive keystrokes can be "recorded" to reduce data entry time. For more info on TPC's ADministrator 3.1 traffic and billing software, call (717) 267-3939.

Telecrafter Products

Announced by Telecrafter were new Service Control Boxes for buried cable systems. The foam-filled cable feed slots expand to accommodate multiple cables, or adapt to receive conduit having exterior dimensions of up to one inch. Seals are maintained to protect drop components from water damage. The interior allows for the addition of ground blocks, traps and splitters upon installation of service. The enclosure is molded of impact-resistant, UV-stabilized, talc-filled polypropylene. For additional info call (800) 548-7243.

Texscan MSI

The Editexpress tape compiler system made its debut in Anaheim. It combines the features of the Texscan PC Marker tape marking system with compilation and checkerboard editing features to reduce the time needed to create and modify commercial ad tapes by making assembling, marking and dubbing a single operation.

An inventory management system, printed reports and direct downloading of market directories from traffic and billing software is also featured. For info, call (801) 359-0077.

Trilithic

Trilithic introduced DLC-600 Precision Calibrator, designed "specifically with leakage equipment in mind," says Greg Marx, director of sales/marketing. The Digital Leakage Calibrator offers accurate level sources for the inspection and calibration of all brands of signal leakage instrumentation. The unit covers the frequency range of 50 MHz to 600 MHz and provides equivalent dipole signals from 1 μV/m to 1000 μV/m or absolute levels ranging from 0.5 μV to 1000 μV. Both 50 ohm and 75 ohm outputs are provided.

Actual output levels are derived from the user's own system carriers, ensuring that calibration data obtained from the DLC-600 is equivalent to field measurement practices. An LED display shows frequency in 1 MHz intervals and μV/m in 1 μV/m increments. The unit weighs 10 pounds, and is available with an optional carrying case and rack mount kit. The DLC-600 is priced at $1295. For more information, contact Trilithic at (800) 344-2412 or (317) 895-3600.

Triple Crown Electronics

The new Titan series of amplifiers was shown by Triple Crown. Available for North American and European markets, the Titan line was designed for high channel capacity and fiber optic cable systems. The 600-MHz amp is available in trunk, trunk/bridger and distribution versions, with push-pull or power doubling available in both the trunk and bridger.

Also, a new series of drop amplifiers was shown. The TDA-6 series is packaged in RFI sealed die-cast aluminum and provide sloped gain from 40 MHz to 600 MHz. For details, call (416) 629-1111.

TVC Supply

TVC Supply has added a new group of 2-, 3-, 4-, and 6-way splitters to its line of CATV products. The passives, all which bear a TVC label, feature high quality zinc diecast casings, a 5 MHz to 600 MHz bandwidth, and 90 dB RFI shielding. A machined flat "F" port provides improved connector fit, while a mechanically inserted back plate provides consistent RFI shielding. For more information on TVC's splitters, call (800) 233-2147. In the West, call (714) 361-2011, and in the Southwest, call (713) 956-2984.

Viewsonics

Viewsonics announced a new Tubular Amplifier which is tap mountable and provides 10 dB gain. It has a flat 40 MHz to 860 MHz response with excellent noise, cross-modulation, triple beat and second order figures, say Viewsonics officials.

Viewsonics also displayed its remote coaxial switches including basic, RF, video and IF sensing for commercial insertion, blackouts, redundancy and alternative signal source. Features include: DC to 1 GHz, return loss 18 dB DC to 600 MHz, isolation 60 dB minimum to 860 MHz and 100 dB RFI minimum. For more info on Viewsonics' products call (800) 645-7600 or (516) 921-7080.

Vu-Tech Communications

This company, which is affiliated with Western CATV, introduced a prototype of its SelecTeVision Plus system, which allows subscribers to control switching of signals between a VCR, cable converter or directly from the cable feed to up to three television sets.

The product, developed as a result of cable group studies, will be distributed through cable systems at a price of $150 for the entire set.

"The idea behind (the product) is a home entertainment center," says Raymond Pawley, president and CEO of Vu-Tech. The product allows viewers to enjoy their choice of entertainment from any room without having to return to the main room to change program sources, control the VCR, change channels or turn equipment on or off. The product also allows for the simultaneous viewing of one channel while recording another without the need for splitters and A/B switches. "It's like having a VCR and converter at each television set, but actually owning only one," adds Pawley.

The product will be ready for production in early January 1991, but preproduction prototypes are available now. For more information call (800) 955-1590 or (404) 850-1590. Western CATV can also be contacted at (800) 551-2288.

Zenith

Zenith is going after Jerrold's addressable converter marketshare with its new PM2-C compatible addressable decoder, which features advanced multimode scrambling and PPV capability. The PMII system features audio masking, process scrambling, channel mapping, volume control, VCR timer and parental control. The converter can replace Jerrold equipment with the addition of the Zenith controller and data inserter.

For information, call (708) 391-7000 ■

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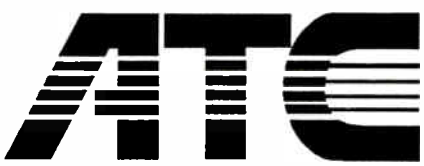

American Television &
Communications Corporation

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Installation testing of AM fiber routes

AM fiber cable television systems, such as those by Jerrold, ONI, Scientific-Atlanta and others, transmit an entire AM vestigial sideband TV spectrum over a singlemode optical fiber. In most configurations, a fiber optic cable extends from a rack-mounted transmitter in a headend to a receiver, which may be rack-mounted if located at a hub site, or strand-mounted or pedestal-mounted if located at a remote node.

This paper discusses procedures for engineering the lightguide route, testing the route during construction, making end-to-end completion tests, turning up the system and troubleshooting.

When engineering an AM fiber route, compromises must be made between system performance (carrier-to-noise ratio—CNR—and distortion), channel loading and route distance (optical loss). A method for doing route design is to first establish a CNR objective for a particular channel loading, and then use this to determine the required system loss budget. This budget imposes a maximum optical loss for the route, and the route is then engineered so that its maximum expected loss does not exceed this budget.

Figure 1 shows a typical installation in which the 15-foot fiber "pigtails" on the transmitter and receiver are spliced to the outside plant (OSP) fiber using the rotary mechanical splice (RMS) or an angled rotary splice (ARS).

For AM cable TV links, the system loss budget, which includes the entire loss between the transmitter and receiver, affects system performance. For example, a high system loss budget produces a poor CNR. High channel loading not only lowers CNR, but also increases distortion. Additionally, the effect of system loss budget depends on how it is apportioned between fiber and component losses.

For example, a 60-channel system may be able to achieve 52 dB CNR if the 8 dB system loss budget is divided equally between fiber and component (splitter and splice) losses. However, the CNR might degrade to 51 dB if all 8 dB were assigned to the fiber. The differing performance arises because double Rayleigh backscattering within the fiber itself introduces interferometric intensity noise (IIN) at the receiver.[1]

Lightguide routes are designed to have a maximum expected loss, which is the maximum loss that one would expect for a fiber path in a given route. Routes must be engineered so that the maximum expected loss is less than the system loss budget. The maximum expected loss of a fiber path is calculated by multiplying the maximum expected fiber loss by its length and adding this to the maximum expected splice loss. Clearly, most fibers and splices will have losses less than their maximum expected values.

Table 1 lists the maximum expected losses for fiber and some mechanical splices when they are used in a particular temperature environment. (Typical loss values are much less than those listed.) These values can be used to compute the maximum expected loss of a route.

As an example of how to engineer a lightguide route, suppose the objective is to achieve a 51 dB CNR with 60 channels. Depending on the manufacturer of the transmission equipment, this might be done with an 8 dB system loss budget.

Assume a 10-mile long aerial installation in a normal temperature environment consisting of six cables containing 0.35 dB/km fiber. The six cables will be spliced to each other and to the pigtails on the transmitter and receiver for a total of seven splices. All splices will be actively tuned using

By James J. Refi, Distinguished Member of Technical Staff, and Michael J. Swiderski, Member of Technical Staff, AT&T Bell Laboratories

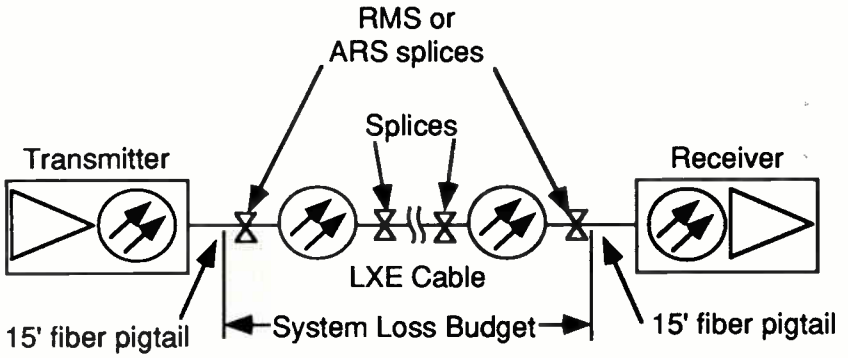

Figure 1

Table 1
1310 nm OSP Maximum Expected Loss Parameters

	Plant Environment		
	Underground & Buried 15° F to 170° F	Normal Aerial -10° F to 170° F	Extended Aerial -40° F to 170° F
Cabled Fiber (dB/km)			
Standard Loss	0.40	0.40	0.45
Low Loss	0.35	0.35	0.40
Splice Loss (dB/splice)			
RMS (non-angled)			
Passive	0.25	0.25	0.30
Active	0.10	0.12	0.15
ARS (angled)			
Passive	0.30	0.30	0.35
Active	0.14	0.16	0.19

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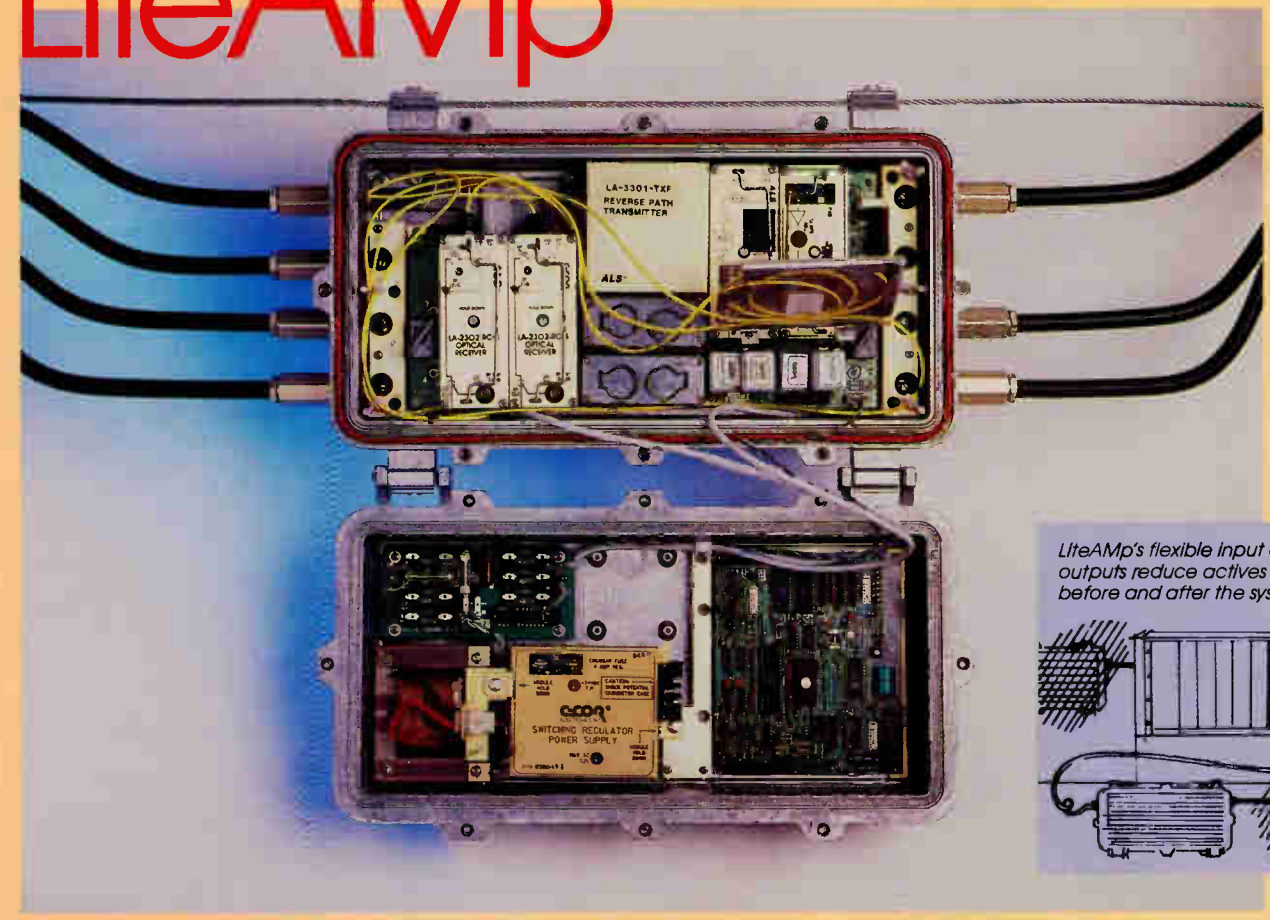

LiteAMp's flexible input and outputs reduce actives before and after the system.

FOUR REASONS TO SWITCH FROM COAX TRUNK AMPLIFIERS TO LiteAMp™ AM FIBER SYSTEMS TODAY

Group W Satellite looks to ALS for critical reliability fiber video links.

1 LiteAMp AM FIBER SYSTEMS NOW BEAT COAXIAL TRUNK AMPS IN PRICE AND PERFORMANCE

For rebuild and system extension applications, LiteAMp costs less than coaxial trunk amplifier runs. Fewer actives translates to better performance and reliability at the tap where it counts.

2 LiteAMp ELIMINATES THE COMPLEXITIES OF OTHER AM FIBER OPTIC SYSTEMS

LiteAMp looks and feels like a standard trunk amplifier, eliminating the need for retraining of field personnel. No special optical test equipment or optical matching is required. LiteAMp's modular architecture is designed for "plug and play" installation and maintenance.

3 LiteAMp SAVES AMPLIFIERS COMPARED TO OTHER AM FIBER SYSTEMS

LiteAMp requires as little as + 10dBmV input for 80 channel operation, which is 15–25 dB lower than other systems. At the node, output levels from trunk to multiple high level (+50 dBmV) bridgers are available, insuring you maximum reach with minimum electronics cost.

4 LiteAMp PRODUCT EXCELLENCE IS BACKED BY ALS CUSTOMER SUPPORT

In addition to CATV applications, ALS fiber systems are used extensively for critical reliability applications such as missile launch control, and network broadcasting. No CATV fiber systems supplier understands reliability and customer support better than ALS.

ALS

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Table 2
Minimum Bending radius (inches) for AT&T Cables

		LXE (metallic, dieletric, rodent lightning)		
	LXE-LW	4-48 Fibers	50-96 Fibers	108-216 Fibers
During Installation	8"	10"	12"	14"
After Installation	4"	5"	6"	7"

angled rotary mechanical splices. In addition, it has been decided that a margin will be reserved for four future repair splices.

Table 1 also shows that the 0.35 dB/km cable fiber loss does not increase in normal aerial environments. The total fiber loss is therefore 0.35 dB/km × 10 miles × 1.61 km/mile = 5.64 dB. The total splice loss is (7 + 4) splices × 0.16 dB/splice = 1.76 dB. The maximum expected loss is therefore 5.64 + 1.76 = 7.4 dB, which is less than the 8.0 dB system loss budget (as it must be for a proper design).

Because not all components will be simultaneously near their maximum loss, most of the time the loss of the installed fiber paths will be less than the maximum expected loss.

Construction sequence

The construction of fiber optic cable routes generally follows these steps:

- Cable placement.
- Fiber splicing.
- Path loss testing.
- Laser turn-up and testing.

Cable placement

Fiber optic cables can be placed in aerial, underground or buried environments. To ensure that cable properties do not degrade because of mishandling during placement, cable installation should be monitored by on-site inspectors who enforce compliance with the minimum bending radii and maximum pulling force limits of the cable.

Fiber splicing

Splice integrity should be verified before the splices are enclosed in splice closures. The verification method depends on the type of splice and whether one wants to verify only the optical continuity or also measure its loss.

Far-end transmission and detection. The simplest way to monitor the optical continuity of a splice during construction is to connect a light source to one end of the first cable and detect the signal at the opposite end of the spliced cable (see Figure 2). Because it requires a minimum of three people (one at each end and a third at the splice location) and communication paths among them, this method is not widely used except for laser turn-up.

Local detection. The number of people required to verify splice integrity can be reduced to two by using far-end transmission with local detection. With this method, light transmitted from location A is detected immediately after the splice rather than at location B, as in Figure 2. The local detection might be done by bending the fiber to cause some of its light to escape onto a photodiode. Equipment using this technique can be used to verify a splice's continuity by alternately clipping the identifier onto the fiber before and after the splice (see Figure 3).

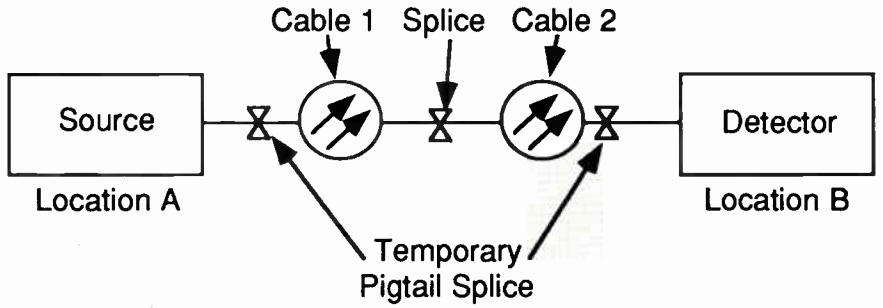

Figure 2

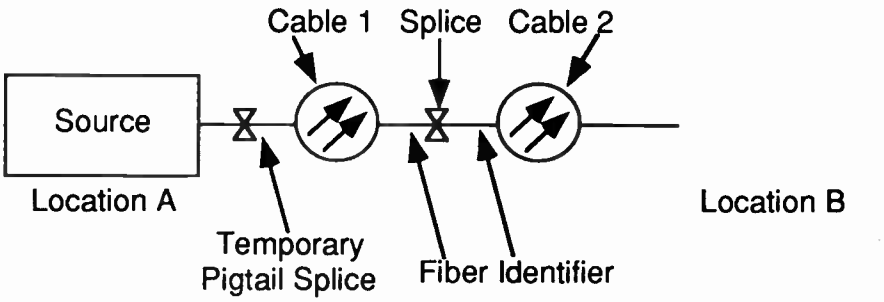

Figure 3

Local Injection and Detection. Local Injection and Detection (LID) systems further simplify the splicing operation and reduce the required number of technicians to one by injecting light into the fiber immediately before the splice and detecting light immediately after it.

LIDs that use macrobends serve as "optimizers"—giving no indication of the splice's loss, but allowing the splice to be tuned to achieve a minimum loss. Some of the light lost at the splice is gathered by the glass ferrule surrounding the fiber and guided through a plastic housing to a photodiode. Because the amount of scattered light is proportional to splice loss, the amount of lost light can be used to determine splice loss.[2]

Optical time domain reflectometry. Optical time domain reflectometry (OTDR) is perhaps the most popular method for measuring splice loss. One technician can measure splice loss, but a second would be needed if doing active tuning.

An optical time domain reflectometer measures the light reflected from discontinuities and continuously backscattered from the fiber itself. Changes in the backscattered signal between two points in a fiber show the loss between those points and this can be used to estimate the loss of the splice. The measurement is an estimate because OTDRs introduce an error that depends on the similarity of the fibers on either side of the splice. Because the error may be either positive or negative, the measured splice loss may appear large when observed from one direction and low (perhaps even a "gainer") when viewed from the opposite direction.

While the magnitude of this error can be as large as 0.5 dB for depressed

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clad fiber and 0.9 dB for some matched clad fibers, usually 95 percent of the errors are less than ±0.22 dB. The only way to overcome this OTDR limitation is to measure the splice from both directions and average the two readings. An OTDR's receiver circuitry might introduce another error when used to measure the loss of a reflective joint. Sudden changes in optical power, such as when going from a small backscattered signal to an intense reflected power, temporarily saturate the receiver—requiring time to recover during which the true signal backscattered from the second fiber is distorted. Unless an OTDR has a masking feature, this sudden change in signal power impairs its ability to measure the loss of reflective joints.

Another limitation, imposed by the pulse width of the OTDR, is its ability to resolve closely spaced events such as two nearby splices. High resolution requires narrow pulses, but this leads to reduced pulse power which decreases measurement range. Even "high resolution" OTDRs require events to be at least 15 meters apart to adequately measure their individual splice losses.

If a single-mode OTDR is used to monitor splice loss, the connection of the fiber to the OTDR is made using a temporary splice to a pigtail (see Figure 5). The pigtail has a connector on one end, which mates with the OTDR, and a bare fiber on the other end for splicing to the test fiber.

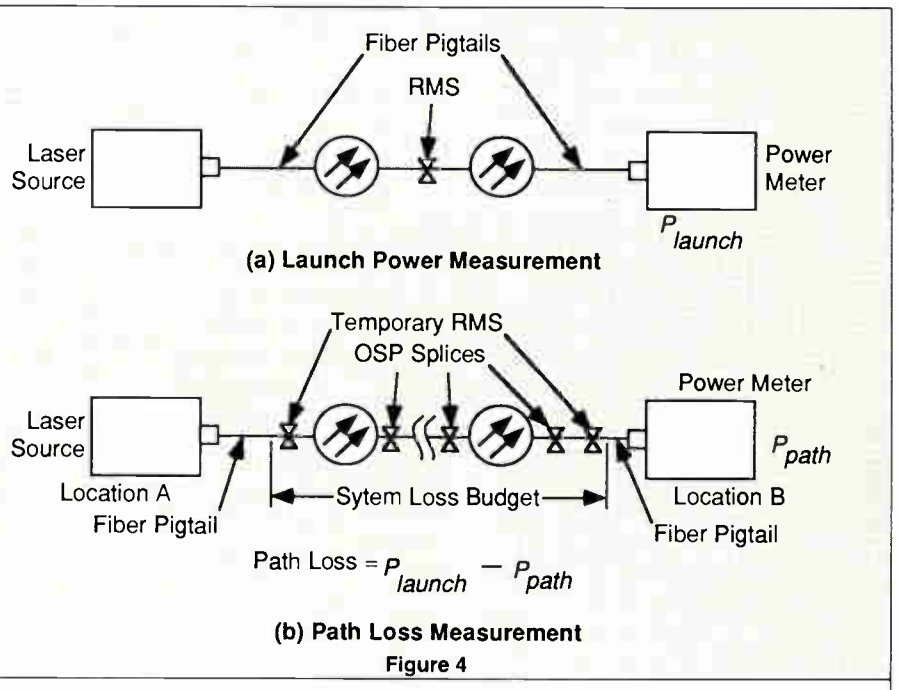


Figure 4

Direct core monitoring. Some fusion splicing machines use video imaging techniques for measuring parameters that affect splice loss.[3] By viewing the fibers vertically and horizontally with a video camera, parameters such as cladding and core offset; type, amplitude and length of core definition; and variation in fiber outer diameters are analyzed by a microprocessor to estimate splice loss. While producing good loss estimates of low loss splices, this method sometimes does not detect broken fibers or high loss splices. Other methods, such as an OTDR, could be used to overcome these limitations.

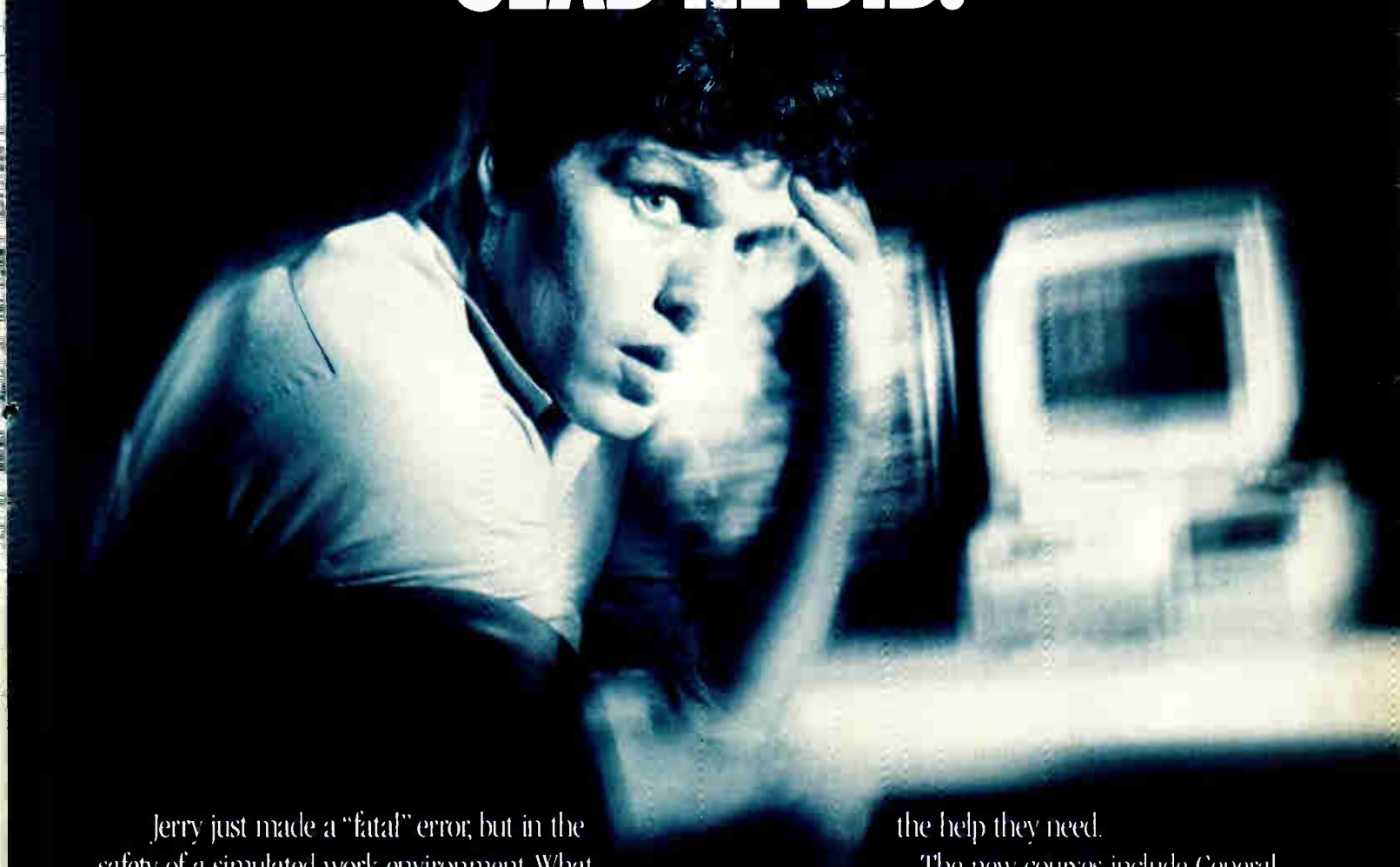
Path loss testing

After installation of the fiber and splices, the end-to-end path loss is measured between the two ends to be connected to the transmitter and receiver fiber pigtails. The testing should be performed at the 1310 nm operating wavelength. The measured path loss is then compared to an adjusted system loss budget which is simply the system loss budget adjusted for the end connections and repair splice margin. If the path loss is smaller than this adjusted system loss budget, then the AM system will perform as intended even after future repair splices are made.

Two ways of measuring path loss are the transmission method and the optical time domain reflectometry method.

Transmission method. The transmission method for measuring path loss uses an optical source (laser or LED) and power meter for measuring the optical power launched into the

JERRY BIRNS ELECTROCUTED HIMSELF TODAY. AND HIS BOSS IS GLAD HE DID.



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fiber path at one end and received at the other. Some test sets incorporate a source and power meter into one unit called a "loss test set." (The power meter should have the capability of measuring power levels as large as 10 dBm.) The following describes the procedure for using a separate source and power meter.

RMS ferrules (non-angled) should be installed on both ends of the fiber-path to be tested. Test pigtails for connecting the source and power meter can be made by cutting a singlemode interconnect cable (having the appropriate optical connector on either end to mate with the test sets) in half, and installing RMS ferrules on the two bare fiber ends.

With the light source and power meter at location A, measure the light output from the source by connecting the RMS ferrules on the pigtails together using a rotary coupler and index matching gel, as in Figure 4a. While looking at the display on the power meter, tune the RMS ferrules to maximize the launch power, P_{launch}.

Without disturbing the optical connections on the pigtails at the test sets, disconnect the rotary ferrules and take the source or power meter to location B. Depending on the test set model, battery power may need to be left on to preserve the calibrated power level readings, while other test sets retain their calibrations even when powered down.

Connect the RMS ferrules on the test set pigtails to the ferrules at the ends of the fiber-path using rotary couplers and index matching gel (see Figure 4b). As before, tune the RMS ferrules at locations A and B to maximize the path power, P_{path}.

The measured path loss in dB equals the absolute magnitude of $P_{launch\text{-}path}$. To determine what components are included in the measurement, notice in Figure 4a that one RMS is included in the P_{launch} measurement and in Figure 4b that two RMS end splices are included in the P_{path} measurement. The measured path loss ($P_{launch\text{-}path}$) thus includes one less RMS splice than the number included in the system loss budget. The adjusted system loss budget must take this additional loss into account as well as the repair splice margin.

If the final splices to the transmitter and receiver are going to be actively tuned RMS, then:

Equation 1. Adjusted system loss budget = System loss budget − Splice repair margin − 0.1.

If the final splices to the transmitter and receiver are going to be actively tuned ARS, then:

Equation 2. Adjusted system loss budget = System loss budget − Splice repair margin − 0.2,

where the losses have been rounded to 0.1 dB. To assure that the AM system will perform as intended even after future repair splices are added,

Equation 3. Path loss(Adjusted system loss budget.

For the previous example, use the second equation and find that the Adjusted system loss budget is 8.0 − 4 splices × 0.16 dB / splice − 0.2 = 7.2 dB.

Optical time domain reflectometry. Another way of measuring path loss is with an OTDR (see Figure 5). The test lead should be about 1 km long so that the first OTDR marker can be set before the temporary RMS splice. While watching this splice's loss on the OTDR, tune the splice to minimize its loss. The second OTDR marker is then positioned before the end of the fiber at location B. The measured path loss between these two points therefore includes the one-way loss of the temporary RMS at location A.

To improve the accuracy of the path loss measurement, the OTDR may be taken to location B and the measurement repeated. The average path loss reading is then compared to the adjusted system budget using the first two equations in the previous example.

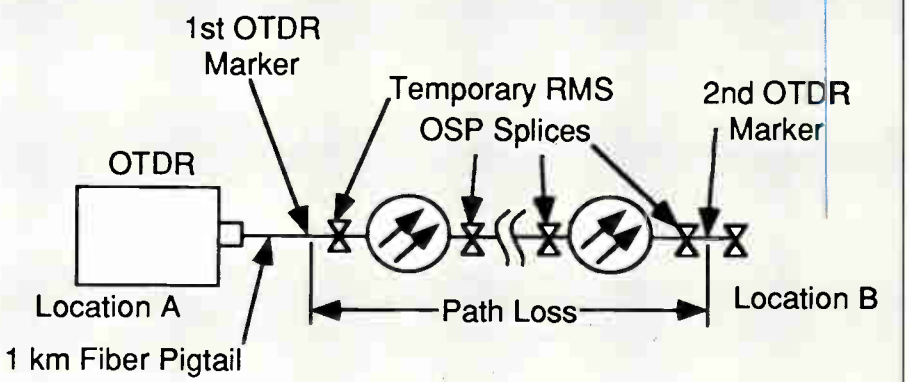

Figure 5

Laser turn-up and testing

After measuring the path loss as described above, and assuring that it meets the loss levels established in the first two equations, the OSP fiber ends are spliced to the pigtails on the transmitter and receiver. If these splices are made with RMS splices, then the ferrules already installed on their ends can be joined to the ferrules on the pigtails. If ARS are being used, the RMS ferrules at either end should be cut off and replaced with ARS.

The RMS should be tuned by first making the splice at the transmitter, connecting a power meter to the receive end, and tuning the splice at the transmitter to obtain maximum power from the transmitter. The splice at the receiver is then made, and this splice is tuned by maximizing the voltage between the + and − "optical power"

test points on the front panel of the Laser Link receiver using a voltmeter. Alternatively, the splices can be tuned using LIDs. The system is now ready for CNR and distortion measurements.

Troubleshooting

OTDRs measure the distance to a fiber break or some region in a cable by measuring the roundtrip time required for a pulse of laser light to travel to and from that feature. The measured time is then converted to distance using the group delay, τ_g, of the fiber. While OTDRs make this conversion internally, the user needs to enter the appropriate information into OTDR. Some OTDRs require the fiber's group delay, while others want a related parameter—the group index of refraction N_g (which equals $c \times \tau_g$, where "c" is the speed of light in a vacuum, or 0.2998 km/μsec.) Table 3 shows these parameters for AT&T depressed clad fiber.

Table 3
Group Delay and Index of Refraction for AT&T Depressed Clad Fiber

Wavelength (nm)	Group Delay τ_g (μsec/km)	Group Index N_g
1310	4.890	1.466
1550	4.893	1.467

Summary

The testing procedures described here are not the only way to test AM fiber cable TV routes. They have, however, proven useful in several installations and can serve as a guide when developing individually tailored test plans. ■

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Anatomy of a failure

Cable, across the board, appears to be one of the most active, progressive and dynamic sectors of the electronic industry today. We see quantum leap advances in every area, from plant to marketing. New and improved cable converters and decoders are becoming available. Our various journals and trade magazines discuss in detail such things as system economy, productivity, rebuilds, project management and virtually every phase of cable operation—except one. That one item that somehow gets ignored is failure. "What do I do when my converter/decoder fails? Shall I buy a new one, or have the old one repaired?"

These questions have been challenging the consumer since manufacturing became a viable technique. I can imagine a Roman charioteer asking himself this very thing about the broken wheel on his chariot.

"Repairing converters is often a wise choice over replacing them."

Repair or replace?

Every one of us who depend on equipment manufactured by someone else have to eventually ask ourselves these questions, and most of us look to the manufacturer for the answers, understanding of course that his most profitable answer will invariably be "buy a new one."

Being based in Alaska lends to some interesting failure conditions—and because of the unique geography of Alaska, we are very familiar with the concept of failure. The temperature in this part of the world varies about 100 degrees from summer to winter. The cost of living is high, and capable technical help is difficult to find. For these and many other reasons, it is mandatory that a service company thoroughly understand the products it maintains.

By George McCleary, President and General Manager, Anchorage Commercial Electronics, Inc.

"Failure rate" is a term often used but seldom understood. We all kow that when something refuses to perform as designed, it has failed. But the big questions are *why*, and *what do I do about it?* We would like to share with you some of our personal definitions of failure.

Attrition failure

Every product has a projected life. Theoretically, if we have 100 units with a projected five-year life, we are assuming that each unit will have failed once during that period. This is a very good starting place. The term "annual attrition failure rate" is a theoretical percentage based on the projected life of the unit and is calculated as follows:

Number of units = number of failures

Number of failures/projected life = failures per year.

For example,

100 units = 100 failures

100 failures/5 years = 20 failures per year

20 failures per year = 20 percent per year.

Therefore, the attrition failure rate = 20 percent per year.

This figure is relatively easy to verify because it deals with "first time failures not related to damage" only. Verification of the annual attrition failure rate provides two valuable management tools: assessment of product quality and management of operational failures.

By identifying failures related to the quality of the product, we have also isolated failures caused by all other conditions. In other words, we are able to start dealing with the solution rather than the problem.

Effective analysis of operational failures requires the use of a failure reporting system. It also requires a high degree of understanding and cooperation between the field tech who will be reporting symptoms and the shop tech who is repairing the unit. Failure codes should be selected to address both the design and complexity of the unit and the actual failure pattern being experienced.

Reporting: keep it simple

An effective failure reporting system must localize the failure and, at the same time, be simple and easy to use in the field. The key to any effective failure reporting system is to "keep it simple." Over-reporting is not productive and will probably be avoided by the technicians involved. Using the "keep it simple" failure reporting technique should provide data in three specific areas:

- First time failures not related to damage
- Symptoms reported by failure code
- Repairs required, reported by repair codes.

Analysis of the data from these three sources can be extremely productive. First-time failures provide a firm fix on the quality of the product. This knowledge will also support management of repair costs and budgeting. We believe the overall failure rate, including that of the reserviced equipment, should never exceed the annual attrition failure rate originally calculated.

Symptoms, reported by failure codes,

reveal why the converter/decoder has been removed from service. Actual repairs, reported by repair codes, will specifically pinpoint the module or component part and/or procedure required to restore the unit to service.

A typical example may be slow lock-on channel. The decoder module appears to be the source of the problem. In truth, the real error may be improper IF alignment. Too often both the IF and decoder modules are replaced, which may restore the unit to a borderline condition. Unfortunately, the cost of repair in this situation is unrealistically high—and the real problem has never been addressed. When this kind of thing happens, the overall failure rate goes sky high, repair and support costs increase, and the quality of the product is in question. It appears as though failures are occurring indiscriminately over the entire field, when actually an inappropriate service procedure, producing a borderline repair that fails again soon after the unit has been put back into service, is the problem. The excessive overall failure rate may be caused by a very small percentage of the product. Unfortunately, this situation is self-supporting. The unit that fails and is then restored to borderline service is the same that goes back into the field as spare stock, replacing equipment that has failed for legitimate reasons.

When we were first asked to look into this area of service by a local cable company, the company told us its installers were taking 12 decoders each day to support eight installs. They had tried a number of options of decoder repair, and had even gone to the expense of setting up their own service center. The cost of decoder repair was totaly out of control. They believed their failure rate was between 25 percent and 30 percent. Installation costs were way over budget because of the added support required. They were seriously questioning the quality of the product and were considering replacement of approximately 45,000 decoders.

Actual repair costs on the decoders, factoring internal repairs, appeared to be in excess of $38 per unit. Cost of support services to install and/or remove the decoders that were failing in the field was escalating, and customer relaitons were at an all-time low. We estimated that our client was spending in excess of $325,000 annually on converter repair—not including support costs and customer relations problems.

Our first step was to set up a simple failure reporting system. Analysis of the repair codes indicated that need for improved alignment procedures. Accurate test equipment used in the proper way virtually eliminated the replacement of IF modules within the first four months. Continued attention to our failure reporting system, aggressive quality control and new service techniques reduced the overall failure rate to 1.1 percent per month. Repair costs were literally halved, support service costs were reduced, and customer complaints of defective decoders were substantially minimized. And even more importantly, these decoders are now over eight years old. The major expenditure of replacement is no longer an immediate requirement.

The answer to our original question—shall I fix it, or replace it?—is *fix it.* Many failures are repetitive, which become easier to solve as time goes on. Repair is a cost-effective alternative to replacement, provided your repair facility does its job effectively. ■

[1]Jan Carlzon, *Moments of Truth.* Ballinger Publishing Company, 1987.

Fundamentals of optical fiber communication systems

Part One

This article highlights the basics of optical fiber communications and its application in the CATV environment. Following a brief review of the physics of light, several key topics in fiber optic communications are covered. These include a discussion of optical fiber characteristics, optical transmitters and receivers and modulation techniques.

The transmission of CATV signals using optical fiber communication technology has seen a rapid growth over the past several years. With fiber optics, light rather than electricity is used to transmit information through an optical fiber. Tremendous advances have been made in the development of various fiber optic components such as low-loss fibers, high-speed transmitters and receivers as well as a variety of low loss connectors, splices and couplers that make fiber optic communication a viable alternative to other transmission methods.

There are many advantages to optical fiber transmission when compared to conventional transmission mediums such as coaxial cable. Perhaps the most important advantage is the great difference in bandwidth or information carrying capacity between fiber and coax. A single fiber optic strand has a potential bandwidth capability of many thousands of GHz—the equivalent of nearly 6 million television channels at 6 MHz per channel. Other advantages include its low attenuation (less than 1 dB/mile), immunity to RFI/EMI (radio frequency and electromagnetic interference) and its relative small size and light weight compared to coaxial cable. Additionally, there is no requirement to equalize i.e., their losses do not depend on the modulation bandwidth.

The physics of light

When describing the transmission of signals through optical fibers, the term "light" is commonly used. However, light is defined as electromagnetic energy visible to the human eye. Today's optical fibers exhibit their lowest attenuation at wavelengths that are longer than visible light hence invisible to the human eye. This longer wavelength region is the infrared region and the signal energy is referred to as optical or infrared (IR) radiation. Both visible light and IR radiation are in a section of the electromagnetic spectrum characterized by wavelengths which are shorter than microwaves. (Figure 1). In free space, all electromagnetic waves, whether they are radio waves, microwaves, IR, light waves, etc., travel at a velocity of 186,000 miles/sec (300,000,000 meters/sec). This is commonly referred to as the speed of light.

The photon nature of light

Under certain circumstances, light can also be thought of as being made of particles known as photons. Physicists have found that although light must sometimes be treated as waves spread out in space, it is sometimes best to describe it as a particle having a discrete location. A photon is considered to be a discrete package or bundle of energy. Each photon has an amount of energy that is proportional to the frequency. An increase in frequency yields an increase in energy. In other words, a higher energy photon is associated with a lightwave of higher frequency. In optical communication systems, photons are the agent for information transfer much like the generated electrons in a metallic cable are used in an electrical current. (The particle nature of light will be helpful to us in describing the operation of optical trannsmitters and receivers.)

Reflection and refraction

As light waves propagate in a medium other than free space, the velocity is reduced. The ratio of the speed of light in free space to the speed of light in a material is given by the refractive index n.

$$n = \frac{C}{Vp}$$

where,
c = velocity of light in vacuum
Vp = velocity of propagation of light in a material

It is of great importance to note that different wavelengths of light travel at different velocities through the same medium. This wavelength dependence on the refractive index significantly affects how light travels through various materials.

The index of refraction of air is regarded as equal to 1. Other values include 1.33 for water, 1.5 for glass, 1.77 for sapphire and 2.4 for diamond. The velocity of propagation, Vp, and can be found from equation 1 by dividing the velocity of light in air by the refractive index of the particular

The Electromagnetic Spectrum

Name	Wavelength	Frequency (Hz)
Gamma rays*	less than 30 pm	over 10^{20}
X-rays*	10 nm to 30 pm	3×10^{16} to 10^{20}
Ultraviolet light*	400 to 10 nm	7.5×10^{14} to 3×10^{16}
Visible light	700 to 400 m	4.2×10^{14} to 7.5×10^{14}
Infrared light	1 mm to 700 nm	10^{11} to 4.2×10^{14}
Microwaves	0.3 m to 1 mm	10^{9} to 10^{11} (1 GHz to 300 GHz)
Radio waves	30,000 to 0.3 m	10^{4} to 10^{9} (1 kHz to 1 GHz)
Low-frequency waves*	over 30,000 m	under 10^{4} (kHz)

*No standard boundaries.

Figure 1

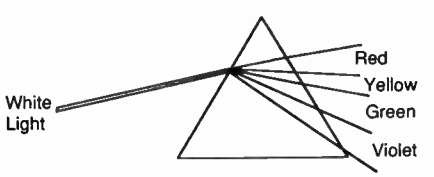

Figure 2

By Robert Harris, Fiber Optic Staff Engineer, C-COR Electronics, Inc.

FIBER OPTICS AND WHITE MOUNTAIN CABLE: THE CHOICE IS CLEAR.

Cable companies everywhere are switching to fiber optic cable for new and retrofit video and data communication systems.

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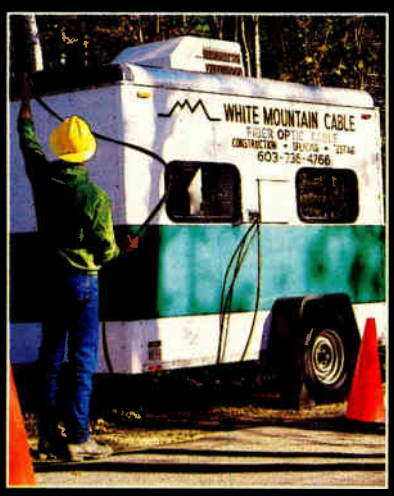
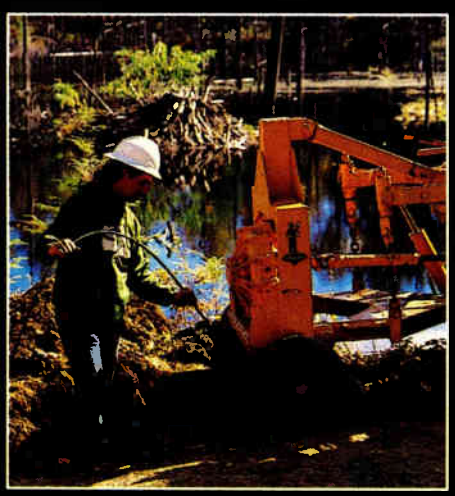




medium.

For example, the velocity of light in glass with a refractive index of 1.5 is about 124,000 miles per second.

Prism effect

As light waves propagate from one medium to another, say from air to glass, its direction of travel is changed. The light wave is bent or refracted. The principles of refraction can be seen with a prism (see Figure 2). As white light (composed of all colors) enters the prism, each color is refracted differently because each color (wavelength) of light travel at different speeds through the prism. Light emerging from the other side is divided into the visible colors of the spectrum.

The index of refraction can be used to determine the direction of a light ray through a particular medium. Mathematically, the direction of propagation can be expressed by using Snell's law.

$$N1 \sin i = n2 \sin i2 \qquad (2)$$

where,

n1 = refractive index of medium 1
n2 = refractive index of medium 2

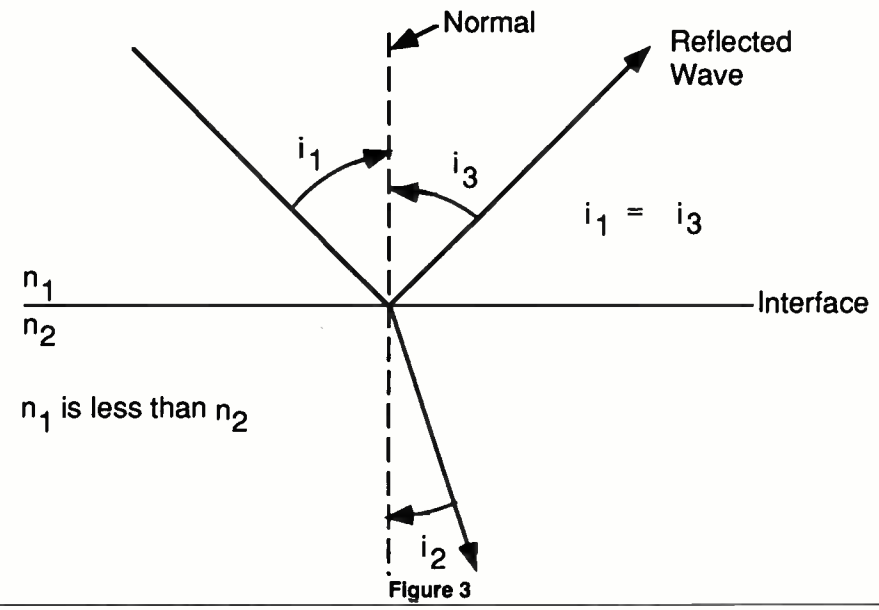


Figure 3

i1 = angle of incidence
i2 = angle of refraction

Note that the angles are defined as normal to the surface where normal implies an imaginary line that is perpendicular to the surface (Figure 3). When light passes from a lower refractive index to a higher one, as in air to glass, light is bent toward the normal, according to Snell's law. Most of the light enters the second medium while a small amount is reflected back into the first. The angle of the reflected light ray equals the angle of the incident light ray.

When light passes from a higher index material to a lower one, the light is bent away from the normal as shown in Figure 4 again following Snell's law. By increasing the angle of incidence, the angle of refraction approaches 90 degrees, the angle of incidence is known as the critical angle. If the incident angle is increased any further, the light will not enter the second material and will be reflected back into the first medium at the same angle of incidence. This is referred to as total internal reflection and it is this physical phenomenon that governs the way in which information is carried through optical fibers.

Optical fibers

An optical fiber is composed of two different optically transparent materials. The center region is a solid cylindrical core and is the area through which the light is guided. The outer region is a solid concentric cladding that surrounds the core. Both regions are composed of silica glass. However, the index of refraction of the core is greater than the index of refraction of the cladding. The cladding not only protects the core but also serves to bend the optical energy back into the core (total internal reflection) allowing the light to continue along the fiber. With this construction the infrared optical

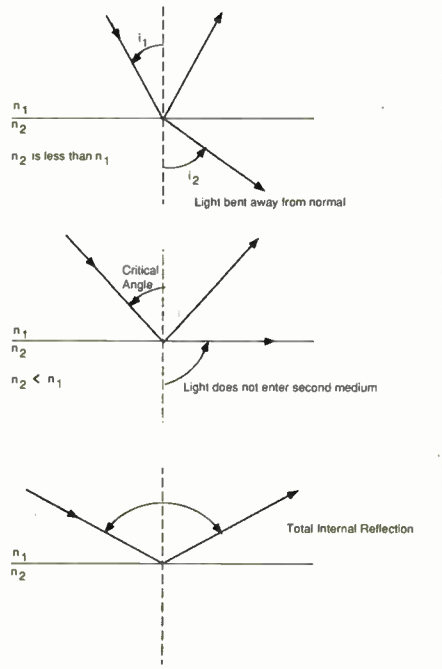


Figure 4

radiation is contained in and guided through the core. As mentioned earlier, there is a definite angle beyond which the optical energy will leave the core entirely. This is the critical angle. In other words, if the light enters the core at angles greater than the critical angle, the light rays will escape into the cladding and not be transmitted through the core.

The first commercially available optical fibers, still widely used today, are known as multimode fibers. These fibers allow the light to travel in a number of different angular paths inside the central core region. The core diameters of these fibers are typically between 50 and 20 micrometers (μm). Each angular path of light through the fiber represents a "mode" of propagatttion thus the name multimode.

Multimode fiber types

There are two styles of multimode optical fibers: step index and graded index. In a stpe index fiber, the indices of refraction of the core and cladding change abruptly at their interface whereas graded index fibers have a more gradual change (see Figure 5). However, because of the bandwidth limitations of multimode fiber (about 600 MHz over 1 km) these are typically not used in CATV applications.

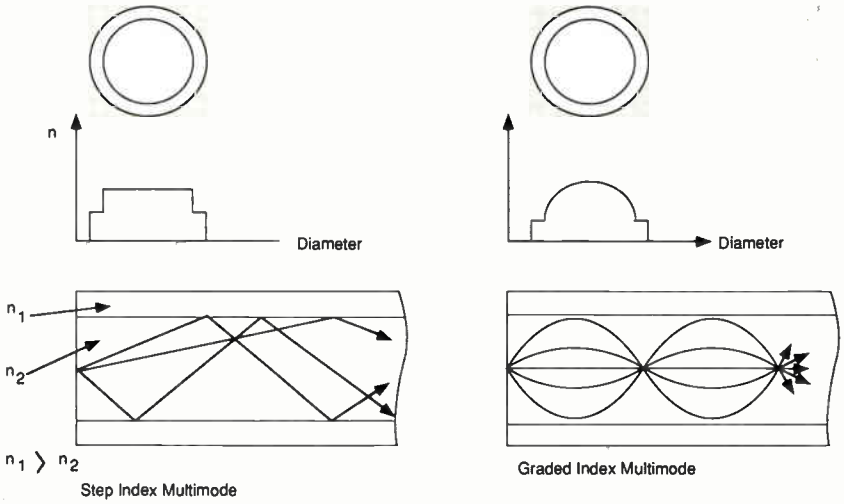


Figure 5

Singlemode fibers use a much smaller core (2 to 8 μm) which results in a single optical path of propagation, hence the name singlemode. The core diameter is the same order of magnitude as the wavelength of optical radiation being transmitted (similar to waveguides in microwave communications) leading to a significantly higher transmission bandwidth. Singlemode fibers are typically of the step index type. This fiber is the preferred optical fiber for use in the CATV industry (see Figure 6).

Numerical aperture

The amount of optical power that can be coupled into the fiber core depends upon the light collecting ability of the fiber. A common measure of this light gathering ability is called the numerical aperture (NA). The NA defines the maximum angles of light to be accepted into the fiber. With these angles de-

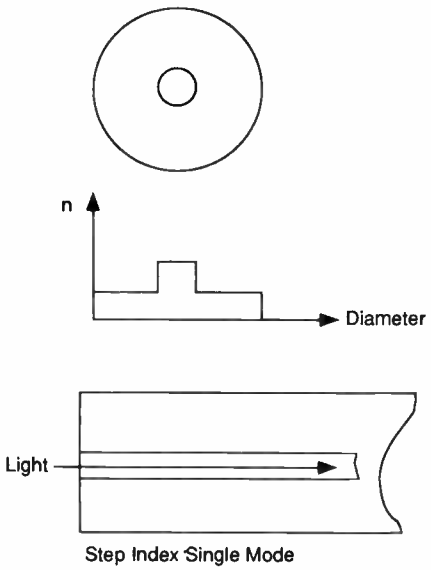


Figure 6

fined, an acceptance cone can be formed in which light entering within this cone will be transmitted while light entering at steeper angles will not. An increase in the NA results in an increase in the optical energy that can be accepted into the core. However, a large NA leads to more paths of light resulting in an increase in dispersion (to be discussed later). The NA for step index fiber is a function of the two indices of refraction and is expressed mathematically by equation 3. For singlemode fibers the NA is typically under 0.2.

$$NA = (n^2 - ni^2)^{1/2} \quad (3)$$

where,
n = refractive index of material 1
ni = refractive index of material 2

Properties of optical fibers

Attenuation: As light energy propagates along an optical waveguide, the average power of the light is attenuated. An important advantage of fiber is that, unlike coax, attenuation is constant at all modulation frequencies. For example, with fiber optics, a 550 MHz signal is attenuated the same as a 50 MHz signal. Attenuation is a function of the distance traveled and wavelength of optical signal being modulated.

In optical fibers, there are several factors that cause attenuation. The fundamental limit below which attenuation cannot be reduced is due to Rayleigh scattering.

Rayleigh scattering is intrinsic to a material such as the glass core of an optical fiber and is caused by microscopic index variations that were "frozen" into the material when it solidified. These random fluctuations, which occur throughout the length of the fiber, are the result of thermodynamic effects which cannot be reduced beyond a certain limit. Typical attenuation values for optical fibers are 0.35 dB/km at 1300 nanometers (nm) and 0.2 dB/km at 1550 nm (Figure 7).

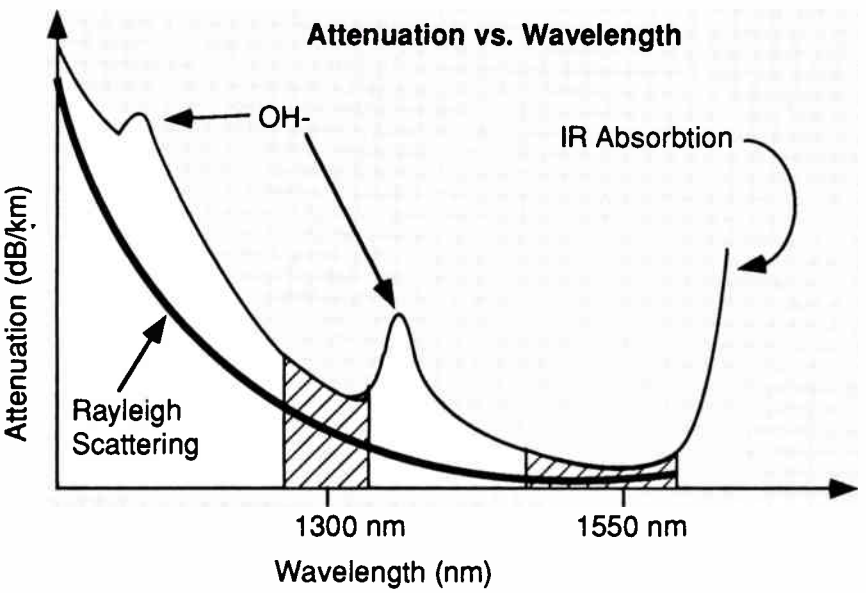
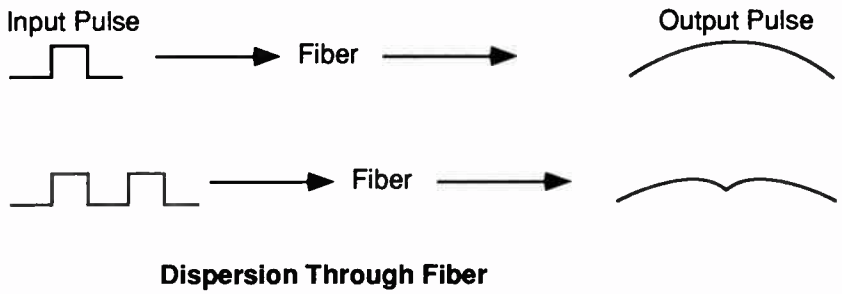


Figure 7

Another source of attenuation is due to impurities within the optical core causing a portion of the signal energy to be absorbed. These impurities, such



Dispersion Through Fiber

Figure 8

Bandwidth and pulse dispersion

Dispersion is the spreading or broadening of an optical pulse in the time domain and is caused by light's interaction with the glass fiber. As the pulse spreads, it can interfere with the following or prior pulses resulting in the inability of the receiver to distinguish between the pulses. Dispersion, therefore, has the effect of limiting the data rate or bandwidth of a fiber transmission system (Figure 8).

as OH- ions (water vapor), have been greatly reduced through enhanced manufacturing techniques.

Bending losses, of which there are two types, is another contributor to attenuation in optical fibers. Macrobend loss refers to the loss caused by bending the fiber cable beyond a certain minimum bend radius (typically less than a couple centimeters). Bending the fiber beyond this minimum causes light energy to escape from the core and be directed into the cladding resulting in a loss of optical power. Microbend loss refers to small bends or minute deviations at the core/cladding interface that are caused by lateral forces. This results in an optical power loss from the fiber core.

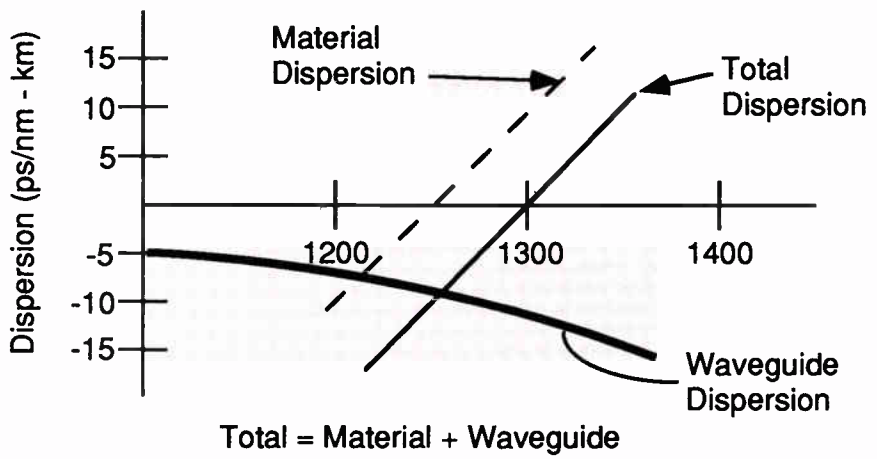


Figure 9

Dispersion types

There are several types of dispersion; modal, material and waveguide dispersion. Modal dispersion is due to the differences in the time of flight between the different paths (modes) of light. Light rays entering parallel to the axis (lowest order modes) will reach the end of the fiber before light rays that enter at say, the critical angle (highest order mode). This occurs only in multimode fiber since singlemode fiber has only one mode of propagation.

We know from our discussion on refraction that different wavelengths of light travel at different velocities through a medium such as glass. Light transmitted from a source is comprised of different wavelengths and therefore each wavelength will travel at slightly different speeds through a fiber, causing dispersion of the optical pulse. This is known as material dispersion.

Waveguide dispersion arises from the waveguide nature of the optical fiber and is analogous to the waveguide properties in microwave communications. The transmitting wavelength is of the same order of magnitude as the size of the transmitting medium. The combined effect of material and waveguide dispersion is often referred to as chromatic dispersion (see Figure 9).

There exists a region in which the chromatic dispersion is at a minimum. The wavelength which corresponds to this minimum point is referred to as the zero dispersion wavelength and in many fibers is located at around 1300 nm. By employing special index profiles at the core/cladding interface it is possible to construct the fiber cable in such a way as to "shift" the zero dispersion wavelength to the lower loss region of 1550 nm.

Further, it is possible to construct a fiber such that it becomes dispersion flattened resulting in minimum dispersion at both 1300 nm and 1550 nm (Figure 10). ■

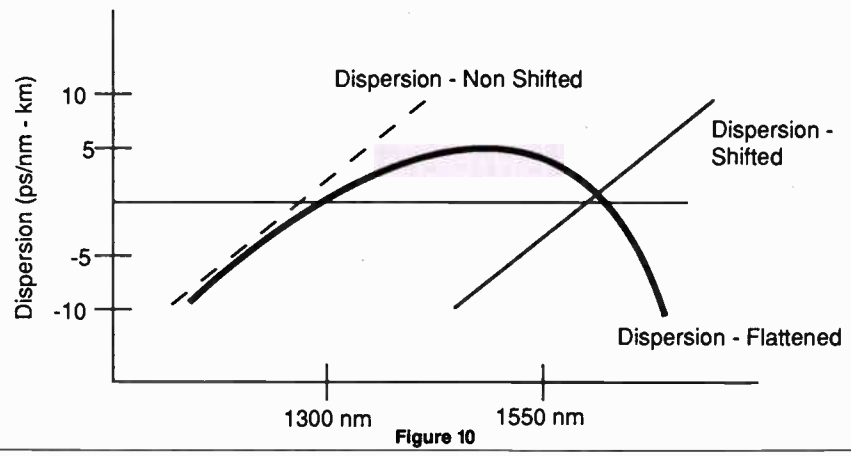


Figure 10

Next month's "Back to Basics" column will feature the second and final part of this series, and will focus on fiber optic transmitters, opto electronic receivers and CATV modulation options.

AD INDEX

The CABLE POLL
TMMidwest CATV & CableVision Magazine

31% of cable systems lack safety, training program

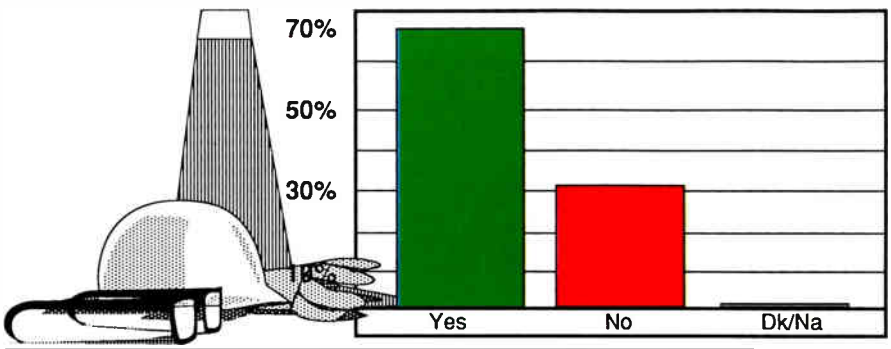
When it comes to training and safety issues, there is both good and bad news for the cable industry. The good news: A growing number of operations report that within the past year they have increased the level of training offered. Now, the bad: Almost one out of every three cable systems has yet to implement a mandatory training and safety program geared to their employees.

According to the latest Cable Poll™, 31 percent of those polled don't have a compulsory training program in place, even as safety and health issues become more critical. On a happier note, 65 percent of those systems that do offer training report they have increased the scope of those educational efforts over the past year.

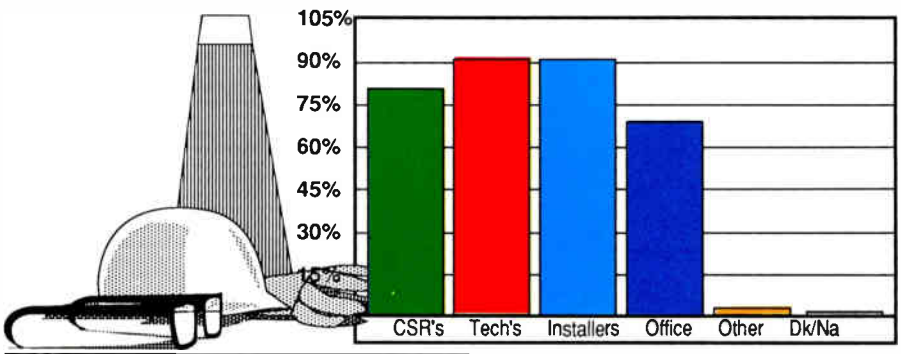
As might be expected, smaller operators—those with fewer than 10,000 subscribers—are more likely than their larger counterparts to be without a formalized educational strategy. By contrast, of those systems that serve more than 50,000 homes, more than 85 percent require employee attendance to training and health programs.

If mandatory training is provided, technicians, installers and customer service reps are the most likely participants. A little over 90 percent of GMs responding to the Cable Poll™ said technicians and installers are required to take part in training; 81 percent said CSRs were included. Just under 75 percent also stipulate that office personnel attend training.

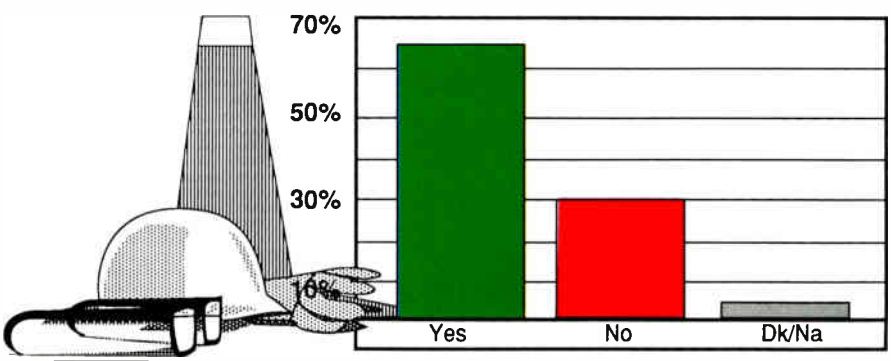
On the safety front, most GMs report they have an ongoing safety program that includes procedure manuals and a specific yardstick that measures how well employees are adhering to safety standards. Only 19 percent said they



Do you have a mandatory training program in place for your employees?



Which of the following employees are required to participate in the program? (Check all that apply)



Have you increased the level of employee training offered by your system in the past 12 months?

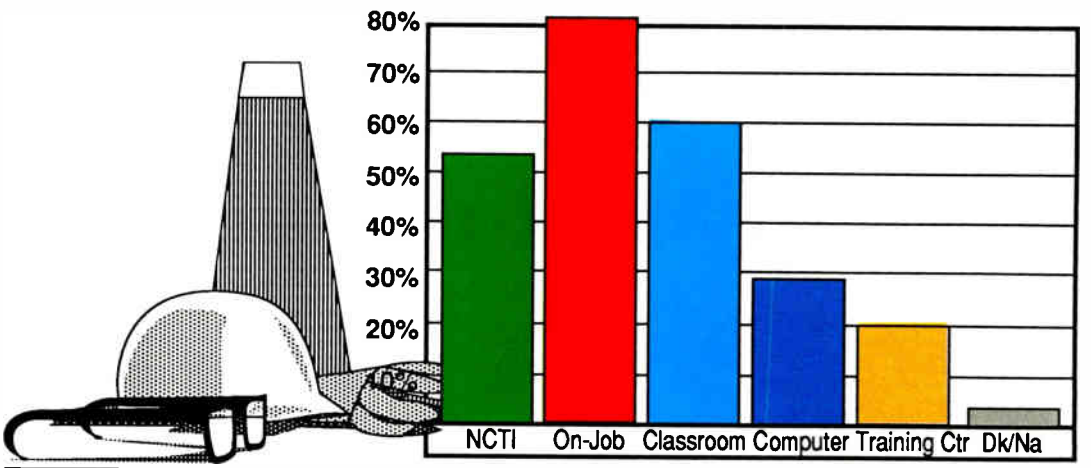
didn't have such a program, a number that is sure to shrink as Occupational Safety and Health Administration-mandated safety programs take effect in the next few years.

The size of the GM's parent MSO appears to be a determining factor whether or not a manual and measuring program exist, according to the Cable Poll™. More than 89 percent of managers who toil for top-25 MSOs report they have a safety manual, while only 64 percent of GMs who work for smaller MSOs do.

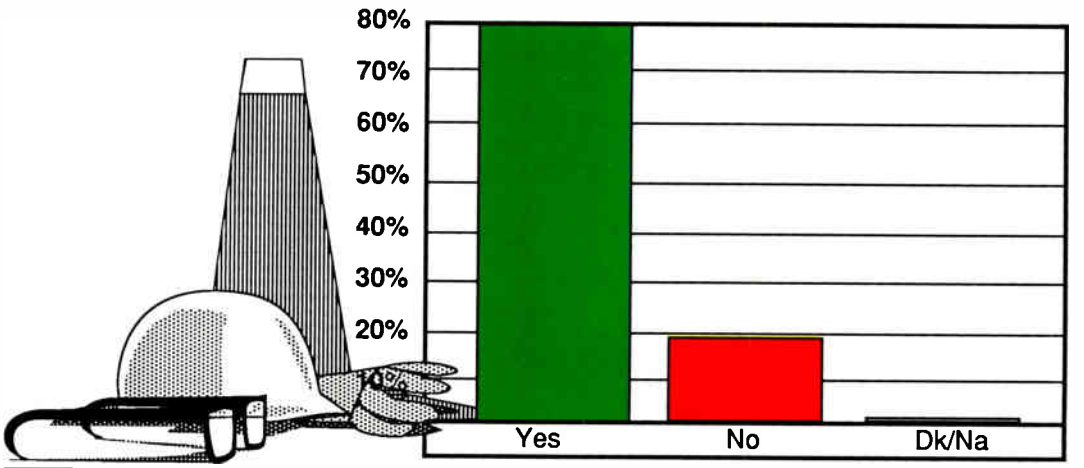
Regardless of whether or not procedure manuals exist, however, a manager's familiarity with OSHA is bound to increase, especially now that the agency has stated its intention to stiffen its enforcement policies (see *CableVision*, 12/3/90, p.50). According to the Cable Poll™, only 16 percent of GMs said they had been visited by an OSHA compliance officer over the past 12 months, but in a National Cable Television Institute-sponsored OSHA seminar held in Denver in October, half of the 80 participants said their offices had been visited by an OSHA official.

Of the educational resources planned by GMs and training directors, on-the-job training heads the list. More than 80 percent report that they prefer to instruct new employees while they perform everyday tasks. Formal, in-house classroom training is the method of choice by 60 percent, while 53 percent placed their vote for correspondence-based courses.

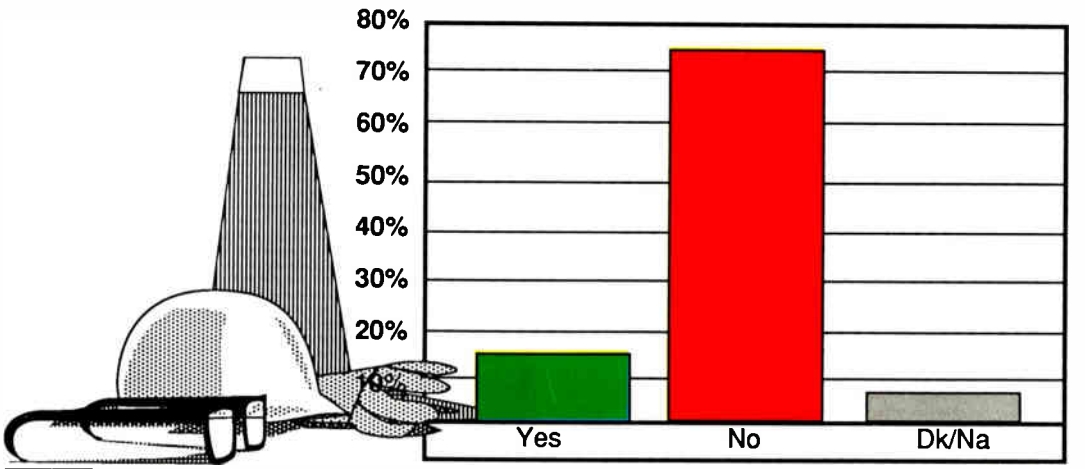
—Chuck Moozakis



Which of the following training resources do you rely upon? (Check all that apply)



Do you have an on-going safety program with procedure manuals and a measurement system for obtaining specific safety goals?



Have you been visited by an OSHA compliance officer during the past 12 months?

VideoCipher modification kits available

This bulletin is being published on order to inform the technical community in the cable industry of recent developments that can improve the performance and reliability of the VideoCipher II C satellite descrambler.

During 1990, General Instrument's VideoCipher Division has held a dialogue with the satellite practices subcommittee of the NCTA Engineering Committee. As a result of this dialogue, GI has made improvements in performance and reliability of the VCII C decoder as well as improved customer service on repairs and new policies dealing with customer repairs and packaging of the product.

Upgrade kits

Two kits are available to cable systems to retrofit VCII C units in the field. Alternatively, cable operators can have these modifications installed by GI either on a "standalone" basis or when returning a unit for repair. The "upgrade kits," along with instructions for installation, are: VCII C descrambler/buffer upgrade and descrambler board upgrade (VCII C Plus).

The descrambler/buffer upgrade kit consists of replacement of certain op-amps, installation of heat sinks and provision for an external battery as backup for an internal battery. Changing the external battery once a year will prevent the decoder from losing memory if the internal battery fails and power line failure occurs.

The descrambler board upgrade kit involves the replacement of the VCII C descrambler board with a VCII C Plus descrambler board, along with the redundant battery modification and op-amp changes (to buffer board) in the descrambler/buffer kit. In addition, an optional modification to the buffer board which fixes the AGC such that no adjustment of the video input (AGC) gain is required, is also included. This AGC range makes set-up procedures much easier.* This buffer board modification can only be implemented on units that have had the descrambler board changed from a VCII C to a VCII C Plus.

Power supply repair policy

General Instrument is providing complete power supply documentation for all of the power supplies used in VCII C production. This means that an operator need not return the units in case of a power supply failure, but can repair the power supply. This power supply information/documentation is included in both upgrade kits.

Clamp streak modification

This modification involves value change of resistors and cutting the PC board trace. It can be performed in the field (GI Service Bulletin #90-CSB-001) or at no charge by the VideoCipher Repair Center. This (no-charge) modification will be applied at the Repair Center to all VCII C standalone descramblers and descrambler modules requiring a descrambler CCA repair. It will also be applied to any VCII C returned to the Repair Center for installation of the battery upgrade kit.

It is the judgment of the satellite practices subcommittee that this is a worthwhile performance enhancement modification. It is especially effective in earth stations with carrier-to-noise of less than 12 dB.

In addition to these reliability/performance modifications, the VideoCipher Division has instituted some enhanced service policies which represent a more customer-oriented attitude. They are:

- Normal repair turnaround time of 10 days (excluding transit time).
- Ninety-day warranty on all VCII C repairs, 30 days on subassembly repairs regardless of reason (except damage caused by lightning or user negligence).
- GI will accept, with no restrictions, individual descrambler and buffer boards and power supply subassemblies for repair. This also applies to those customers who have re-packaged VCII C units for space-saving reasons.
- Repair or replacement options.

General Instrument has published two documents describing the upgrade kits. They are: (for descrambler/buffer upgrade) Publication number 73891-1 (Revision A); and (for the descrambler board upgrade) Publication number 73891-2 (Revision A).

For additional ordering information and procedures, including price and availability, contact the VideoCipher Customer Service Center by mail: General Instrument, VideoCipher Division Service Office, 890 F Ave. Dr. SE, Hickory, N.C. 28602

* If the satellite receiver "composite video output" (which feeds the VCII C) level is not nominally 1 volt peak-to-peak, either the buffer board modification should not be made or an amplifier should be included between the receiver output and VCII C input.

—Norman Weinhouse, chairman
Satellite practices subcommittee
NCTA Engineering Committee

New products

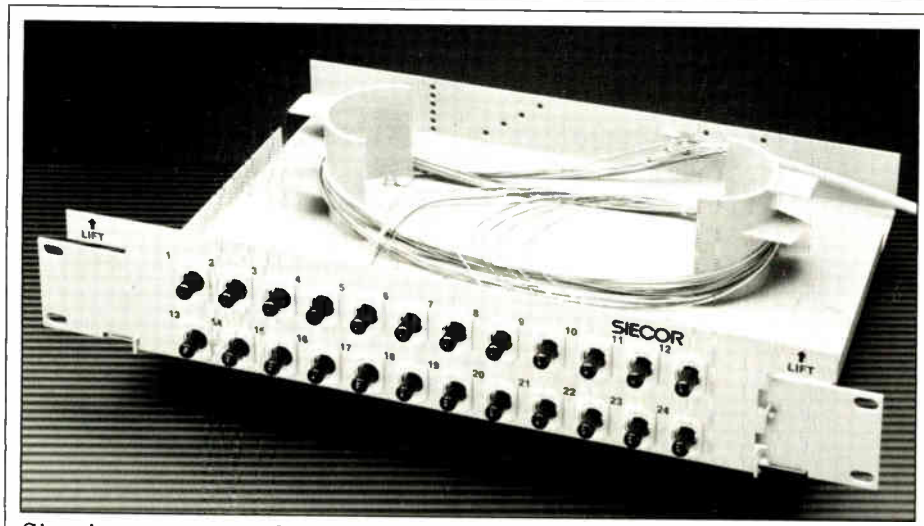
Two product announcements have been made by **CableData**. First, the company's new TeleClerk ARU software is available, which is designed to enhance the operation of the Automated Attendant applicaiton. In the software, multiple menues and activity reports give offer both user-friendliness and the ability to discern high volume areas.

Secondly, **CableData**'s new Tandem NonStop Cyclone has been introduced, designed to complement the company's existing line of Tandem-based hardware by providing advanced mainframe technology to large data centers. The announcement follows a two month beta test at United Artists Entertainment which resulted in the sale and delivery of two Cyclone computers, one at UA's Western data center and the other at their Eastern data center.

The NonStop Cyclone uses a combination of leading-edge architecture and technology which enables operators to simultaneously run online transaction processing, batch and query applications without interrupting performance. For more information, call (916) 636-5631.

Clic Instruments Ltd. has announced the availability of its new CCR-4 coaxial fault locator, priced at $2,800. The CCR-4 is a step-rise domain reflectometer designed for CATV and LAN applications. The CCR-4 locates and identifies impedance mismatches on coaxial cable with a display resolution of 3.5 inches and a maximum range to 3,000 ft. It locates taps, splitters, traps or filters, bad splices, poor connections and partial shorts. For more information, call (613) 731-9030.

ComNet has introduced an upgrade to its BSE-Pro CATV design software that adds the ability to designing city-wide fiber optics systems. BSE-Pro designs AM or FM fiber from the laser



Siecor's connector panel

headend source to the field receivers, and will continue to design to the RF drop in both feet or meters. The updates software also defines star couplers and tracks any fiber size by color or alphanumeric notation. Nominal insertion losses for fused or mechanical splices can also be determined. The system sells for $4,995. For more information or a working trial disk, call (512) 892-2085.

Siecor Corporation has announced its new Jumper Storage Module, capable of holding up to five meters of jumpers in existing Siecor FDC patch panels. FDC units purchased from Siecor or authorized distributors will provide additional mounting holes for up to 24 Jumper Storage Modules each. FDC modules already in the field can be retrofitted with the new modules using a snap-in adaptor plate included with each module. For more information, call (704) 327-5000.

TE Products has announced the Studio Pro, a programmable machine control and switching system. Studio Pro is an automation devise designed to control eight playback machines and two auxiliary sources. By using an ANSI compatible terminal, the Studio Pro can be programmed for playback and simultaneous recording from an alternate satellite feed. User selectivity of playback priority, sequential operation of a group of playback units and spot random access of other units is also available. For more information, call (800) 832-8353 or (508) 877-6494.

TelVue Corporation has announced an interface of its On-Line Qualification (OLQ) system to **Cable Services Group**'s Cable Control System. The interface agreement will serve the pay-per-view arena in "delivering quality pay-per=view customer service," says Jay Oxten, president, Cable Services Group. TelVue's OLQ, introduced at the 1990 NCTA show, uses an automatic number identification (ANI) technology that allows cable operators to provide its customers with instant verification and acknowledgement of pay-per-view events. Operationally, TelVue collects the subscriber's telephone number, account records, and credit information and immediately transmits the information to the CSG computer, to provide quick authorization status. The process is transparent to the subscriber and occurs while ordering the event. For more information, Cable Services Group officials can be reached at (402) 399-7475.

CableLabs news

Cable Television Laboratories Inc. (CableLabs) has added two new staff members. **Tom Williams**, formerly with Scientific-Atlanta, has been named transmission engineering specialist working on advanced television projects. In this capacity, Williams will be working on CableLabs' digital transmission test program and will be part of the team that tests ATV proponents in Alexandria, Va. Also added is **Lorna Campbell**, previously employed by Career Track, to the position of chief accountant.

In a final announcement, existing staffer **Claude Baggett**, previously director of systems engineering, has been appointed to director of consumer electronics systems. The new title reflects the importance CableLabs places on a cable industry liaison with the consumer electronics industry.

■ *—Leslie Miller*

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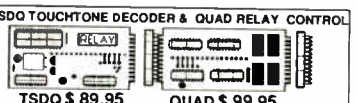

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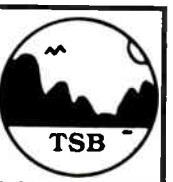

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More on video compression

Last month we began discussing what was probably the hottest topic of 1990, video compression. It will be interesting to see if 12 months from now, compression holds its grip on our imagination or if it is displaced by something even more compelling.

The previous article discussed some of the sources of redundancy in the television signal. We'll continue that discussion and move closer to a consideration of new artifacts.

Simple minded video compression

Let's not forget the most simple-minded and effective bandwidth compression schemes: transmit less bandwidth! This technique is employed in the VCR. Instead of 4.2 MHz of luminance bandwidth, only about 3 MHz is recorded in the VHS format. Over 70 million users of this format in the U.S find this near-30 percent reduction quite acceptable. Why is this? I believe it is because the loss of resolution is a natural, easily tolerable artifact. This is in sharp contrast to the complaints brought out by ghosting and co-channel interference in broadcast and beats and cross modulation in cable systems.

An even greater loss of resolution occurs in the VCR long playing mode. This saves even more bandwidth. If we opened the doors on VCRs across the country, we'd note that the switch is almost always set to the Extended Play ("EP") position, yielding six hours from a "T-120" VHS tape.

Even though noticeably better video quality can be obtained in the standard play ("SP") mode, most viewers think that the longer playing time is a worthwhile tradeoff. They are quite pleased to accept the lower video quality in order to have a longer playing time. Given the choice between "more" and "better," the U.S. consuming public has always chosen "more."

The logical conclusion has to be that the VHS standard provides commercially acceptable video quality. It has become a standard of comparison as video compression developers term their results to be of "VCR quality."

The design of consumer services and consumer electronics products have always gone hand-in-hand. Compromises have been made to allow affordable products so that large audiences might be achieved in short periods of time. A favorite example is AM radio. Double sideband amplitude modulation is wasteful of power and spectrum. Yet it makes possible an inexpensive receiver. It made possible the crystal radio.

Clearly, suppression of the carrier would have allowed a much greater range of coverage. Just as clearly, the information in either sideband is totally redundant with the information in the other. Twice the spectrum is utilized. These two "wasteful" practices made possible early introduction of cost-effective radio receivers. The radio business was launched on the technical tradeoff. Without it, we might have seen much slower growth. To this day, however, we pay the price in excessive power and bandwidth consumption.

The modulation methods required to allow affordable television receivers at the beginning of NTSC seems wasteful by today's standards. Without them, television would still be an interesting technical curiosity. Several major inefficiencies are built into the NTSC standard. The amplitude of the synchronization pulses are the highest of any part of the signal. These components carry no picture information. Thus, signal-to-noise ratio suffers. Likewise, the D.C. component of the picture carries a high amount of energy. Other parts of the signal are transmitted with relatively little energy. The result is that the picture is a lot noisier than it might otherwise be.

Another inefficiency is the amount of vestigial sideband which is transmitted. This was originally done to allow practical filters in the television receiver. Fortunately, we aren't stuck with full double sideband modulation! However, 30 percent of the spectrum carries redundant information. If single sideband circuitry were affordable at the introduction of television, today we could have had 30 percent more channels.

Application specific compression

If the video originates as motion picture film, an important compression opportunity presents itself. Movie film has a frame rate of 24 frames per second (fps). Television images are sent at a rate of 30 fps. In normal NTSC, the discrepancy is handled by the "2-3-pulldown" method. First, a movie frame is sent using two interlaced television fields, then the next movie frame is sent using three television fields. The third field is completely redundant and unnecessary. It could be reconstructed in the receiver. That would require more complex hardware. In NTSC, hardware complexity was the design criteria. In a compressed scheme, bandwidth is the design criteria. Here, when movies are transmitted, a further 20 percent saving in transmission capacity is possible.

What will the viewer tolerate?

The toughest question centers on the viewer's level of tolerance for video artifacts and imperfections. A video engineer is a poor judge of this tradeoff. A video engineer will always press for more quality. "Uncompromising quality" seems like a virtue. But like pride, it can be a "capital" sin. "Capital" is used here in the financial sense. The goal should be to deliver what the subscriber wants at an affordable price. The engineer must not make the decision for the subscriber. It may be that the subscriber wants more choice and a holding of the line on cost much more than better video quality. To force video quality may be a mistake. That mistake may be compounded if the subscriber can pick another delivery medium which offers more of what the subscriber desires.

Next month we will continue the pursuit of the tradeoffs involving compression vs. artifacts. That is, we're still on the trail begun last month is search of the "killer bees." ■

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

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