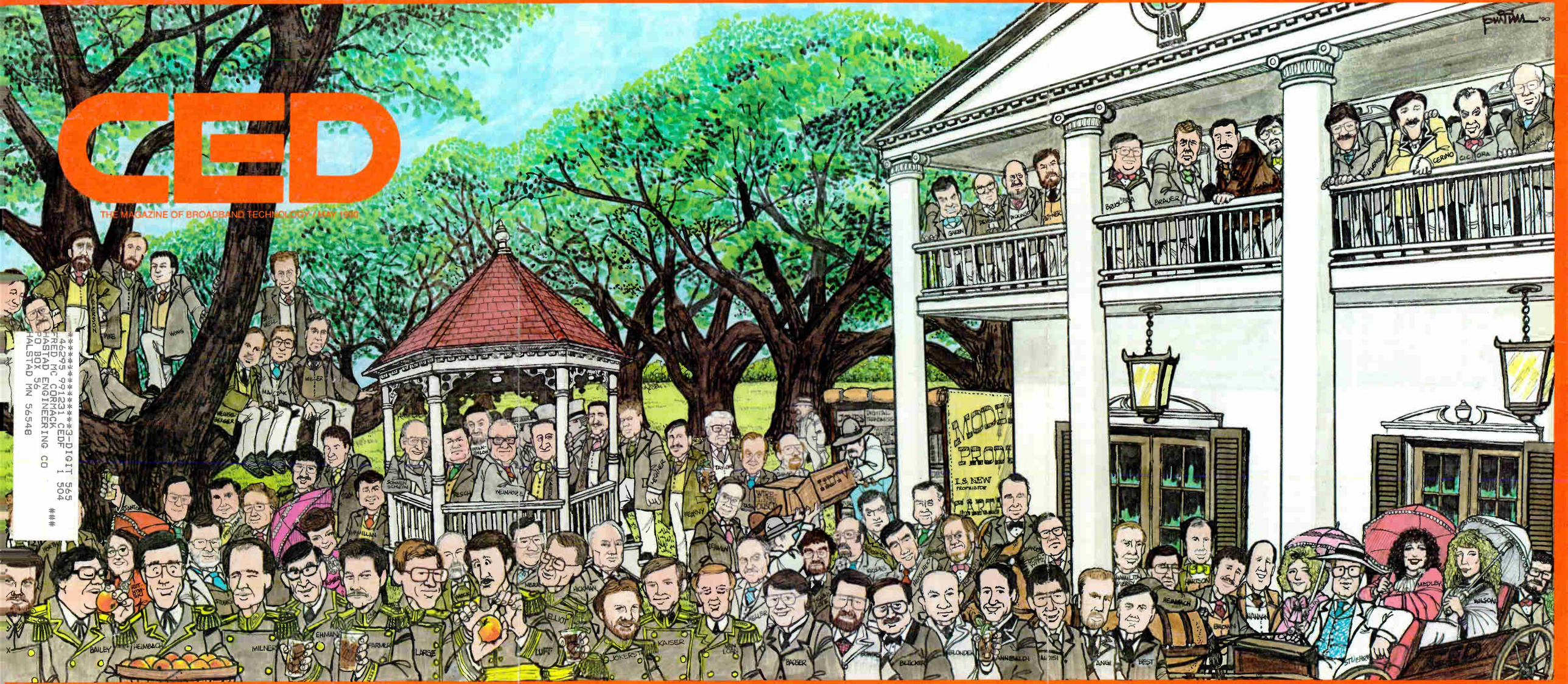
CED

THE MAGAZINE OF BROADBAND TECHNOLOGY / MAY 1998



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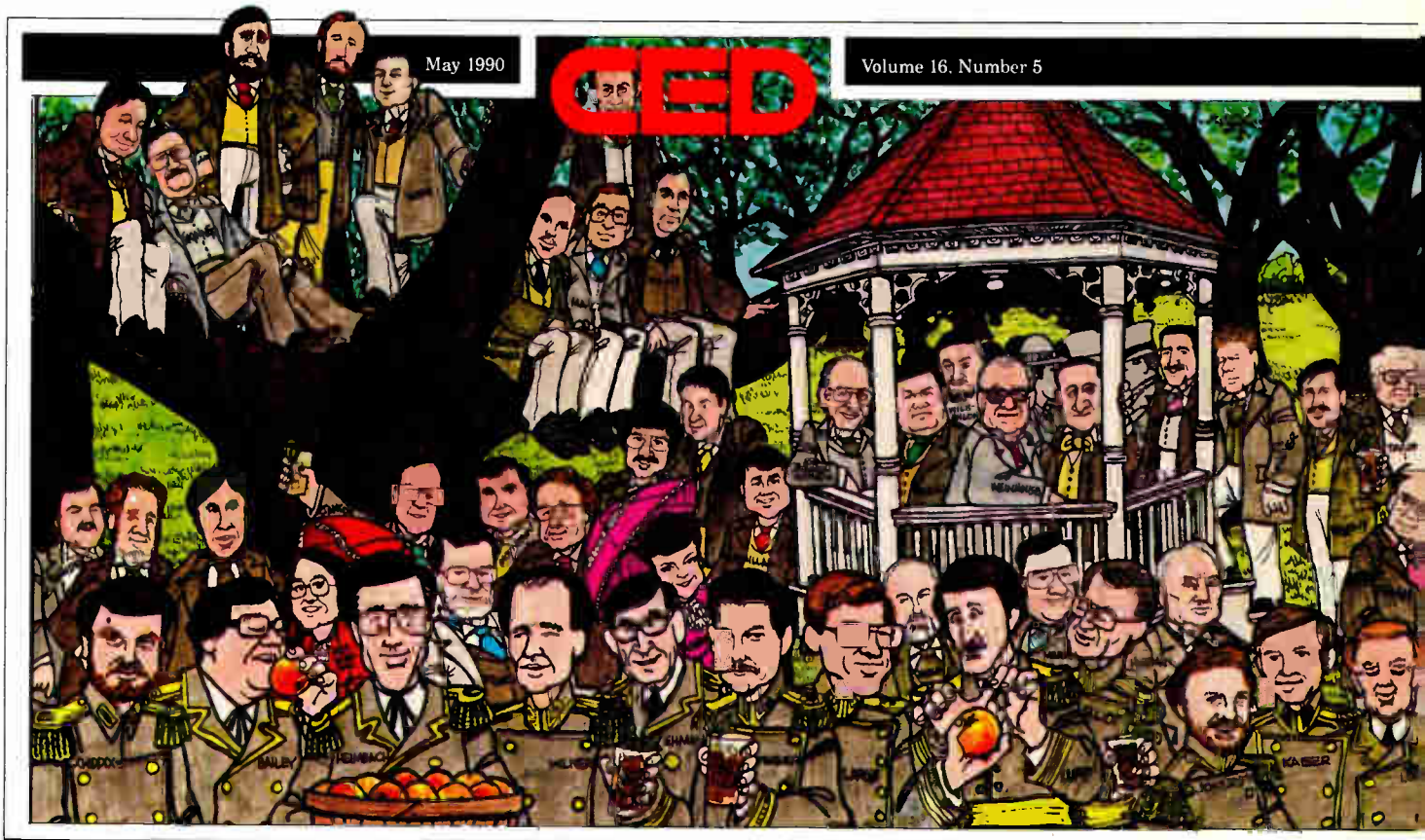
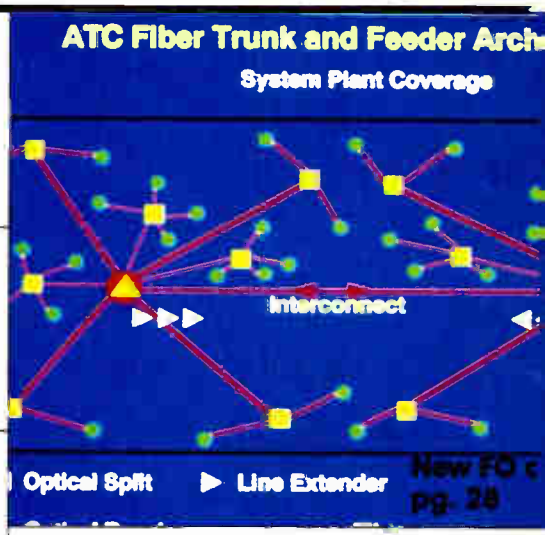
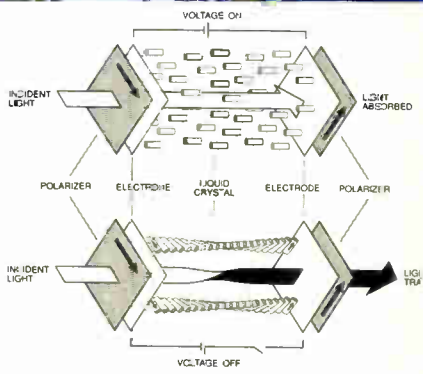
May 1990

CED

Volume 16, Number 5





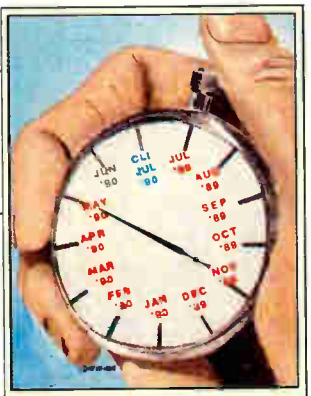


Twisted Nematic LCD — Off/On States

HDTV display technology
pg. 96

About the Cover:
The NCTA Engineering Committee members relax on a Southern plantation before beginning the 1990 NCTA Show in Atlanta, Ga. Illustration by Rob Pudim

CLI COMPLIANCE



Completing a Form 320. *See page 102.*

DEPARTMENTS

CED. (USPS 330-510) (ISSN 1044-2871) is published monthly except twice in May by Fairchild Publications, a Division of Capital Cities Media, Inc., 600 S. Cherry St., Denver, CO 80222. ©May 1990, Volume 16, Number 5. Subscriptions free to qualified industry readers. All other one-year subscriptions are $36, prepaid in U.S. funds only. Second-class postage paid at Denver, CO. and additional mailing offices. CED is published on behalf of the cable television and broadband communications industries. POSTMASTER: Please send address changes to CED Circulation, 600 S. Cherry St., Suite 400, Denver, CO 80222. MEMBERS OF THE BPA.

Have you ever stopped and considered just how a magazine containing information so important to your job and your future arrives every month free of charge?

No, I'm not trying to make you feel guilty and I'm not here to announce a new subscription policy. I guess it's on my mind because of my day-to-day work with the people who make it all possible...our advertisers. They are willing to invest their money each month in this magazine because they believe you are interested in CATV products and services and have the authority to buy them. That stems from their belief that *CED* provides quality information that keeps you reading the magazine month after month.

With that in mind, *CED* strives to go beyond the basics to present editorial that is truly informative, thought-provoking, sometimes controversial, but always useful. Two recent independent studies tell us we're on the right track.

This issue of *CED* represents the level of dedication and editorial quality I am referring to. Many of you personally know the members of the *CED* editorial staff and know how much effort they put into covering this industry. What you may not know is how much effort comes from those *behind* the scenes: in production, art, sales and circulation. Success is truly a team effort, and I must say, this is one of the finest teams I've ever worked with—and you, the reader, should know that *CED* considers you part of that team.

In the coming months, *CED* will be bringing you improved tools and brand new ones that can be used to build your career in cable television. An expanded CATV Buyer's Guide will be more complete and easier than ever to use. In-depth special issues on consumer interface, CLI, fiber optics and a valuable year-end wrap-up will complement our monthly issues. Everything we do is written and edited with your success in mind. If you find that these articles are not quite what you need or they're exactly what you have been looking for, please let us know. We enjoy hearing from you and, indeed, want to help you.

So, you may ask, what's the point? Well, it's simple enough.... You can help guarantee the free-flow of quality information by recognizing and supporting those advertisiers that support *CED*. Their products are also designed to help you, and like us, they want to hear from you. I encourage you to call them or take advantage of our free reader service system to get information on the products or services they provide.

In October, *CED* celebrates 15 years of service to the CATV engineering community and to those of you who have believed in and supported *CED* for so many years—THANKS!

We're proud to have you on our team.

Rob Stuehrk
Associate Publisher

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NEXUS builds two VideoCipher® solutions to satisfy all your descrambling needs - the Nexus IRD-1 Integrated Receiver Descrambler and the VCMB VideoCipher® Mainframe. Nexus was the first manufacturer in the world with two commercial VC®II products approved by General Instrument.

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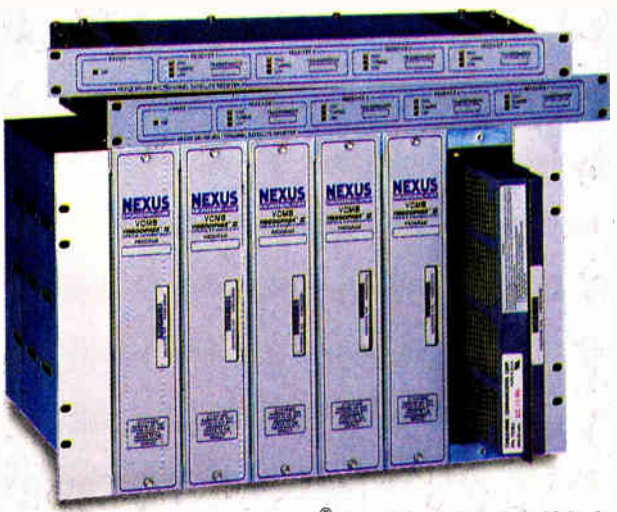

The Nexus VCMB packages six VC® II modules in less than 13 inches of rack space.

All Nexus headend products are covered by our **FAMOUS FIVE-YEAR WARRANTY.*** VideoCipher®II modules are covered by General Instrument's warranty.

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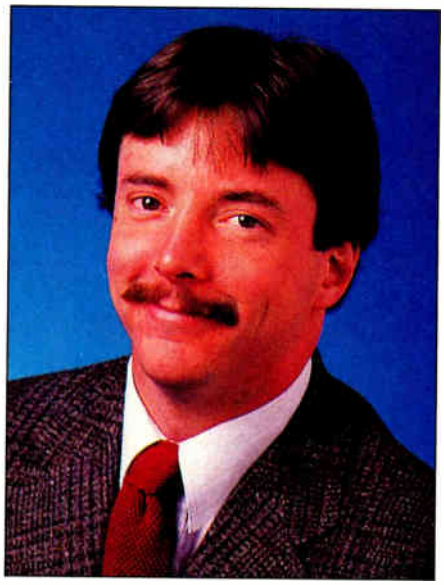
Reader Service Number 4

Waiting now will cost you later

Cable operators waiting for the outcome of re-regulation legislation before rebuilding their systems are making major contributions to the rise of DBS and wireless cable and may provide the impetus for Congress to allow telcos to directly compete for the provision of video entertainment services.

Unfettered by rate regulation, the cable industry felt free to spend money on capital to improve their plants, add fiber and at least attempt to shore up their customer service campaigns. But lately, some operators have viewed the prospect of possible re-regulation as a chance to raise rates, pull back on spending and prepare to pocket as much money as possible before rate caps are applied. While this mentality isn't surprising—the industry is carrying a lot of debt, remember—it's far from wise.



First off, rate regulation doesn't appear to be imminent. Several things are working against that legislation: an ever-vigilant NCTA, an already-crowded Congressional agenda (combined with numerous recesses and the fact this is an election year) that will keep our representatives busy with matters other than cable TV. Although a Congressional consensus can change in a hurry, six leading members of Congress, including members of subcommittees with direct influence over telecommunications policies, unanimously agreed during a panel session at last month's National Association of Broadcasters convention that cable-TV rate regulation isn't in the offing this year, and probably not next year, either.

Instead, Congress has sent strong signals that it plans to allow competition to drive rates and service levels. Wireless cable is beginning to blossom as a result of new FCC policy and DBS will likely benefit from being viewed as a competitor to cable.

As one veteran of Washington said recently, what happened in Congress yesterday is a reflection of reality about two years ago. If that's true, the recent bashings on Capitol Hill reflect the cable industry of 1988—one without fiber optics, without "Customer First" programs, in short, one different than today.

Cable operators have to realize this and move forward as if re-regulation is little more than a remote possibility. If action isn't taken to improve your plant and customer service programs, an angry public will demand re-regulation. By that time, the impediments facing cable's competitors will have been removed and they'll be formidable foes indeed.

Yes, it's true that technology is changing the face of the cable industry at an alarming rate. But halting capital spending now sends all the wrong signals to the people who can do the most harm.

* * * * * *

In the April issue of *CED*, a photograph showing an enclosure manufactured by Cable Security Systems Inc. was misidentified as an enclosure that could be easily tampered with. In reality, the product shown is a secure enclosure manufactured to a cable operator's specifications. *CED* sincerely apologizes to Cable Security Systems and regrets any damage that may have been done to the company.

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Reader Service Number 5

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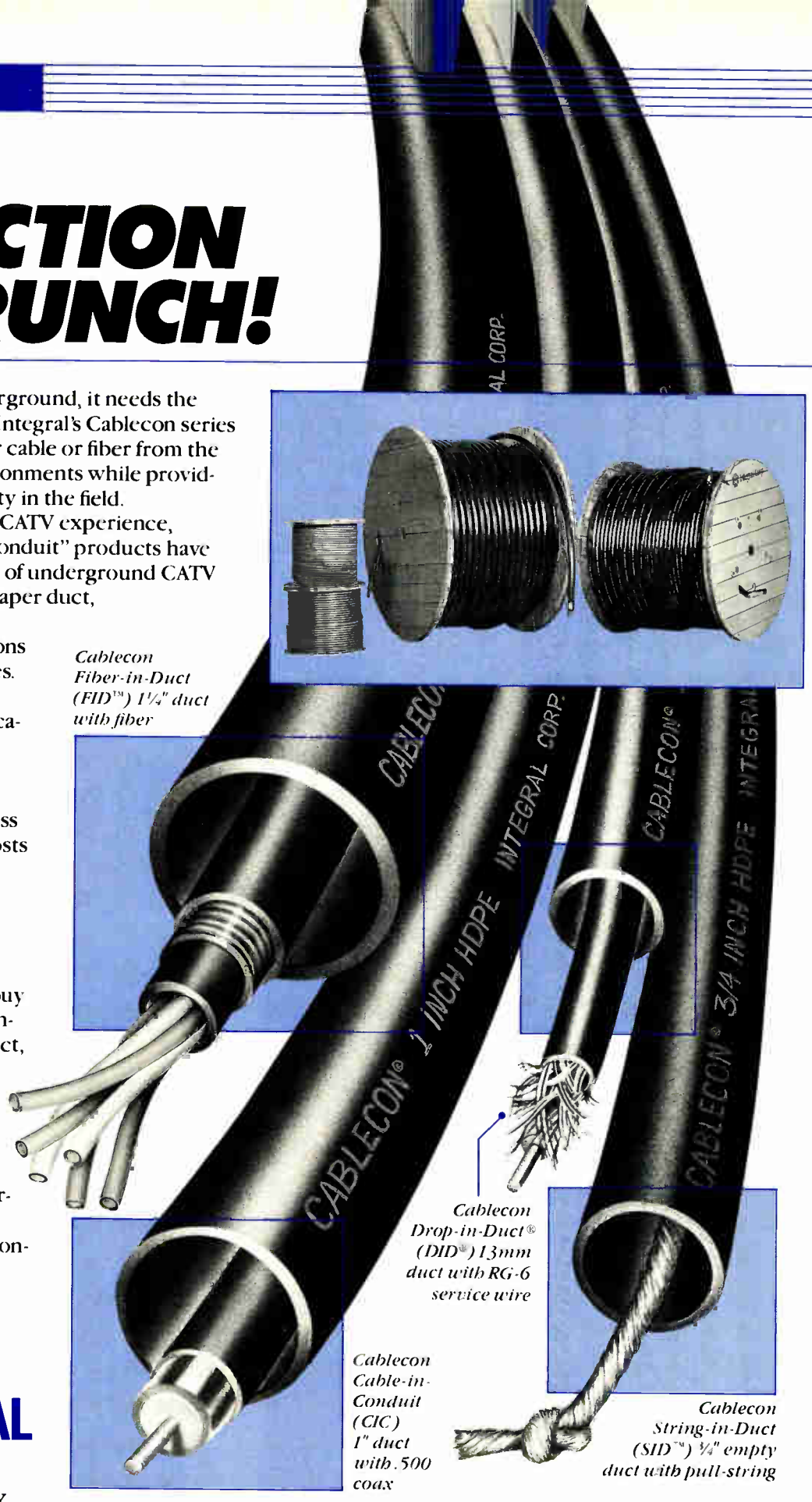
To avoid the "20 year crunch" and protect your underground assets, specify only Cablecon—the "user friendly" conduit systems.



Cablecon Fiber-in-Duct (FID™) 1¼" duct with fiber

Cablecon Drop-in-Duct® (DID®) 13mm duct with RG-6 service wire

Cablecon Cable-in-Conduit (CIC) 1" duct with .500 coax

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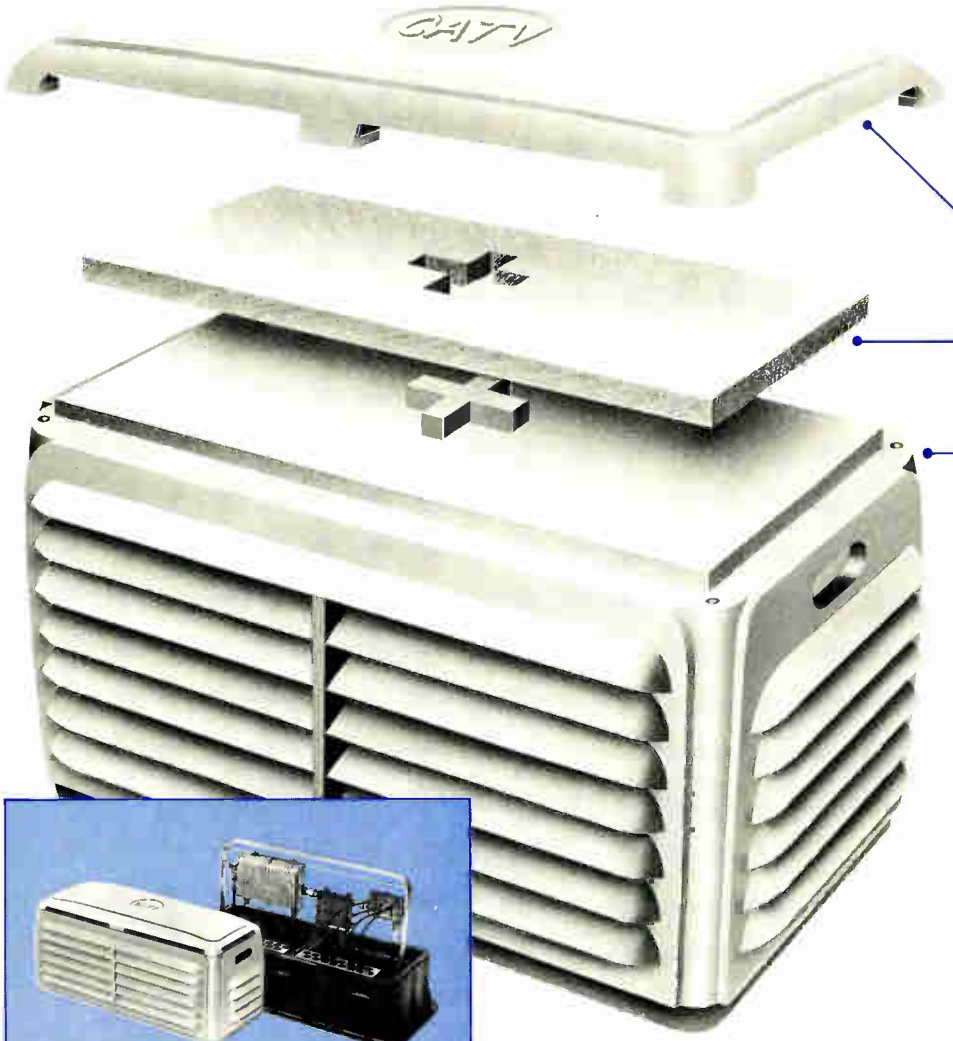

What do San Diego, CA, Fairfax County, VA, Jacksonville, FL and Sacramento, CA have in common? They've all switched to Channell's 5 Series Heat Dissipation Covers (HDC)! In fact, in just 12 months, 38% of our active equipment enclosure customers have switched to HDC. Why? Because these unique pedestal covers are designed to take the heat off underground active electronics.

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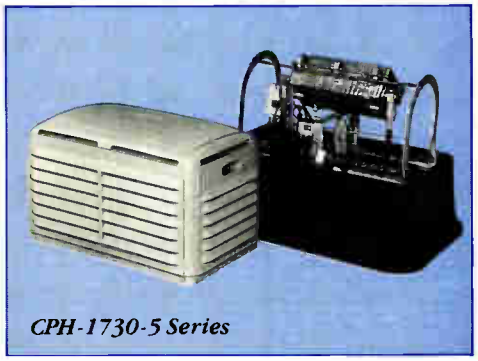
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Reader Service Number 6

New CLI service finds leaks, too

A new flyover service utilizing proprietary hardware and software that can more accurately locate the source of cable plant leakage is about to take off. Aero-Trac Systems President and CEO C. David Leyrer says his new system is unique in that it employs direction-finding techniques to locate the source of signal leakage to within one-quarter of a mile. If that claim is true, the Aero-Trac Aerial Monitoring and Location (AML) system would offer consistent location accuracy unmatched by other current technologies.

Leyrer brings to Aero-Trac a cable operator's perspective. Prior to starting his own firm, he was employed in engineering capacities with Colony Communications and Heritage Cablevision. He says he started Aero-Trac because existing flyover methods offered cable operators little benefit other than a pass/fail test. "I felt that without reliable location information, (a flyover) just wasn't worth the expense," Leyrer says.

Leyrer points out that radiation emanating from a cable system does not go straight up into the atmosphere, which means that a peak level from a leak could actually be a mile or more away from the source. Through the use of direction-finding equipment, Leyrer says he can more accurately locate leakage sources. This would allow cable operators to use flyovers as a primary means of detecting and measuring leakage, instead of relying on ground-based methods.

But by no means is Leyrer advocating that cable operators abandon their vigorous ground-based monitoring programs. He believes the two could complement each other.

The Aero-Trac technology has already been tested by Heritage in Rhode Island and sample reports have been submitted to several MSOs for comment, says Leyrer. So far, response has been good, he reports and contracts have been signed with some cable systems.

Leyrer plans to offer the system nationally, eventually working out of six to eight locations. Initially, detection data will be provided on an x,y graph, however, Leyrer plans to offer the option of providing the data on customized street maps tailored to the cable system. This technique will greatly improve accuracy and make it easier for cable systems to correct leaks, says Leyrer.

From his perspective, how is the industry's war on leakage progressing? Leyrer says he knows of cable operators who will voluntarily shut down channels in the aeronautical bands because they're too leaky. And he also knows of systems that will have to employ third-party testing procedures to get the FCC to believe the results.

ALS gear set for Goodwill Games

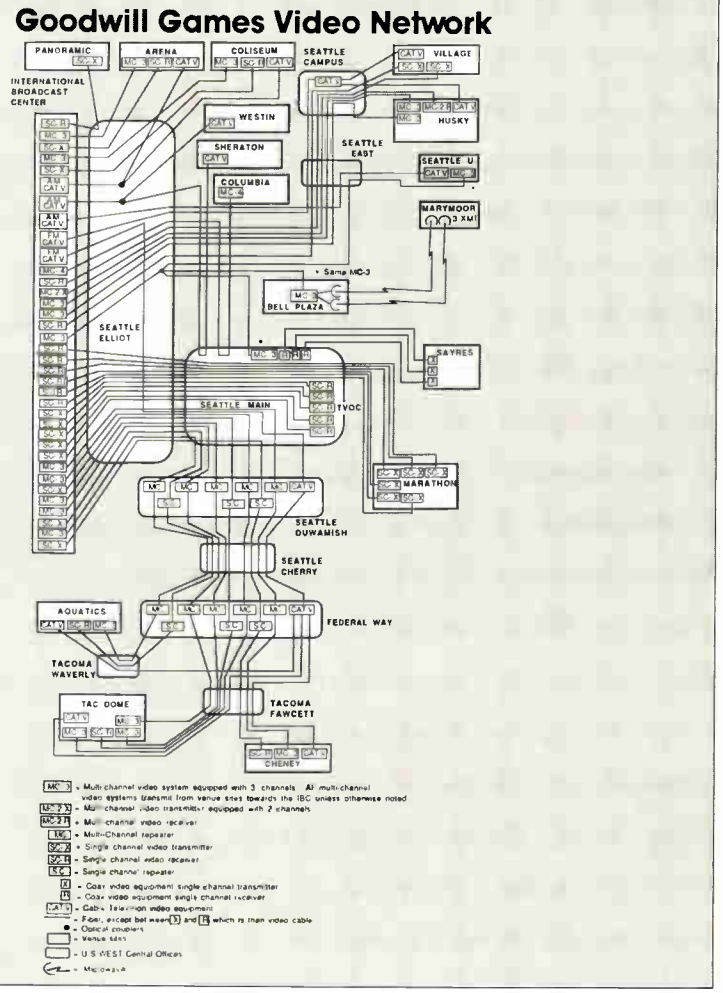
In case you thought no one's had any need for FM fiber equipment lately, you're wrong. American Lightwave Systems has been selected by US West Communications and Turner Broadcasting System to deliver high quality signals from the Goodwill Games, slated to take place in Seattle this summer. The announcement was made during the National Association of Broadcasters convention in Atlanta last month.

The agreement calls for more than 20 of ALS' FT-1310 systems to be utilized in various venues throughout the state of Washington. The equipment is capable of delivering 16 channels of video and audio over a single fiber, but, according to James Kitchell, a TBS vice president overseeing the project, only about four signals will be sent over any one fiber.

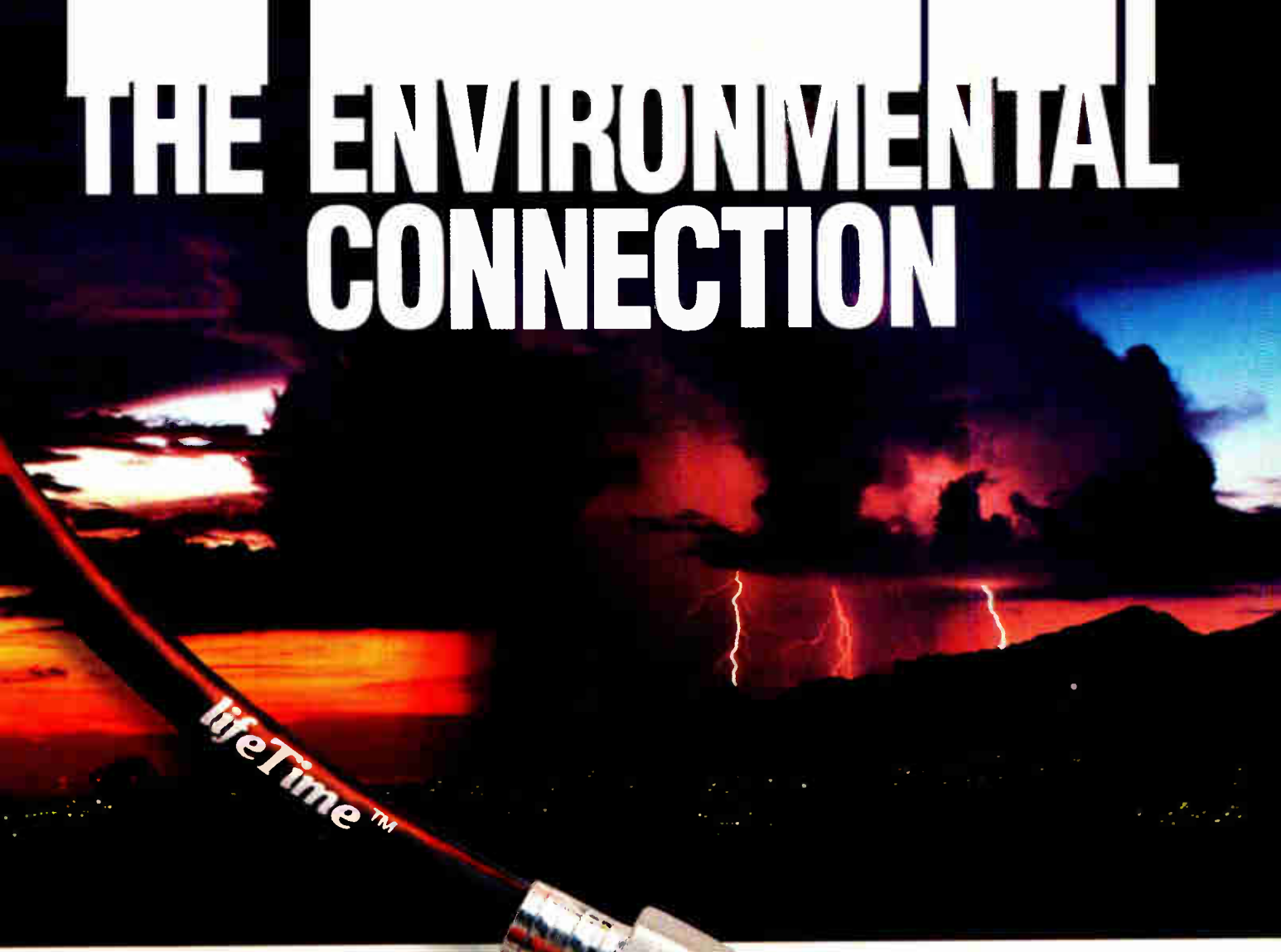
The Goodwill Games, staged and hosted by Turner, will feature 2,500 top athletes from more than 50 countries participating in 21 different sports. The events will be broadcast from July 20 to August 5.

Turner chose to utilize FM gear because it provides high quality, reliable pictures over long distances. It chose analog equipment because it is still more inexpensive than digital equipment.

The passive fiber optic video network (see accompanying figure) was already primarily in place, according to Turner



THE ENVIRONMENTAL CONNECTION



THE CONNECTOR

Amphenol's* new design features three separate seals to protect against signal and environmental leakage — more than any other connector on the market. Its unique round crimp eliminates the six "water channels" found in traditional hex crimp connectors. An O-ring helps prevent corrosion and an inner gasket effectively seals the interface to dramatically decrease drop-related service calls. The connector's innovative one-piece design is easy to install — no lost pieces or cumbersome boots and grease. All three seals in one easy piece!

Amphenol® 59 Series Environmental Connector

Amphenol® 6 Series Environmental Connector

THE CABLE

Times Fiber* has recently introduced T-10 drop cable, the perfect complement to Amphenol's triple-sealed connector. T-10 drop cable features 1GHz capacity and comes with Times Fiber's own lifeTime™, the original corrosion-inhibiting, nonflowing, aerial flooding agent.

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- Prepare your cable system *today* for the technological needs of tomorrow.

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Reader Service Number 7

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officials. Terms of the agreement with ALS were not disclosed.

New equipment debuts at NAB

Other news of interest to the cable industry that emanated from the NAB confab included an agreement between Wegener Communications and Dolby Laboratories, and new products from Channelmatic and Avcom of Virginia.

Wegener announced that it has become the first OEM licensee of Dolby's new digital coding process, dubbed Dolby AC-2, for use in its decoders. This new coding process uses frequency domain signal processing in narrow bands to mask noise. Quantization noise is confined to narrow regions where it is masked by spectral components of the audio source signal. This allows for a more effective data rate reduction while maintaining signal transparency.

The technique also effectively doubles the satellite capacity for audio transmissions. For example, a service like Jones Intercable's Galactic Radio, which provides cable operators and others with a variety of radio program formats, could offer twice as many "channels" of audio programs than it currently does today.

The AC-2 process, announced last fall, is built into professional Dolby encoders and decoders which operate at 128 kbits/sec, or one-sixth the rate of conventional 16-bit PCM.

Wegener plans to use the technology in its SCPC, video subcarrier and FM^2 subcarrier transmission systems.

Meanwhile, Channelmatic unveiled its new microprocessor-based clock controller which features sequential scheduling to enable cable opertors to schedule and view daily events in the order in which they'll run. The new clock, the PCU-1A allows operators to modify the schedule,too.

An automatic schedule template generator is offered to allow an operator to quickly create two weeks of schedules. With optional software the unit can create macro schedule events, which activate eight control outputs from one event command. The unit can be controlled remotely via modems. It is priced at $2,350.

New from Avcom of Virginia is a microwave video transmitter and portable receiver system that could be used for such applications as video surveillance by law enforcement entities.

The MVT-3000A transmitter and PSR-3000A receiver uses the microwave band to relay video signals. Color or black-and-white pictures can be transmitted and the output can be fed to either a monitor or VCR.

Telcos focus on fiber-to-the-curb

Two telephone companies have announced plans to test BroadBand Technologies' fiber-to-the-curb fiber optic system, which uses fiber to neighborhood locations and copper twisted pairs (for voice) and coaxial cable (for video) to the home.

Nynex and Bell Atlantic both announced plans to test BBT's technology. Bell Atlantic, through C&P Telephone of Virginia, plans to wire 77 townhomes in The Cascades, a new housing development in Loudoun County, Va., with the fiber-to-the-curb technology, starting last month. Additionally, it will wire 49 single-family homes with fiber-to-the-home technology. Nynex plans to test the equipment in its lab in May.

Cablevision of Loudoun, which serves about 15,000 subscribers in this community located about 30 minutes from Washington, D.C., is expected to join C&P Telephone in the trial and offer its service over the BBT digital network during the test's second phase next fall. "The delivery of cable services over a switched, digital fiber system is new to our industry and is something we're very interested in," says Jerry Orris, director of engineering for Benchmark Communications, the parent company of Cablevision.

Bell Atlantic already has fiber-to-the-home tests ongoing in New Jersey and Pennsylvania.

The BBT system was a development of Siecor, a supplier of fiber optic cable. However, in 1988, the company decided to abandon development of the system after two years of study. Rights to the system were acquired by BBT's principals and the company was founded. BBT reportedly has more than $8 million in financial backing.

The system was designed to allow telephone companies to effectively install fiber optics as deep into their networks as economically feasible while providing a seamless method for future addition of fiber over the "last mile" and the provision of video services when they become legally and economically feasible.

Interactive TV tested by cable MSO

Continental Cablevision of Springfield, Mass. will evaluate ACTV Domestic Corp.'s interactive television service in 300 homes. starting this spring.

ACTV will provide 100 hours of interactive programming each week during the market evaluation over a period of four weeks. Programs have been selected to appeal to a wide range of viewers.

The ACTV technology uses a small device similar in size to a TV remote control and a cable converter incorporating ACTV's patented technology to allow viewers to respond to questions, make choices or choose camera angles during concerts or sporting events. The one-way system doesn't need fiber optics or telephone lines to work.

VideoCipher delays upgrade program

In a development that will doubtless anger many of its detractors, General Instrument's VideoCipher division has announced a one-month delay in the roll-out of its VC II-Plus upgrade program.

Scheduled to begin on April 2, VideoCipher officials decided to postpone the program's implementation until May 1 because of "higher than expected demand throughout the marketplace" for VC II-Plus modules. The high demand did not allow VideoCipher to build an inventory of modules, which is necessary to support the upgrade program. Perhaps the silver lining in the cloud is that the module is being met with a high level of interest and orders, which signals a wide acceptance of the new technology.

As previously announced, the upgrade program allows consumers to trade-in old, untampered VC II modules for new ones for just $129, plus shipping and handling fees. Consumers with tampered modules may trade theirs in for $299 plus shipping and handling. Dealers or distributors with tampered equipment may trade in their modules for $279, plus fees.

VC II-Plus was developed to address widespread piracy which has plagued the VideoCipher satellite encryption system almost since its inception in 1985.

—Roger Brown

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Reader Service Number 8

Tom Gillett

Addicted to success

Known to many of those around him as an "adrenalin addict," Tom Gillett, vice president of business development and technology transfer for Cable Television Laboratories (CableLabs), loves to get excited—especially when that excitement is focused on the cable industry. "I found in my first year here at CableLabs that it's a really exciting environment to talk about ideas, present them to executives of our industry, get a quick response back on what they like and don't like, (and see) where they'd like us to go or where they wouldn't like us to go."

"I think it's going to be a competitive advantage going forward," continues Gillett. "We must hold to that entrepreneurial spirit, the ability to move quickly and respond to the market needs is going to be, not only our heritage, but it's going to be our competitive advantage."

In this day and age, speaking of competitive advantages brings a primary opponent into mind—the telcos. But when it comes to telephone companies, Gillett not only has the knowledge of where they're coming from, but the experience to back that knowledge.

Telco background

Gillett began his working career after graduating in 1970 with a masters degree in management, which complemented a previous degree in management engineering, from the Rensselaer Polytechnic Institute. After interviewing on campus, Gillett became employed in Bell's one-year supervisory assignment program where his chances of staying employed with the company was 50/50.

Gillett passed muster and stayed with the New York Telephone system from 1970 to 1976. After deciding the grind of a four-hour round-trip commute wasn't allowing him to watch his two children grow, Gillett transferred to Wisconsin Telephone.

Gillett left Wisconsin in 1980 to work for GTE in San Jose, California. Unfortunately, shortly thereafter GTE decided to reorganize and eliminate the California organization. Instead, Gillett was offered a job at GTE's headquarters in Connecticut and decided to take it. One of Gillett's jobs at GTE was network services planning. While in this position, an opportunity came along that many at GTE thought was of great interest—Group W Cable was available. "In our architecture planning for GTE," says Gillett, "there had been some thought about the importance of video transport in the future so it looked like an interesting opportunity to pursue."

Instead, GTE decided not to spend $500 million in an acquisition, but rather, make a more focused effort on something that had a technological bent to it as well as services. "And so I conceived of the idea of this video services test bed, which was Cerritos," says Gillett. "It was my baby. I put together the plan that in January of 1987 was approved by GTE's board of directors. It was a very exciting opportunity both to conceive of the idea, plant it and then be given the responsibility to make it happen.

It was during the Cerritos debate that Gillett spent a lot of time dealing with cable industry executives at the FCC. During the confrontations, Gillett began to understand CATV. "Although we were certainly arguing strongly against each other," says Gillett, "I think we built a mutual respect for each other. So when the CableLabs concept came along and started to be developed, it was suggested to Dick Green (President and CEO of CableLabs) that maybe he'd want to give me a call and see if I was interested." After meeting Green, Gillett was impressed enough by both Green and the idea of CableLabs to join the organization in 1989, after nine years with GTE.

"I think we (CableLabs) have developed very close working relationships with almost all the industry. We support the NCTA at their request... on technological issues...and regulatory concerns, and we work actively with all our member companies to try and help them with technological development," says Gillett.

However, technology isn't Gillett's only concern. "I'm a firm beliver in making certain that there's always a marketing balance to technological opportunites," says Gillett. "People (lately) are putting the technological cart in front of the marketing horse. They're saying first technology, then marketing. I disagree with that. I say first you find the services the customers want and you give it to them now."

This type of thinking was actually what put the Cerritos project together. "If you take the three technologies of coax, fiber and twisted pair," muses Gillett, "and you use your imagination to think of any kind of service you can, the customer really ends up benefiting from what you're doing."

Fiber is focus

Unfortunately, the customer didn't end up being the focus of the Cerritos experiment. Instead, the project accelerated people's attention to the use of fiber for video. It was this attention that won Gillett the honor of being chosen as the 1988 Fiberoptics Man of the Year by the *Fiberoptics Marketing Intelligence* newsletter. "It would also have been appropriate," adds Gillett, "if there had been a coax man of the year because Cerritos was supposed to demonstrate that these services were possible on either a coax or fiber network."

Regardless of the transport medium, Gillett still focuses heavily on the subscriber. "I think the most important thing we (the cable industry) have to develop plans for is taking care of our existing customers," says Gillett.

In Gillett's mind, the industry faces some interesting challenges in order to keep its customer base—challenges that "come from either regulatory fronts or potential competitors, like DBS," says Gillett, brimming with excitement and enthusiasm. "The nice thing is that no matter what happens on those fronts, our direction and vision of really concentrating on serving our customers better—where the quality of the signal and options we provide will be better—is such a success story, that I think we have a tremendously exciting decade ahead of us." ■

—Kathy Berlin

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Reader Service Number 9

More than entertainment

As we approach the time for the national convention, and you will probably be reading this issue at that show, pay particular attention to the number of fiber optics vendors on the floor of the exhibit hall. And I don't just mean those people who are selling fiber optics itself, because there are precious few of them, but those people who are selling systems with the electronics and do-dads that make up an actual fiber optic system. Two years ago there were only two such vendors with fiber optic gear at the NCTA show. Last year there were 14 and this year that number will increase yet again.

When you look at the other booths, look at those companies that have ideas for new services to benefit our subscribers. There is certainly no lack of experimental data about how our consumers react to new services, and there is no lack of anecdotes about how cable operators have tried and failed to bring some of these ideas to the market. If you look at why they failed, you are confronted with a long list of possible reasons.

Somehow, none of these reasons are completely satisfactory. Indeed, of all the people who have tried new enhanced services using cable architecture and technology, you rarely find someone who is completely put off by the idea of cable television doing some of these things. It is almost as if they are beset by a vision of how it could be.

By Wendell Bailey, Vice President Science and Technology, NCTA

An expensive vision

The problem for people with this vision is that it's expensive to try these services. To really do it right, you frequently have to make modifications to a large portion of your plant: install headend equipment, train technicians, market an entire community, etc. This all adds up to money that, as we have found out, has mostly uncertain returns.

Tie this with the aforementioned interest in fiber optics, and some interesting possibilities present themselves. For instance, if in fact our cable systems evolve over the next few years to be a form of "tree-and-branch" which has been dubbed "tree-and-bush," (compliments of Bob Luff of Jones Intercable), the result of this happy marriage of fiber and traditional coaxial technology allows for some possibilities for enhanced services that we have not had before.

We should all be well acquainted with the notion that feeding a small number of amplifiers with a fiber optic run might overcome one of the major problems with doing upstream traffic on a modern cable system. In particular, remember that doing upstream traffic on a traditional cable system means that for every source that generates upstream information, a potential noise and interference source also exists. If all these sources going into the trunk and back upstream to the cable headend are summed, you create an awful lot of noise and interference on an already busy transmission medium. This makes doing additional things more difficult than it otherwise would be.

Perhaps with the new impetus to deploy fiber optics we are also getting another opportunity to use our creative talents...

This in and of itself is not impossible to overcome. Indeed, there are many systems that perform two-way services. It simply means that you must work extra hard to keep your system in good shape—a goal we should all pursue anyway.

With the small number of amplifiers fed by a fiber optic node, which carries signals back to the headend, each group of amplifiers takes its customer inputs and other signals and places them back on an individual fiber link. They are not necessarily summed with the other "clusters of signals" on the way back. This is a real boon to the ability to implement two-way services and make them more reliable.

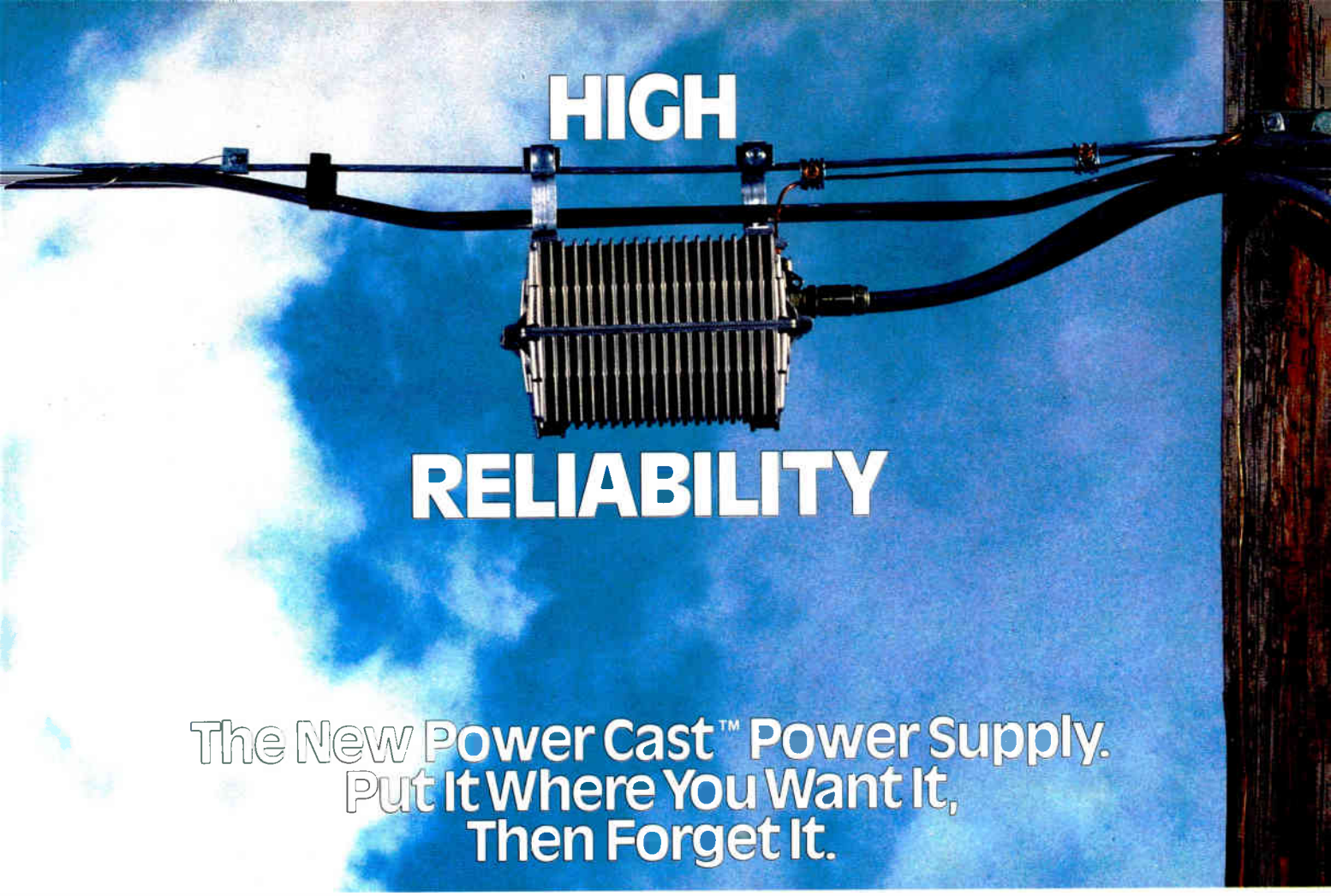
Trial marketing possible

Also consider another possibility: with individual fiber optic links feeding small groups of amplifiers, the possibility exists for trial marketing a small number of customers and, conversely, modifying only a small amount of equipment. Perhaps you pick one or two of these small groups of amps and the customers attached thereto for intensive marketing and focus group activity. This allows you to see what sells and what doesn't.

You will not have had to make a massive investment or modify large amounts of equipment; you can keep whatever you do segregated from the rest of your system and the traffic you are sending to all your other customers; and perhaps you can make more sense of the data you receive if it is in smaller bunches. It even means that if you hit the right formula for marketing and provision of service, that you can roll it out in small segments as the business begins to support itself.

This is a much more palatable way to invest in a new service technology than modifying your entire plant—only to find it is not a real business or for some reason you are unable to market it to that particular community.

There are lots of interactive functions that we can undertake that would still fit in well with the cable industry's main business of entertainment television. We have talked about it for many years, and many attempts have been made to provide these services. Perhaps with the new impetus to deploy fiber optics we are also getting another opportunity to use our creative talents to enhance the services that we provide and to bring some new services to the table. ■



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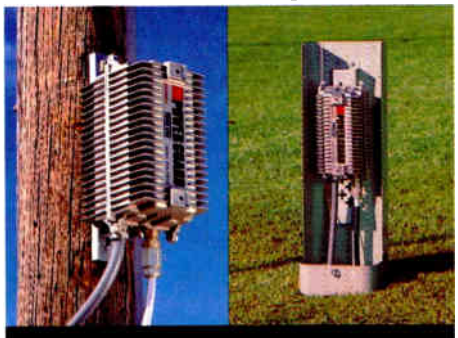

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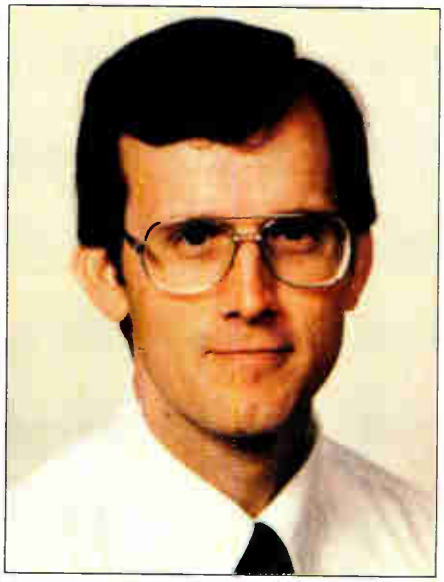
Reader Service Number 10



Measurement errors

The use of an envelope detector for video measurements can result in the demodulator contributing to the value obtained. The errors will show up in measurements such as (but not limited to) frequency response, differential gain, chrominance-to-luminance gain inequality and chrominance-to-luminance intermodulation.

Anytime you try to verify the performance of a modulator you are actually measuring the performance of the modulator and demodulator. Note also that verification becomes more clouded when you try to verify the performance of a signal processor. In this case, you are actually measuring the performance of the modulator, the demodulator and the signal processor sandwiched between the two.

This would lead some to mistakenly believe that because test equipment manufacturers publish performance specs for test demodulators when operating in either the envelope or synchronous modes, one can simply subtract the demodulator's published numbers from the measured modulator-demodulator numbers to get the "correct" value for the modulator under test! It simply cannot be done! Published numbers are "worst case" and have nothing to do with the actual performance of the test demodulator.

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

In addition, we don't know if the demodulator's actual distortion performance is additive or subtractive in nature relative to the performance of the modulator under test. The optimum solution then, is to use a test demodulator in the synchronous mode so that its individual contribution to the measured distortion is minimized.

Some real tests

Consider the data shown below. I have summarized data that was taken by a Tektronix VM-700 Automatic Measurement System used to measure a single modulator in back-to-back configuration with a Tektronix 1450 demodulator operating in both the synchronous and envelope detection modes. As always, when using the VM-700 in automatic mode, these measurements were backed-up with visual observation of the waveforms.

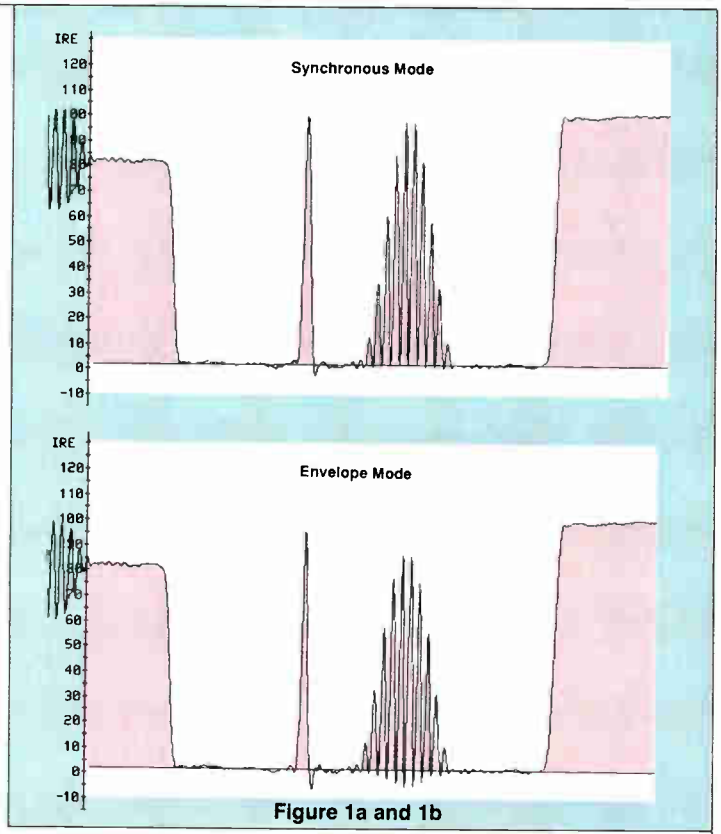


Figure 1a and 1b

Distortion	Sync.	Envelope
Differential Gain	1%	3.7%
Differential Phase	0.36°	0.32°
Frequency Response	0.4 dB	1.1 dB C/L
Gain Inequality	101%	114%
C/L Delay	0.5 ns	3.5 ns

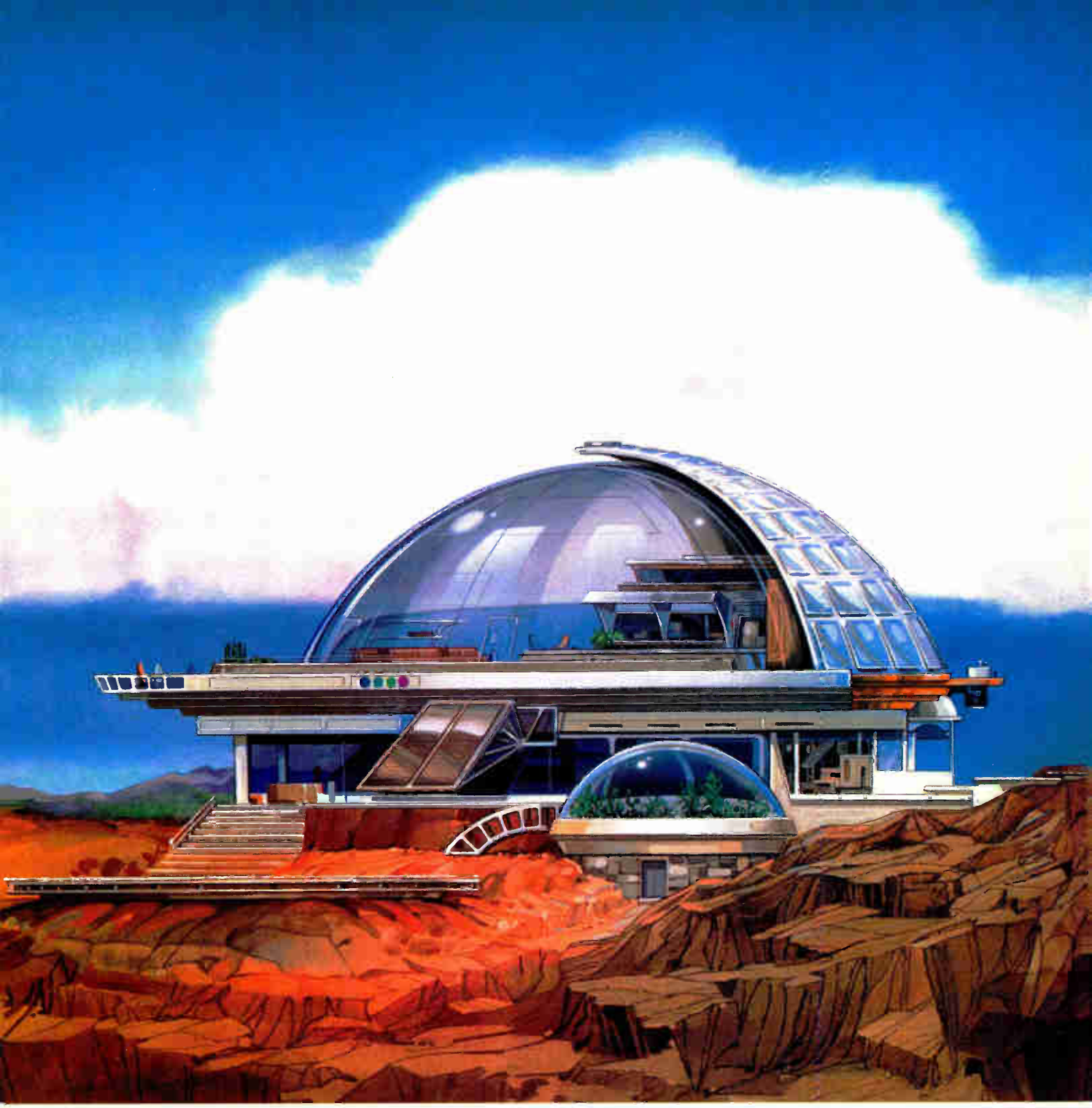
As expected, the envelope mode of operation exhibited some slight distortion degradation with respect to differential gain, frequency response and C/L gain inequality. Also as expected, the measurements for differential phase and C/L delay, on the other hand, were very close no matter how the demodulator was configured. Had we noticed a significant difference in the differential phase measurement between the demodulator's two modes of operation, I would have suspected an ICPM problem in the modulator under test. In this case, there was none.

Note the difference in measured values for C/L gain inequality. Chrominance-to-luminance gain inequality is supposed to be a measure of the amplitude of the 12.5-T pulse relative to the amplitude of the white bar (See Figure 1). In the synchronous mode, the measured value tells us that the pulse is about 1 percent or 1 IRE higher in amplitude than the white bar. And, in fact, the waveform of Figure 1a (and actual observation) agrees with the automatic measurement.

For the envelope mode, the measured value of 114 percent leads us to believe that the amplitude of the pulse should be 14 IRE *higher* than the amplitude of the white bar which would indicate "peaking" in the amplitude response around the subcarrier frequency. Figure 1b, however, shows the pulse to be much lower in amplitude than the white bar, implying a "dip" or roll-off in the frequency response around the subcarrier frequency.

So which is correct? In this case, the measured value of 114 percent for C/L gain inequality in the envelope mode was inaccurate. A review of the actual frequency response of the modulator/demodulator pair did, in fact, reveal a roll-off around the subcarrier frequency with the demodulator operating in the envelope mode.

My thanks to Vic Williams for performing the measurements. ■



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Reader Service Number 11

'Fiber trunk and feeder': ATC's new architecture

In 1988, ATC introduced a new architecture that made use of a significant amount of fiber, improved picture quality, improved reliability, simplified maintenance and made bandwidth electronic upgrades practical and economical. It was called "Fiber Backbone" and was said to be an "evolutionary" architecture.

'Fiber Backbone'

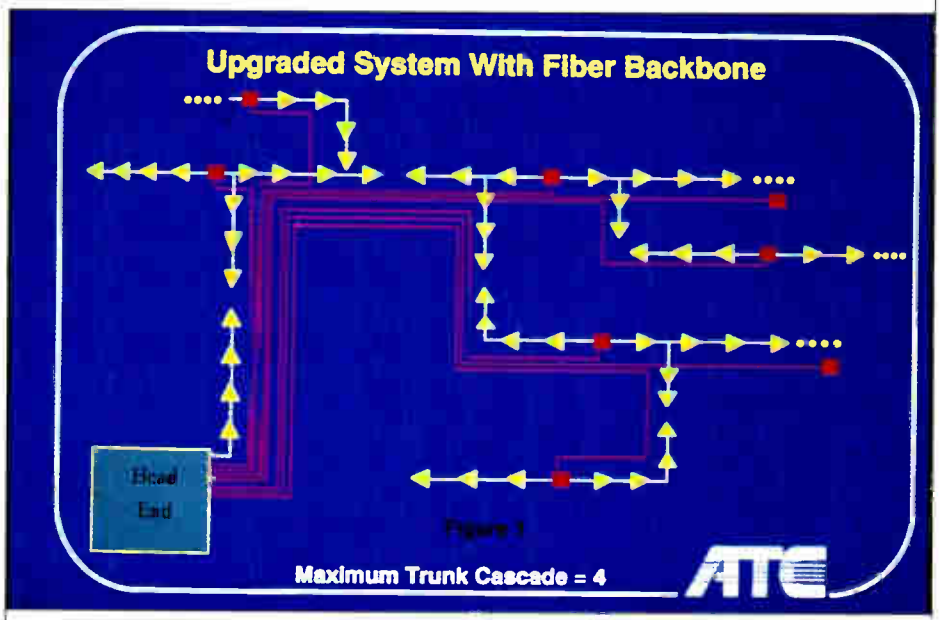
The "Fiber Backbone" (Figure 1) has become a useful tool in system upgrades because it allows you to reuse the coaxial cable and keep the existing amplifier locations in place. This is made possible because of the short, four amplifier cascades that provide additional distortion headroom. This extra headroom can be used to drive amplifiers at higher levels to overcome the higher losses at the expanded bandwidth and also improve picture quality.

When building a new system (or rebuilding an old one) nearly 60 percent of the cost of the plant is made up of the strand, hardware, cable and labor to install it. The balance, or 40 percent, is in the electronics and passives. By being able to reuse the cable, we are able to save almost 60 percent of the cost of a new plant. This is making "Fiber Backbone" the architecture of choice for bandwidth upgrades at ATC.

'Fiber trunk and feeder'

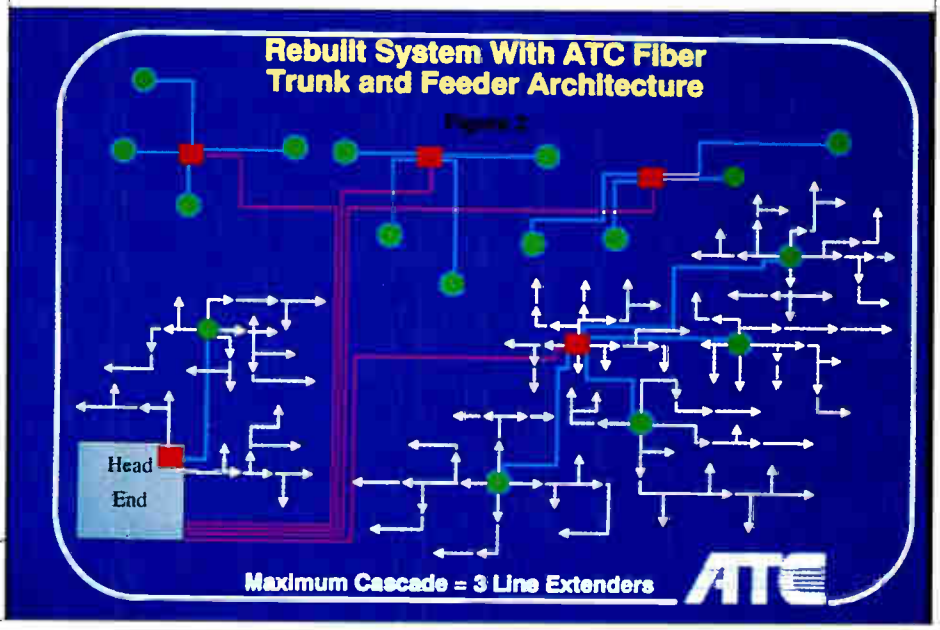
In some cases, it becomes necessary to rebuild a coaxial system due to the deterioration of the cable plant. Fiber Backbone is usually not part of a rebuild (or new build) because it adds a significant incremental cost to the project.

This fact has resulted in many operators spending money to build new expanded bandwidth systems using the old tree and branch architecture that has been used for decades. As a rule, very little fiber is being used with these new plants, other than for super trunking and some small cascade reduction projects. This means that a brand new plant has fewer state-of-the-art features (reliability, performance, etc.) than our old upgraded plants that make extensive use of fiber.



The FTF concept is really very simple. See Figure 2. First, the area around the headend is served by a three line extender coaxial cascade. Once the geographical limit of the three line extenders has been reached, which is about one mile (1.6 km) from the headend, a fiber is used to transport the signals out to a four way power divider which in turn feeds four small optical receivers called distribution nodes. There the light is converted to RF and feeds other three line extender cascades. The distance from the headend can be up to 6.1 miles (10 km) of fiber plus the one mile of coaxial plant or nearly seven miles from the headend.

When the seven mile limit has been reached, we can still extend the fiber another 3.7 miles (6 km) out to a



By David M. Pangrac, Director of Engineering, ATC

distance of about 10.5 miles (17 km) plus the one mile of RF or about 11.5 miles from the headend. At this point we can only use a two way power divider however. Beyond 11.5 miles, an active repeater is used.

The reach of the system becomes a very important concept to understand. Figure 3 shows an ATC plant consisting of about 1100 miles of cable served by two headends and a number of passive optical links. While not all of the optical links required to serve a system of this size are shown (for the sake of clarity) the diagram does show that by making use of the existing headends—tied together with AM super trunk—the entire plant can be served with passive fiber links.

All components are off the shelf parts including the optical electronics. Nothing has to be "invented" to make this architecture work. In fact, as the performance of the system is looked at, it can be seen that even lasers that have mediocre specs, by today's standards, can be used in much of this system.

For example, a laser with a 10 dB loss budget, C/N of 50 dB and other distortions at −61 dB could be split four ways and serve fiber nodes as much as 3.7 miles from the headend. The three line extender coaxial cascade would add about one more mile for a total reach of near five miles.

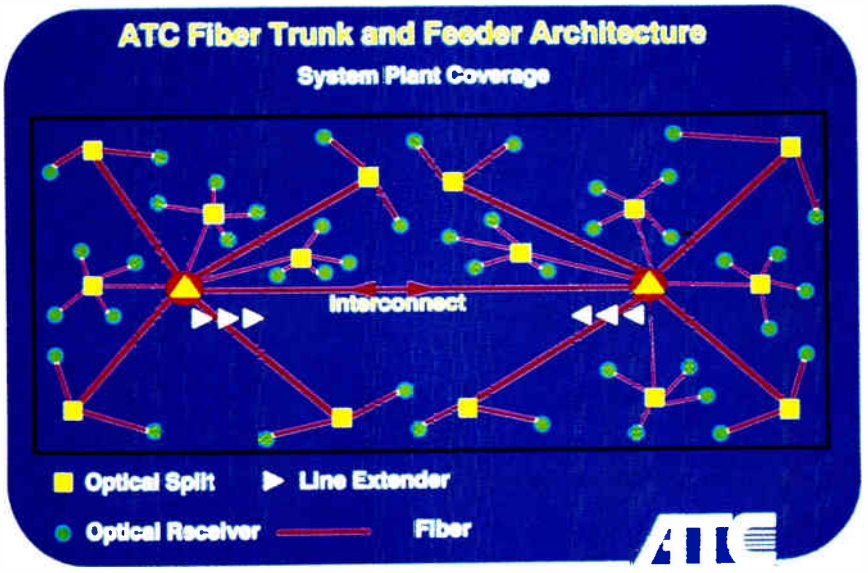


Figure 3

With the performance of the fiber link added to the coaxial plant specs, the "at the tap" numbers would be about:

C/N = 49 dB
CTB = −54 dB
CSO = −59 dB

Not too bad for what today would have been called a low grade laser.

To realize the more distant reach required for large systems, lasers with the following performance could be used:

C/N = 54 dB Loss Budget = 10 dB

Other distortions:
Down at least −65 dB

If we assume a conservative 0.5 dB/km fiber loss and a four way splitter loss of 7.1 dB, we could provide signals to four optical receivers up to 6.1 miles from the source. This is accomplished as follows: For an optical link performance of 54 dB C/N, total optical loss can be no more than 10 dB. However since the needed C/N is only 50 dB, 2 dB of optical loss can be added to the path. This will result in a 4 dB reduction in C/N (at RF) at the output of the optical node. This will provide an "at the tap" performance of 49 dB C/N and excellent distortions.

If more distance is needed, an active repeater can be used. In this case, any combination of laser transmitter and laser repeater performance that will result in the RF output at the optical node of at least 50 dB C/N and other distortions of at least −61 dB will provide the required "at the tap" numbers.

It is obvious that with loss budgets smaller than 10 dB, the reach will be less, but lower performance lasers can be used closer to the headend and still provide excellent results. This fact alone should allow laser manufacturers to effectively increase these yields, thereby lowering the cost of the product.

By deploying fiber deep in the cable plant, the bandwidth expansions of the future become much easier.

It is interesting to note that with careful design of the three line extender cascades, each optical node is able to serve about the same geographical area as four bridgers.

The main features of the "Fiber Trunk and Feeder" are:

1. There are no coaxial trunk cables, amplifiers, bridgers or passives.
2. There are not more than five active devices between any subscriber and the headend. (Only four devices if a repeater is not needed.)
3. It can use push pull line extenders instead of power doubling or feedforward amplifiers.
4. It costs the same or a little less than a conventional new build tree and branch system of the same bandwidth.
5. There is nothing new to invent.

The financial studies completed by ATC have indicated that the cost of this new architecture will allow the deployment of fiber technology deep into a cable plant for no more than the price of conventional coaxial systems. This results in approaching many of the company's goals of better picture quality, better reliability, simpler maintenance, improved customer image at no increase in cost over a traditional plant.

By deploying fiber deep in the cable plant, the bandwidth expansions of the future become much easier. The "Fiber Trunk and Feeder" architecture is evolutionary as has been the Fiber Backbone. It positions a system for future services such as switch video for pay-per-view and makes two way operations practical. With all the features that have been identified by using "Fiber Trunk and Feeder," (and new ones seem to come along every week) this new architecture is now the "design of choice" for ATC's new build or rebuild operations. ■

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Non-standby power supplies: install it and forget it?

The juice that powers the cable distribution plant is electricity. Keeping that juice flowing is essential. Power supplies, the units that inject the juice all along the distribution network, have become very reliable workhorses, especially non-standby, ferroresonant transformer power supplies. With this type of power supply, for use in both small systems and larger systems that extend out to long distances, you should be able to install it and forget it.

But as in all highly competitive equipment markets, with equipment that is so reliable, what can vendors do to distinguish their product from others? If they are so reliable, what's the difference? Choosing one over another is a toss of the coin. Or is it?

As any advertising guru will tell you, one of the best ways to sell product is to play on the fears of the customer. With so much riding on power supplies—without power the cable system is down and out—one of the best issues to tout is reliability. But if virtually all non-standby power supplies are highly reliable, what can you talk about?

Heat and noise

Electrical products always generate heat and heat contributes to degradation of functioning parts. Cable engineers certainly know this is true with amplifiers and line extenders. And ferroresonant transformers create a lot of internal heat.

"I would say that heat is probably an issue in every electrical product," states Larry Roper, CATV product manager for Alpha Technologies, a vendor of power supplies. "You always have to deal with heat."

Power supplies from RMS Electronics and Alpha, much like others, use natural internal convection, or airflow, to cool their units. "We have found that with the way we've got the enclosures vented, it doesn't seem to be as much a problem than perhaps some of the other (active) products on the market," Roper claims.

"In the power supply, and they are quite reliable in our industry," says Mike Kearns, national sales manager for Lectro Products, "the main piece of equipment that is affected by heat is the transformer. The ferroresonant transformer technology can take many different forms and Lectro has a proprietary design that uses high quality materials and the latest in vacuum technology for the building of the ferro. We also use high quality mil-spec paper and varnishes which gives our ferros a very high reliability rate," Kearns goes on. "To add to that reliability, we heat-sink them directly to the cabinet."

By George Sell, Contributing Editor

Some manufacturers put a rubber bushing between the mount of the power supply and the enclosure to deal with vibration and noise. The loud humming noise coming from transformers is caused by the windings and varnish deteriorating in the ferro, causing, in turn, the windings to rattle.

> 'Basically, the less heat you've got, the more reliable the product.'

"Our transformers have a better heat-sink, therefore they stay cool and less noisy and last longer. We can go with a five year warranty because they just don't deteriorate," Kearns says. Most non-standby power supply vendors offer long product warranties.

"Heat in any form is a killer. That's the thing that causes failures," agrees Jerry Shultz of Power Guard. "It may be normal failures, it may be premature failures or it may be way off in the distance. So, basically, the less heat you've got, the more reliable the product." Shultz has been designing power supplies for cable television for many years and was responsible for designing Lectro's units before heading up the effort at Power Guard. The last unit he designed for Lectro was the Century II power supply.

"Even if you've got a reliable product, if you can make it run at a lower temperature, it will be even more reliable," advises Shultz. "Heat is always detrimental in any amount."

"In the case of the (ferroresonant transformer), all ferros run hot anyway. Dissipating heat becomes a big factor. Reliability isn't the problem it used to be, but still, the more heat you can dissipate, the better," Shultz says.

Shultz's latest design effort is Power Guard's "Power Cast," a small, lightweight, power supply fully encased and sealed in an aluminum housing. This design allows it to be mounted in a pedestal, on the pole or bracketed and mounted overhead on the strand.

But if heat is such a killer, how is heat dissipated in the Power Cast units, which are enclosed in a sealed compartment and hung out in the sun?

"Normally, you have the ability to pass air through and around your devices and, of course, if you have moisture and humidity, blowing sand or snow, that can get in through the louvers. In the case of the Power Cast, it's completely sealed. So, we have to talk about heat dissipation because we have to get the heat out of there without having air circulating inside of it," Shultz explains. "We conduct heat straight out to the aluminum and then we have 600 square inches of surface area which is much larger than most." The aluminum housing is designed with rows of fins for maximum surface area heat dissipation.

But what about this heat dissipating quality when it's placed in a pedestal? "That limits your airflow," Shultz admits, "and what we do there is sell them on an anodized housing which has better heat dissipating characteristics without the airflow. Even in a pedestal there will be airflow but it would be more limited than it would be out in the open. The black anodized would dissipate heat better but it also gets hotter in (direct) sun. If it's in a pedestal, you don't have the sun to contend with."

Werner Krajicek, president of Power Technologies, questions the emphasis on heat. "If the transfomer is properly designed, it should have absolutely no effect on the transformer in the prod-

Continued on page 36

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Reader Service Number 15

Outside-premise conversion: Who should power?

The latest development of outside-the-home addressable conversion system architectures has raised again the debate over whether the cable system operator should pay the bill for powering this processing or shift that expense to the subscriber. With in-the-home set-top converters, the customer plugs the device into his own wall socket for powering just as he does with other consumer electronics he may have. But if that conversion processing is now outside somewhere, should he continue to pay that bill?

With "off-premise" systems, it's certainly hard to justify shifting the power bill to the people if the off-premise conversion is done well away from the subscriber's home such as on a pole or in an enclosure somewhere in the neighborhood. But with the so-called "on-premise" systems, where the conversion electronics are mounted on the outside of the subscriber's home, is the shift now justifiable?

Have on-premise equipment vendors made efforts to minimize the additional cost to the subscriber or, being freed from the stringent cost requirements that operators demand, have they simply assumed that there is now no such pressure to provide built-in conservation? Prominent among the hyped up claims for on-premise is that it is consumer friendly, but at what price?

Well, it turns out that the subscriber will be paying for less power consumption with on-premise equipment than he currently pays with set-top converters. Most set-top converters draw about six to 10 watts. On-premise conversion systems draw less power. For example, Eagle Comtronics' on-premise addressable trap system draws four watts of power. Jerrold's Starport system draws three to four watts. And the Syrcuits Matrix system marketed by Midwest CATV consumes three watts.

How would this compute into dollars and cents? "We calculated that the other day," says Bill Dancy of Midwest CATV. Midwest is offering the Syrcuits Matrix addressable trap system.

Midwest was testing the Syrcuits Matrix unit at ATC's labs in Denver. "One of the reasons we were doing the calculations was because ATC is one of those companies that feels that, if they put something into a customer's house or apartment complex that draws anything from the customer, they have to give him credit for it—quite unlike anybody else."

By George Sell, Contributing Editor

According to Dancy's calculations, the Matrix unit would draw about 90 watts a month. In kilowatt terms, and with kilowatt hours at about five cents, the subscriber would be paying about ten or eleven cents per month to power the Matrix on-premise unit, Dancy reports. Jerrold's Starport and Eagle Comtronics' on-premise addressable units also draw from the home about the same amount of power.

Off-premise conversion systems, alternatively, require powering from the cable plant rather than from the subscriber's home. And by some reports, this powering will require not only more power but changes in line powering equipment.

> 'If you are going to utilize more power, you're going to need more power supplies.'

According to one vendor of an on-premise system who preferred to speak off the record about a competitor's off-premise architecture, "There was a test done on a two mile hard line in which 200 subscribers were being powered prior to this test by two 60 volt power supplies on the cable line. When they added off-premise addressability to that same path, to serve the same number of customers, they had to add six power supplies."

According to Jerry Shultz of Power Guard, off-premise can change the situation for powering cable systems. "It can because what they are really talking about is powering the device that they are addressing with (power from the cable at the antenna input), which means you're going to have to have an awful lot more power in a local location. You have to have the power supply capable of doing that in addition to what the amplifiers draw. That way they don't have to rely on customers furnishing the power to these devices and, of course, the power will be higher."

So, the issue is higher powering? "And much more numerous," says Shultz. "When you start putting in lots of supplies, in fact, they probably won't be 15 amps. They will probably put them in each line because they will want to keep them fairly local so they may serve a small area. So, instead of a 15 amp power supply, you may want to put in a whole bunch of 5 amp supplies."

In response, Steve Necessary of Scientific-Atlanta states, "In our approach to securing signals outside the home, we are using the interdiction approach of jamming signals. That is a location indifferent technology. We have in our family of products versions which fit on the strand or in a pedestal, as well as on the side of the subscriber's home. In fact, we believe a reference to "off-premise" or "on-premise", as it relates to our technology, is actually erroneous," Necessary asserts.

"We are neither 'off-premise' or 'on-premise' but both. Powering from the cable versus powering from the subscriber's residence is not necessarily an issue with our product because our product is designed to allow for either one of those powering methods." And, this is true for any mounting configuration of the S-A product, Necessary suggests.

"It is clearly an accurate fact that if the product is powered from the cable plant, yes, indeed, there is a cost associated with that and the 10 watts (per unit or 2.5 watts per active subscriber port) for the four-port (version) gives a good rule of thumb. And there's clearly a requirement for additional power supplies (in the strand or pedestal mount versions). If you are going to utilize more power, you're going to need more power supplies," Necessary admits.

"Secondly, in our system we can support the opportunity to power either from the cable or from the subscriber's residence itself. Clearly, in the application where our interdiction product is on the side of the house, a single dwelling unit application, it makes the most sense to power that from the subscriber's home. In that application, it's expected that there would be no increase in power required from the cable plant," for the S-A hardware, Necessary says. ■

not at full rated voltage of 660 volts AC, they can have longer lifetimes.

"Now, you could do two things with the transformer," Krajicek suggests. "You could either drive the transformer very hard, which means you would get your 660 volts on this ferroresonant circuit with the capacitor. But then the capacitor has a limited life—typically five years or 50,000 hours. Now, if instead of running it at 660 volts, you ran it at 550 or 500 volts, you have extended the life of the capacitor two- or three-fold.

"The problem, of course, is it costs you more money to manufacture the transformer. So, I think it must be stressed that if somebody gives you a five year warranty, the indications are that the transformer is designed to survive these five years. And, hopefully, not at the cost of the capacitor. Now, I think everybody puts a little bit more money in their transformers and these capacitors live 10 years-plus."

Mounting options

A feature recently developed by Power Guard for its Power Cast power supply is the ability to strand mount the unit. With supplied bracketry, these small, light-weight units can be mounted anywhere other units can, in addition to the strand, thus ostensibly reducing the amount of pole rental fees charged by utility companies.

Power Guard reports that it's received widespread acceptance of the idea from many cable operators. But is the idea such a winner that other manufacturers will follow the same strategy? It doesn't appear likely.

"There isn't a whole heck of a lot to (the Power Cast) power supplies," says Roper. "It's a pretty simple, pretty basic power supply. "You could probably strand mount our pole-mount power supply with a bracket and call it good," Roper offers. "But I don't know how the weight and balance would be."

Krajicek says he's tried the same approach, without much success. "We did some prototyping of this type of strand mount but we immediately ran into some utility power contradictions," says Krajicek. "First of all, you have to feed this power supply 110 volts somehow. That's normally coming off a power pole and there's a transformer on the pole... to give you 110 volts. So, you can mount your power supply on the strand, that's all right. But the power company will not mount its breaker on the strand because they go strictly to the pole. The idea of not having to pay pole rentals is obsolete because now instead of having one power supply with a breaker on the pole you have a breaker box on the pole and the power supply strand mounted."

All vendors use essentially the same surge protectors.

Be that as it may, the future development where the small, lightweight Power Cast might have unique application is in powering off-premise addressable conversion systems. With off-premise architectures (see accompanying sidebar), the customer's unit that is being addressed requires locally generated power.

"That's where we feel the Power Cast's strand mounting is going to be (very effective)," says Shultz, "because they are very easy and inexpensive to install and not bad looking. If you start getting installations of power supplies in front of people's houses, they don't like that."

Spikes and surges

The non-standby ferroresonant transformer has a very fast reaction time for either over-voltages or under-voltages. It's actually a regulating transformer. "So, if you have some spikes coming down the line," Krajicek explains, "normally they're limited with a surge protection (device) which takes out surges of about 175 volts that are on the AC input line. What you do is take out everything above 175 volts and let those from 175 volts down to 117 volts be handled by the transformer itself."

All vendors use essentially the same surge protectors. On the input is a soft limiting metal oxide varistor (MOV). On the output is a zener diode transorb. Another is a time delay relay which keeps the line off of the cable until it has had a chance to stabilize.

"The MOV, which is soft-limiting, if you hit it with a bigger surge," says Shultz, "the clamping voltage goes up and typically you have much more power or unlimited spike available in the primary. So, you have to be careful

what you put in there." The harder the MOV gets hit, the higher the clamping voltage is, so the less strain it is on the device.

"On the transorb or zener diode in the output, it clamps at 90 volts in the case of the PIP-60 (Power Guard's transorb), but when it turns on at 90 volts, it is *on*. It hangs in there at 90 volts. If you give it more power, it takes it until it burns up.

"The reason you get by with that in the output is because the ferro transformer itself is attempting to do some surge limiting, too," Shultz says. "If the surge comes in from the line side, of course it has to go through the transformer, so there's quite a bit of impedance between the surge and the protection device."

Krajicek has done some testing of the amount of surge limiting the transformer itself can do. "You could apply 5,000 volts or 6,000 volts from the output side and you will not see these 6,000 volts appearing on the line as soon as the transformer is turned on because the transformer has a very small winding and has less than 20 feet of a number-10 guage wire on the output winding.

"This 20 feet of wire wound in a coil is essentially a short for the 6,000 volts. Some people like to see a time delay option after a power outage when the power comes back up, so they can hook up the output to their amplifiers after the line has stabilized," Krajicek says.

Another surge protector that's been available for a some time but is only now seeing some popularity is a "crowbar" type of device, which Alpha calls its "Amp Clamp." This device actually shorts out a heavy surge right to ground.

RMS Electronics uses a standard MOV on the input and several other optional surge protectors such as a valve-type lightning surge protector. It also offers a time delay relay.

Even in high lightning areas, power supplies are remarkably reliable.

Lectro uses a plug-in MOV for surge protection on the power line input. For storm-prone areas they offer an optional solid-state device called the Unilec surge protector. "Three separate circuits within the assembly provide 500 joules of suppression when applied across the AC input," says Kearns.

Outage causes

Surprisingly, even in high lightning areas, power supplies are remarkably reliable. In fact, most outages are caused by devices placed along the line that are designed to reduce damage.

John Walsh, vice president of engineering at the ATC system in Orlando, Florida, a decidedly storm-prone region, has not found power supplies to be a major contributor to power outages. "Interruption of commercial power service was one of the contributors to power interruptions but it was not the major contributor. There were other reliability weaknesses that were actually greater than interruptions in commercial power source."

In Walsh's system and other ATC systems in the central Florida region, outages are more often caused by surge protector devices factory installed on trunk and distribution amplifiers. For example, Walsh and his crew ran tests on a gas discharge surge protector to determine their effectiveness. "After removing them, we determined there was actually less damage to amplifiers (after removal of) those devices and a dramatic improvement in reliability. In many cases the surge condition that occurred was only a momentary condition that would have self-corrected if the device hadn't been there. And if it hadn't been in there, there would not have been a fault in the line."

Consequently, Walsh made many modifications to the Orlando system after these studies. The result has been a 40 percent reduction in trunk outages over the previous year. "Prior to that (modification), trunk interruptions represented over 50 percent of our interruptions. Today they are about 26 percent. In number of subscriber hours per day, which takes into account the number of outages and the number of customers affected and the duration of that outage, we see a 75 percent improvement," Walsh reports.

If Walsh's discovery is indicative of other systems, it seems that power supply failures aren't necessarily much to be feared. In fact, the ferroresonant non-standby power transformer available to the cable industry is highly reliable and can take it. ■

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Whither two-way?

Operators posed to activate two-way plant, but search for reasons

During the early 1980s, the cable industry went through a period where two-way cable systems were built because of franchise requirements. These systems were often the focus of experimentation, with the outcome often a bloody bath for both the hardware vendors and the operators involved with the project. Because of this, serious interest in the technology seemed to disappear, although many of the original systems were left in place. For those system operators, dealing with a two-way system meant learning about noise effects, and the notion that a system must be maintained in a tighter fashion to ensure RF integrity.

However, the past few years have changed the face of two-way technology. The advent of fiber optics deeper into the plant has resulted in a reduction in the number of active devices between the headend and subscriber, thereby eliminating some of the noise problems. Secondly, and perhaps even more importantly, the rules on cumulative leakage index (CLI) within a system have caused operators to tighten 'F' connectors and other "leaky" areas that once were considered nothing but a nuisance to those running a one-way plant.

The question is, has this trend toward improved plant maintenance, along with fiber optic capabilities, triggered a renewed interest in two-way capabilities? Recent murmurings seem to indicate operators are considering the technology as they continue rebuilding and upgrading plant. However, the reasons are varied as to why two-way is effective. For many operators, the question to offer two-way is not one of technology, but rather a business decision based on additional revenue.

IPPV a deciding factor

"The decision was not solely an engineering based decision," says Jerry Genova, director of engineering for Cablevision Systems, when asked about the two-way plant in New York City currently being built for the Bronx and Brooklyn areas. "Cablevision, as a company, packages its services and the decision was made to include impulse pay-per-view (IPPV) at a number of our highest tiered services. We anticipated being successful and we were. The only way to handle that volume of impulse buying is through RF return. The maintenance of two way plant was of major concern. However, we were certain with the RF integrity required for CLI and the availability of automatic return path disconnect features typically available in most status monitoring systems, that plant maintenance could be handled much more efficiently."

> 'Two-way is integral because we're heavily deploying and using status monitoring and also using the two-way system to help us perform our preventive maintenance.

However, Wilt Hildenbrand, vice president of engineering for Cablevision Systems, sees technical benefits stemming from the decision. "I don't remember what the major catalyst was," says Hildenbrand about why the two-way system was constructed. "We built it (New York) with 550 MHz feedforward equipment. One of the technical iterations about feedforward is the way in which you get the improvements for beat cancellation and things like that—the technical configuration of the trunk module. There's certain parameters of the module that you have to keep track of to make sure that feedforward is still working in terms of beat cancellation. The easiest and most logical way to do that is with status monitoring. And by the time you get done putting in status monitoring, you've now defined a two-way system."

KBLCOM Inc., in San Antonio, Texas, (which acquired the two-way system from Rogers Cablesystems) uses two-way technology for its IPPV business and is now involved with using the technology for other purposes. "Our view is that it's an absolutely critical portion of our business plan," says Richard Clevenger, vice president of engineering and operations for KBLCOM Inc. "Two-way is integral because we're heavily deploying and using status monitoring and also using the two-way system to help us perform our preventive maintenance, which falls back on picture reception and CLI compliance."

Even Warner Cable Communications Inc., who was responsible for the development of Qube in the late '70s, sees a two-way operation as the best way to offer IPPV. "Warner has never really taken the focus off two-way plant operation," says Mark Bowers, vice president of engineering for the Columbus, Ohio-based MSO. "They've always felt that it was a good way for true impulse and never really felt that it created unmanageable problems in terms of maintaining the system."

As for Qube itself, Bowers looks at the "failure" as a result of market forces. "Qube was not a failure technically," says Bowers. "The system still works and works very well. It has some very innovative features and does a lot of things that even the best addressable systems don't do and can't do, just because the architecture is different. There were a lot of other things Warner was attempting to do that caused the problems."

James Hannan, vice president of engineering for Times Mirror Cable Television, was with the Qube system when it was first operational. To Hannan, Qube is "a phenomenal system. It got some bad rap, not because of the technology, but because of the functionality of the box," says Hannan. "Qube had some drawbacks. One, it was expensive to buy (converters); secondly, it was extremely onerous in terms of what the system operators were required to do—(build) fantastic studios, spend huge amounts of money on a franchise which later on, there was not the revenue to pick it up; and third, there was not the market for the kinds of things Qube could provide but had not yet developed."

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Why two-way?

This latter drawback brings to mind other questions voiced by many in the industry. Why use a two-way system when PPV can be offered via automatic number identification (ANI) or automated response units (ARUs)? What exactly is it the cable industry is hoping to offer via two-way: IPPV? Voice? Data?

"In our discussions with Congress and the FCC," says Tom Gillett, vice president of business development and technology transfer at Cable Television Laboratories (CableLabs), "is a thoughtful analysis of, do we want to have a network that does everything, i.e., voice, data and video with broadcast that does two-way, or do we need multiple networks—each of which is optimized to do its own particular task but the networks can talk to each other and communicate.

"That debate is still raging and I think it's an important one," continues Gillett. "I tend to believe that in this discussion of America's future infrastructure that the answers are really going to be multiple infrastructures. We're going to have interactive, point-to-point networks—high efficiency broadcast networks and, from the customer's perspective, they won't know which network is delivering service to them, they just know they're getting the service they want."

But to Jim Chiddix, senior vice president of technology and engineering for ATC, the question is not how to deliver the services, but rather what those services will be. "There's a lot of advanced services people have tried," says Chiddix. "Alarms, information services, Qube—they've all been unmitigated financial disasters. I think that we as a company, in fact our whole industry, have yet to be convinced that the residential market is ready to pay for any services other than entertainment television and telephone service."

This perception of consumers wanting only entertainment services from their cable system is what Bob Luff, vice president of engineering and technology for Jones Intercable, views as the answer to whether a system should be two-way capable. "The cable industry has got some noodling to do in determining what business they're in within the next decade," says Luff. "If we think we're in the cable TV business, which almost by definition is a one-way, outward-bound broadcast service, then we're not going to be doing much two-way. Which would be a shame. If, as Jones has defined its role, we think cable TV is really destined to be a telecommunications service, it's a little bit broader definition."

Still, Jones is not currently activating two-way plant. "Because of the nature of coax being naturally two-way," states Luff, "it doesn't take much effort to activate a bunch of two-way plant when it's needed. But today, the line of people lining up outside our offices for two-way services is extremely short. And therefore, our planning to build, activate and operate two-way systems is directly proportional to the interest expressed to us."

Not a minority

Jones is not alone in its thinking. "We're in an observational mode right now," says Times Mirror's Hannan. "We see other MSOs working through the issues of two-way addressability

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and we hope they're successful, but we're not willing to make that jump yet." To Hannan, the decision is "a cost benefit kind of situation, in terms of waiting for revenue to come about."

"We have found," says Bob Saunders, director of engineering for Sammons Communications, "that it (two-way) is very expensive to maintain and we've found more effective, as far as costs are concerned, alternatives (to offering IPPV)."

Steve Raimondi, senior vice president of engineering at United Artists Cable Systems, couldn't agree more. "As you know, we acquired United Cable who has a lot of experience with two-way. And although they've applied the technology and a lot of hardware in the field, we cannot display a great deal of revenue attached to that. So we've been very soft with it."

However, Raimondi also voices a sentiment felt by many in the industry. "We still think that we don't want to close the door to it so what we have done is, every time we build or upgrade plant, we are building with two-way in mind. We have two-way capable plant, we're just not activating two-way."

This thinking has placed the set-top converter manufacturers in a precarious position. "If you're going to be in the set-top terminal ballgame," says Tony Wechselberger, senior vice president of domestic operations for Oak Communications, "you've got to have all the widgets. Whether or not you make money on them is a totally different situation. Operators want to know that later on, if something happens to change their philosophy or decision matrix, they can always have that flexibility. People are looking at two-way as a possibility for the future."

> 'If we can get the cost down by some of these means of improving the distribution plant and getting fiber optics out there—you'll see a lot more two-way application in the future.'

"There are a lot of operators who see applications for two-way in the future who don't utilize two-way today," says Dan Moloney, director of product management for the Jerrold Subscriber Group. "If we can get the cost down by some of these means of improving the distribution plant and getting fiber optics out there—you'll see a lot more two-way application in the future. Like Wechselberger, Moloney also sees operators buying two-way capable. "Operators have left the return path module installed in the amp station but aren't using it for anything. If it (the plant) gets clean, they'll certainly find application for it."

"The caveat is two-way capable," adds Paul Dempsey, manager of CATV sales engineering for Pioneer Communications of America. "Operators know

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TWO WAY ADDRESSABILITY

we could supply the two-way capability with the converter, whether it's phone or RF. So people are aware of that. Whether they buy them from the get-go is another issue."

Phone or RF?

Deciding whether to use RF or phone technology can be another consideration. Although using a phone return alleviates some of the earlier concerns about maintenance costs in a RF return, there are some simple drawbacks to the technology. One of the more obvious is the installation procedure.

When installing a telephone return link, it is necessary to find the telephone jack and TV relationship. If there is no jack near the TV, the installer needs to string a jack closer. Then, the telephone modem has to be plugged into the house phone system. Regardless of these problems, it also seems the attitude of cable operators toward using a phone return has changed.

"Many cable operators have expressed to us a reluctance to be so heavily reliant on the telephone company for a critical portion of their business," says Steve Necessary, vice president of marketing for subscriber systems at Scientific-Atlanta Inc. "Now, obviously ANI directly relies on the telcos, so it's clearly not a universally felt sentiment. But I think in some cases it at least factors in."

"My perception," says Bowers, "is that many of those operators are finding out now there are technical problems with telephone return as well as the telephone system in a particular area may not be up to snuff. And the frustration there is now it's really out of your control, you have to deal with another entity and the telephone company to boot."

The answer to this is to use the cable plant and existing CATV technology. "We feel we have a technology that will work in a real-world cable plant," says Vito Brugliera, vice president of marketing and product planning for Zenith Cable Products. "And the advantages of doing it real-time means that you can do other things besides what we call PPV or pay-per-event."

These "other things" Brugliera refers to brings the industry back to those elusive other services that cable could offer. Is two-way technology a means to provide IPPV or the foundation for future services—including the obvious possibility of delivering voice, i.e. plain old telephone services (POTS)?

"Providing telephone services is an idea that we have kicked around," says Bowers. "But there would certainly be some, at least at present, regulatory concerns about doing that. And beyond that, there are some technical problems in doing that with our present plant architecture. You can deliver dial tone today, but there would be a lot of work involved...it's got a ways to go before I would want to see it implemented in one of our systems. I think what brings us, and other operators, up short at this point would be regulatory concerns. We've got to decide how we answer those issues first and then the engineering concerns I'm sure could be taken care of."

Hildenbrand agrees that voice service is being considered but the technology is a problem. "Have we honestly looked at two-way plant to do voice services? No. Has it been talked about? Sure. But I'm not sure the architecture makes sense. If you were really going to look at it, you'd probably have to get into a completely different system architecture than a tree-and-branch."

But for others, offering voice via cable is something to be strongly considered. "Once you're there with two-way," says an industry engineer who asked not to be identified, "and you're already maintaining the plant, everything else you put on it incrementally is not costing you any more. So yes, of course, it makes logical sense to start thinking about voice. We have some unique opportunities there."

Although voice may not be on the top of the "services to be offered" list at the moment, there are other future services, as well as present services, such as status monitoring and channel polling, that operators can use if a two-way plant is in place. "The weapons are out there in the plant and the subscribers' homes," says Hildenbrand of Cablevision Systems. "If the services evolve and they make sense, at least you've got the architecture and the equipment to take advantage of it.

To Hannan, the issue of two-way will be solved by these and other MSOs willing to "prime the pump to get the two-way waters flowing. I think there are some MSOs that have a very strong vision of what they believe the future of cable television is," says Hannan. "And they're willing to invest today in that future and take the risk on it. For some of those, not only does it include things like fiber optics and new architectures, but it also includes these two-way systems and the revenue sources they're looking for." ■

—Kathy Berlin

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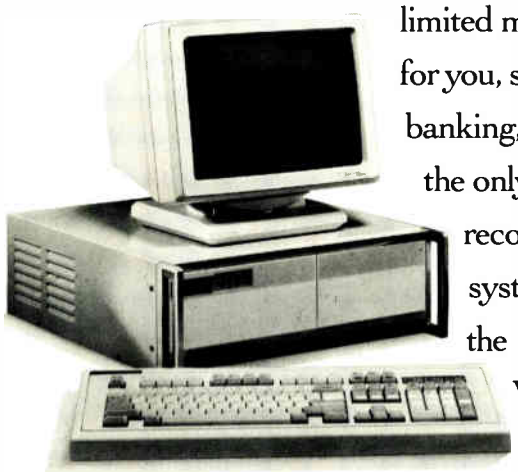

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ADDRESSING YOUR FUTURE TODAY

Using T-1 in CATV applications

The CATV industry has become quite adept in the last decade at squeezing additional revenue from existing operations. Examples of this include local ad insertion, pay-per-view (PPV) and the profileration of regional networks providing local sports and entertainment venue.

Another technology that some CATV operators have already tapped, and many more could profitably exploit, is the transmission of a T-carrier. However, for the CATV operator to have financial success in this endeavor, the proper application must be selected that yields adequate reliability and accounts for all hidden costs.

T-1 or DS-1, the first all-digital telephone system, was introduced by AT&T in 1962 and is the fundamental building block for T-carrier transmission.[1] The basic T-1 hierarchy consists of 24 digitized voice channels time-division multiplexed into a synchronous, bi-directional, 1.544 MB/s data stream. Data may also be multiplexed into the T-1 bit stream. Most commonly, T-1 is available at the output of Private Branch Exchanges (PBX).

One requirement is a 750 kHz bandwidth which, typically, may be transmitted up to 1,500 feet, unrepeated, using four-wire, twisted-pair, copper transmission lines.

To increase the channel capacity in a given transmission medium, most telephone companies (telcos) time division multiplex (TDM) multiple T-1s into higher bit rate data streams. Table 1 lists some of the T-carriers that AT&T uses.[2]

System	Name	No. of voice grade channels	Bit rate	Effective # of T-1 carriers
T1	(DS-1)	24	1.544 MB/s	1
T1C		48	3.152 MB/s	2
T2	(DS-2)	96	6.312 MB/s	4
T3	(DS-3)	672	44.736 MB/s	28

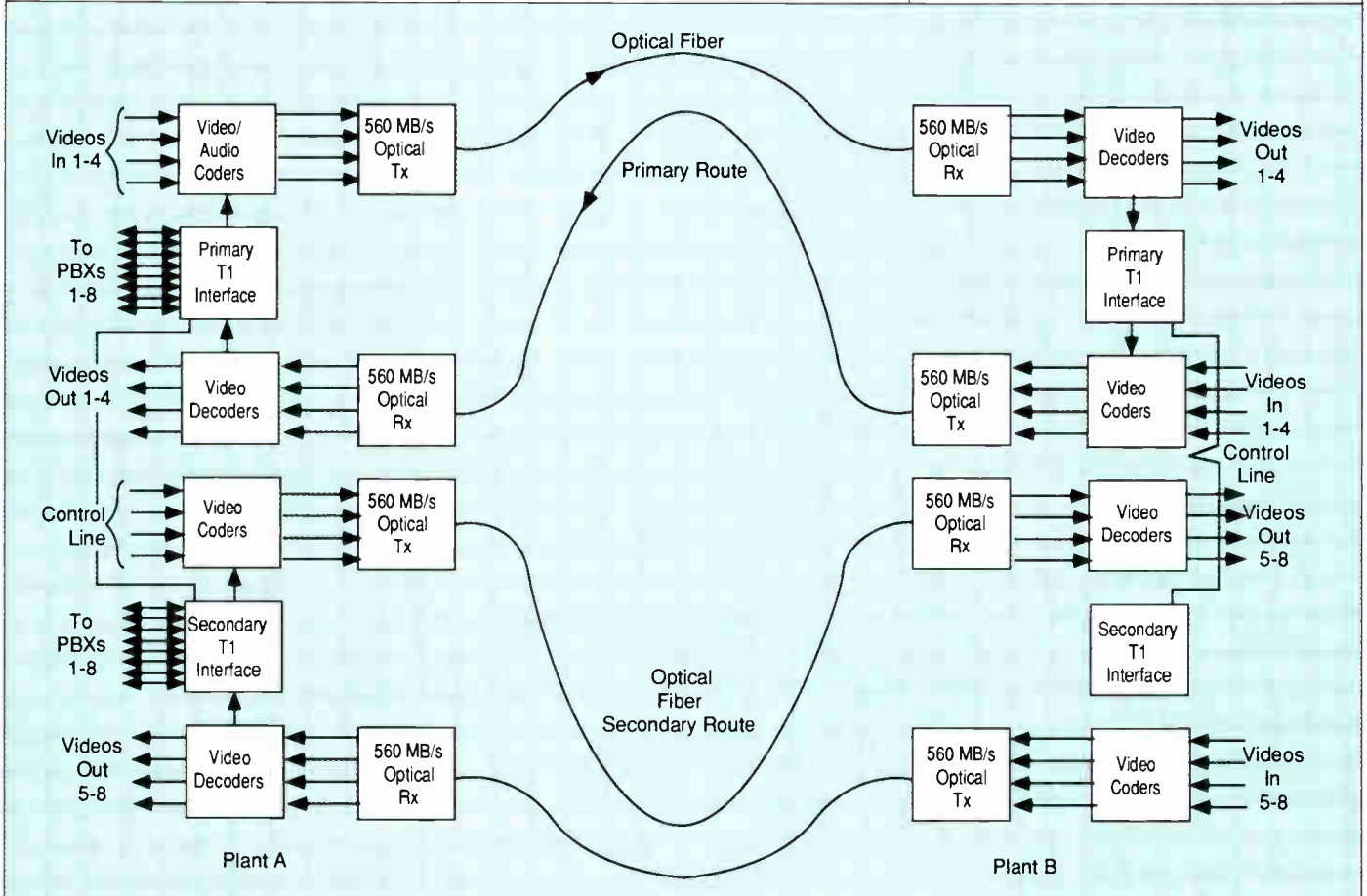
Table 1

By Ken Pyle, Product Manager, Comlux

T-carrier applications

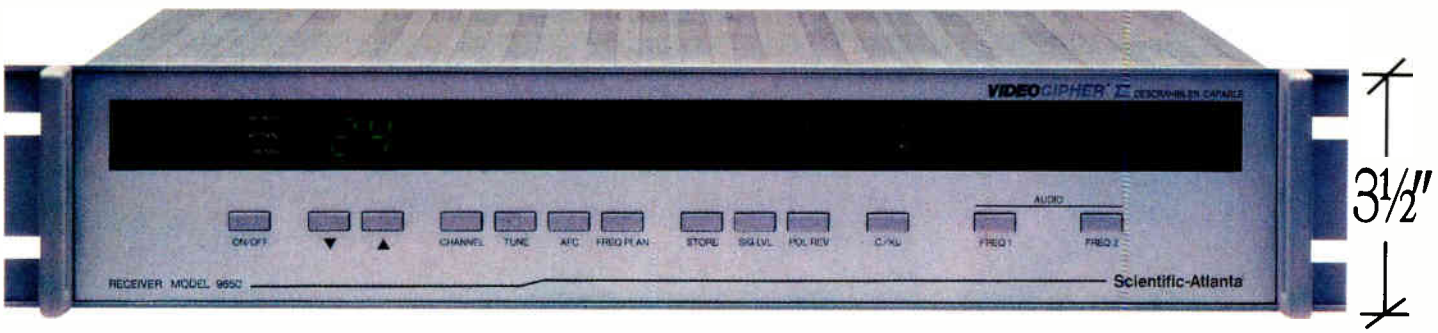
The optimum T-carrier application utilizes the CATV operator's video and audio expertise. The reason for this is the CATV operator has a wider array of choices available for merging video/audio and T-carriers into one medium than do the telcos.

This is because the telcos are generally restricted to the digital hierarchy of Table 1. The telcos are restricted to



Comlux Digital Video/Audio/T-1 Fiber Optic Solution
Figure 1

How Do You Fit 10½" Of Equipment Into 3½" Of Space?



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this structure because they normally send T-carriers from the customer's site to their central office and then multiplex these signals with other traffic for transmission at higher bit rates. This necessitates the use of high-cost, compressed video codes when video is transmitted with T-carriers.

CATV operators, on the other hand, are not limited to the telco's T-carrier transmission scheme. This allows the CATV operator to use more cost effective solutions. These solutions range from broadband coaxial to fiber optics or a combination of the two. Vendors of T-1 to coaxial interfaces include Catel, EF Data and Olson Technology. Video and T-1 interfaces that can be merged into the same fiber are provided by Catel and Comlux.

A specific example is depicted in Figure 1. In this example, the Comlux digital fiber optics CATV solution is used to transmit eight channels of bi-directional, RS-250B medium haul video and eight channels of bi-directional audio from Plant A to Plant B. Also, the phone systems of both plants are connected via the eight redundant, bi-directional T-1 lines.

An immediate T-carrier application that some CATV systems have, is the need to connect a customer service office/headend in one city to a customer service office/headend in another city. In this scenario, shown in Figure 2, the internal telephone systems of the two offices could be integrated via the same link that is used for video and audio. A second feature allows for the PPV computer to be located at Office A. In this way, the subscriber in City B would not have to pay the toll charges necessary to call Office A directly.

Reliability

A key issue to any customer of a T-carrier transmission service is system reliability. Besides being price competitive, the CATV operator must be reliability competitive. The specified goal of AT&T for an outage, a measure of reliability, at the T-1 level is four minutes per year. (An outage is defined as any one second with a bit error rate equal to or worse than 10^{-3}.)[3]

The method of calculation they use to determine the probability of outage of a protected component system is as follows:

$$P(\text{Componet or system outage}) = \frac{(N+M)!}{N!\,(M+1)!}\left(\frac{MTTR}{MTBF}\right)^{M+1}$$

The equation for an unprotected component or system is:

$$P\langle\text{Component or system outage}\rangle = \frac{MTTR}{MTBF}$$

Where:

N = The number of working components or signal paths in a protection group.

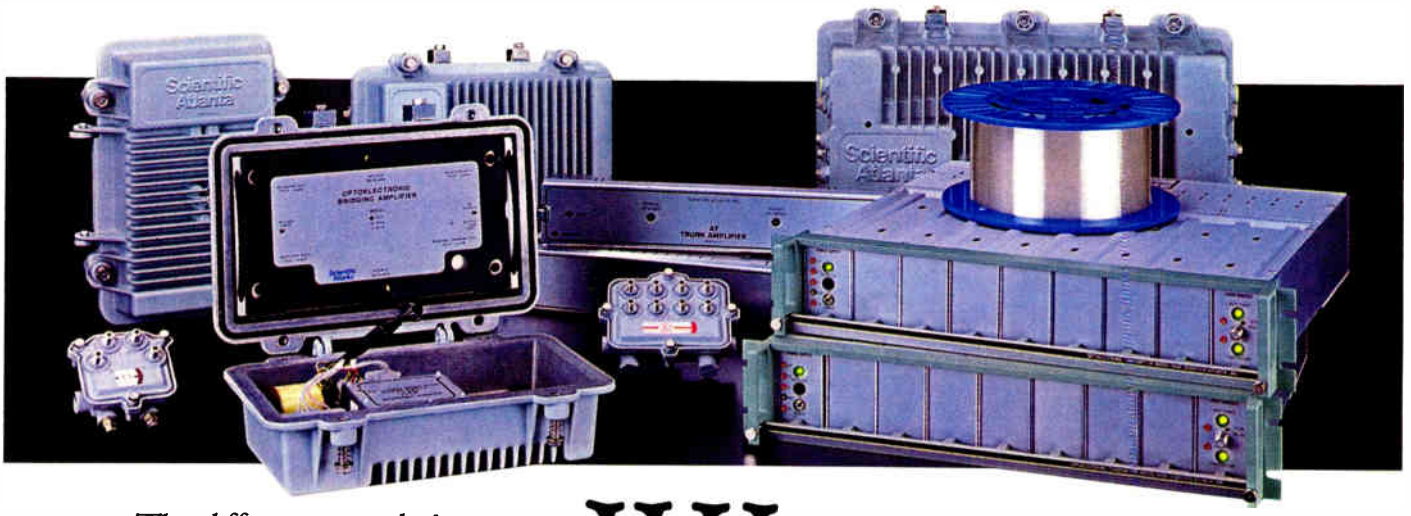
M = The number of protection components or signal paths in a protection group.

MTTR = Mean time to repair. AT&T uses four hours for plug-in and 48 hours for hardwired equipment.

MTBF = Mean time before failure. This number is specified by a product manufacturer. AT&T's publication IP10425 explains the derivation of this figure. Note: to calculate MTBF for a system, the MTBFs of each component are summed.

Using these equations, it is possible to quantify reliability, allowing the system design to be optimized with respect to cost and customer required reliability. For instance, for an unprotected piece of equipment, decreasing the MTTR or increasing the MTBF will cause the probability of outage to decrease. As common sense dictates, the equation for protected equipment

Do You Know The Difference Between Telephone And CATV Fiber?



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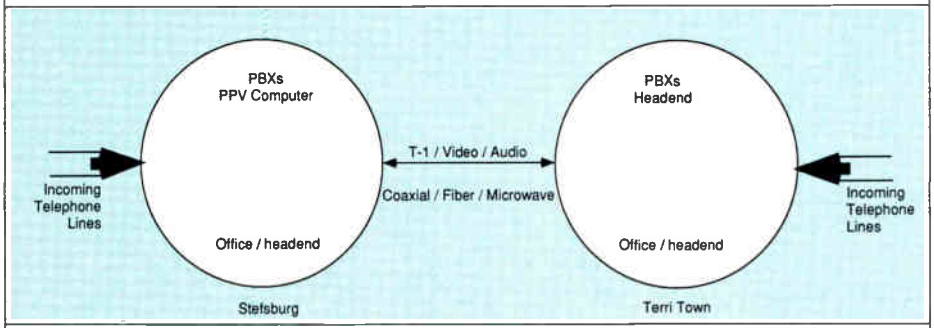
shows that protection improves reliability.

To achieve the MTTR goal, a contingency plan is essential. This plan might include provisions for spare system components, test equipment and deployment of personnel. Additionally, the components of the system should have alarm outputs that can be monitored. Monitoring these alarms will reduce the time between a failure and its detection.

Another product to consider as part of the contingency plan is the use of cross-connect panels. These are jack panels that allow for signal monitoring via high impedance test points. These panels can also provide a method of patching signals in case of failure. Suppliers of this type of equipment include ADC, Glasgal Communications and Graybar.



Hidden costs

Subtle considerations that often are overlooked in the design of a new system can adversely affect the project's profit margin. Regarding T-1 transmission, three items the CATV operator needs to be aware of are: a) the relative locations of T-carrier origination equipment; b) a contingency plan in case of failure and; c) the T-1 framing protocol that the transmission interface must pass.

The T-1 origination and transmission is normally connected with four-wire twisted pair available from Belden, Times, or Western Electric. For runs longer than 55 feet, the lines must be pre-equalized at both ends. Usually, the product vendors can supply these equalizers.

The T-1 data stream may be organized into several framing protocols, two of the most popular being Alternate Mark Inversion (AMI) and Bipolar with 8 zero substitution (B8ZS). T-1 transmission equipment must interface with the particular protocol used by the customer's PBX. ■

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3. *Ibid*, pg. 257.
4. *General Metropolitan Interoffice Digital Lightwave Systems Requirements and Objectives*, AT&T, Basking Ridge, N.J. ©April 1982, pg. 4.
5. *Glascal Data-Connect*, Glascal Communications Inc., Northvale, N.J., February 1988, pp. 174-175.

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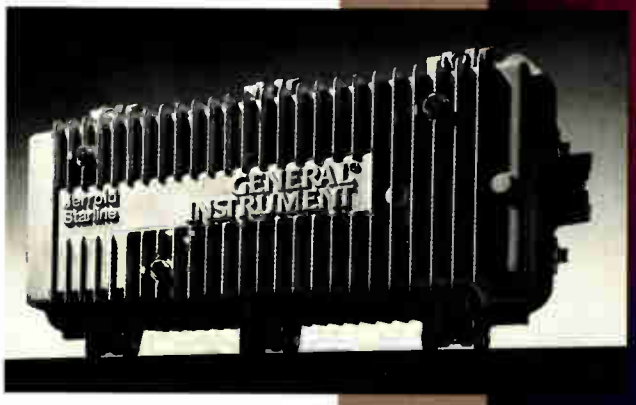

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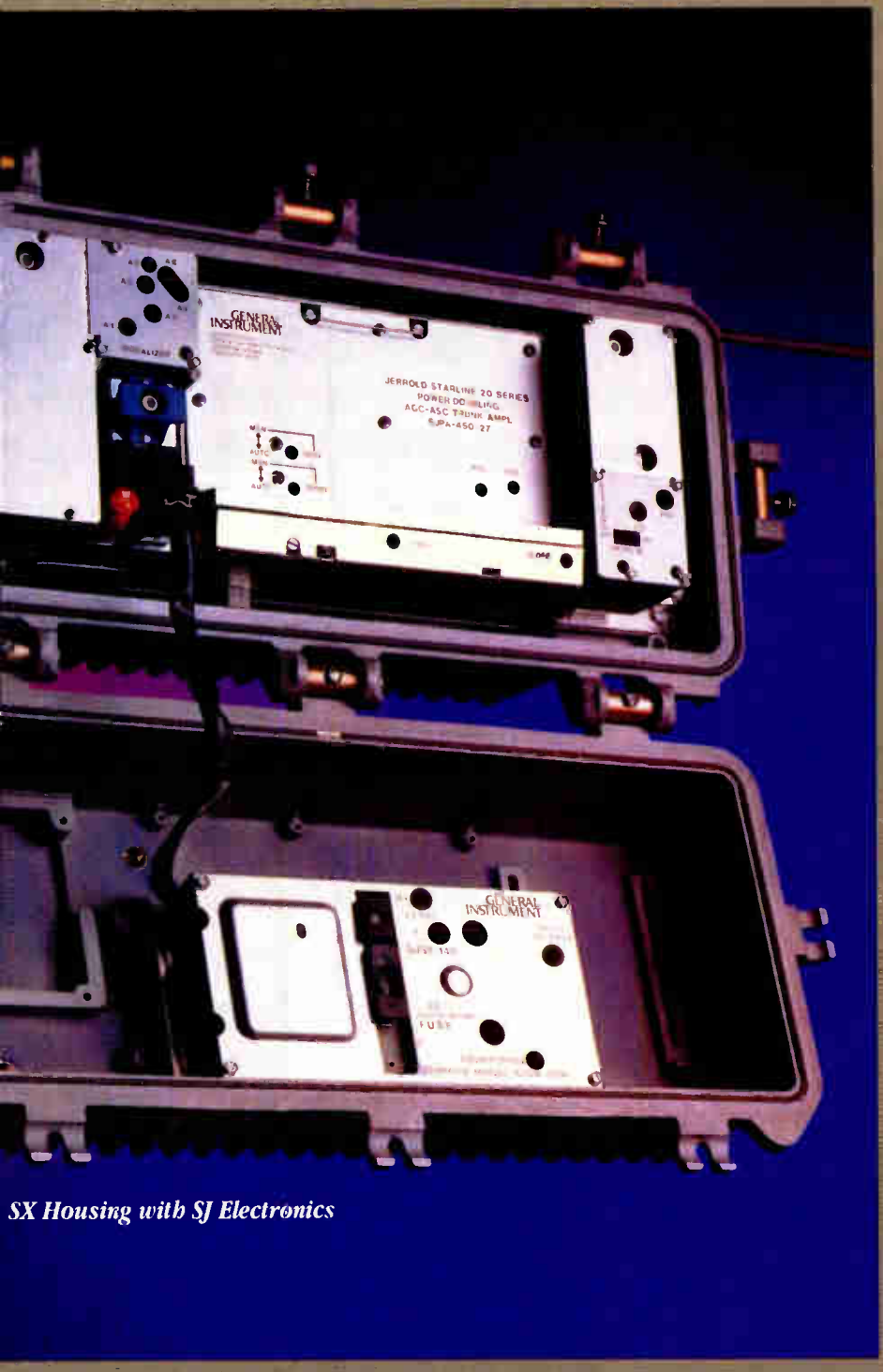

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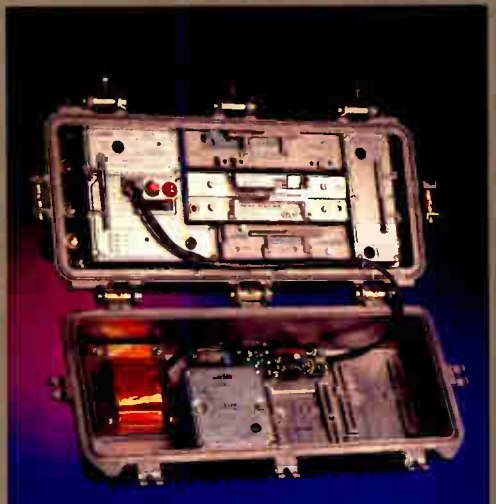

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ming to operators without secure signals. Those who use the Comband system get security via scrambling in addition to the companding.

This standoff was the status quo until recently. With the FCC poised to make more spectrum available to MMDS operators and loosen up some of the licensing requirements, MMDS operators have had more success lately in securing enough venture capital to build systems and acquire programming. And the national consumer press has paid more attention to MMDS lately, too, which has had positive effects.

"This has been the best (National Association of Broadcasters) show for me in five years," says Frank Trainor, director of sales and marketing for Emcee, a manufacturer of broadcast and MMDS products.

He points to a recent million-dollar agreement with Mitchell Communications to provide equipment for several wireless systems. Trainor adds that Emcee's business has tripled over the past three years. "Our phones are ringing off the hook again," he reports, mainly because of the FCC's proposed rulemaking on additional spectrum.

In essence, what the FCC wants to do is give wireless operators access to additional spectrum by reallocating MMDS, ITFS (Institutional Television Fixed Services) and OFS (Operational-Fixed Microwave Service) and provide up to 33 6-MHz channels (see chart). Reply comments were due to be filed last month, but it is widely expected the proposal will be implemented.

A new optimism

The result has been a resurgence in optimism in operators who have mortgaged the farm in the belief the technology works and provides non-cable subscribers a low-cost alternative for video service.

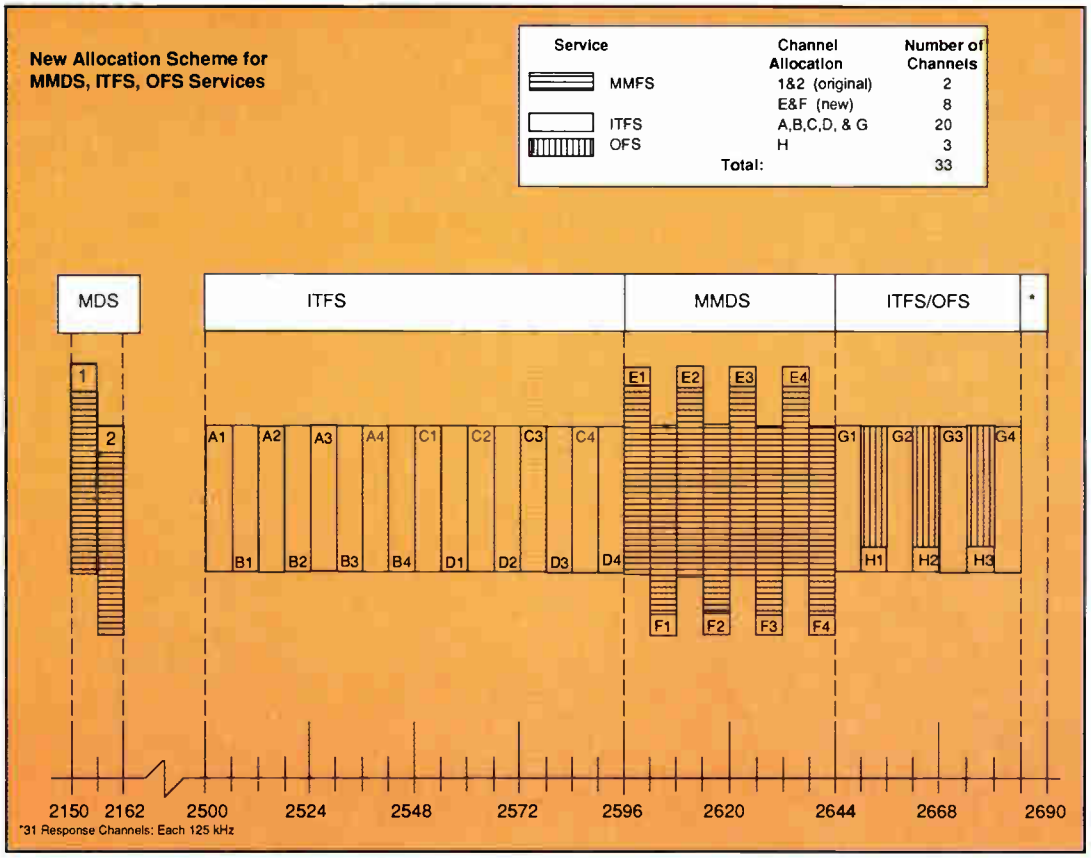
Kirk McNab, president of Mitchell Communications, who recently closed the previously mentioned deal with Emcee (and who expected an even larger deal to be consummated after press time), sees the wireless industry as a "keg of dynamite" about to explode. "Within three to five years, this will be a full-blown industry," says McNab, and he plans to be an integral part of its success.

McNab, who intends to build systems in as many as 20 cities, isn't planning on head-to-head confrontations with cable operators to get subscribers. Instead, he's targeting rural areas with low densities and populations of between 75,000 and 400,000 people. His strategy is to launch a system with between eight and 12 channels initially, but only if he can get licenses to double those numbers.

Mitchell already has one system up and running and another was slated to launch at the end of April. The company has enough equipment to launch eight-channel systems in 10 cities within the next six months. McNab is sitting on licenses in more than 100 markets, 66 of which he has at least eight channels. "And we're working to lock up more," says McNab.

"Ultimately, cable (operators) will have to see this as an inexpensive way to get into rural markets," McNab continues. "Smaller cable companies will look to make deals. Those operators will see competition as important because they don't want regulation."

"Years ago, the cable industry tried to ignore wireless," says Jim Clark, sales manager at Conifer Corp., an equipment vendor. "They figured that if the technology wasn't acknowledged, it would just go away. That didn't happen."



Clark believes the close networking between the cable brethren was more responsible for wireless' lack of progress than any doubt about the technology. "People would agree the technology works and can even be superior in quality (to coax cable plant), but it would still get kicked around," he says.

Clark says the programming issues remain a volatile subject because wireless operators still pay higher rates and have marketing restrictions in place where the cable operators in the same locales offer the same service. But he admits it's better than it used to be. "I think (the industry) is moving in a positive direction to get that resolved."

New infusion of believers

"Overall, I have a very bright outlook" on the future, Clark says. "There's enough in the works currently to make this a successful business. I'm much more bullish than I was a year ago because we've been able to open a number of eyes to the technical advantage of (wireless)."

One wireless operator who has been immensely successful in convincing investors in MMDS' potential is Ken Roznoy, vice president and director of TVCN, which has been up and running in Denver.

"This has been an amazing year in many ways," reports Roznoy. First off, TVCN secured $3 million through venture capitalists to purchase equipment. Since then, a series of agreements have been made which infused another $3.9 million in cash and equipment into the system.

Finally, the acquisition of a gold mine all contributed to the formulation of an asset base strong enough that the company has filed for a NASDAQ listing.

Roznoy reports that the new clout has resulted in an enhanced ability to lock up programming. "There's a very different attitude than there was a year ago," he says. "The viability of the product has proven itself. Programmers realize there are a lot of uncabled homes and they want to get to those markets."

Although Roznoy, like other wireless operators, refuse to disclose the number of subscribers they serve, he says reaction has been very positive. And Denver, which has it's share of tall buildings and hills, is adequately covered by the signal, which emanates from El Dorado Mountain. In fact, Roznoy says, with just 10 watts of power, the TVCN signal can be received in watchable condition as far as 39 miles to the north and south and 43 miles to the east. The company plans to boost its signal to the legal limit of 250 ERP in two to three years and place repeater stations all along the Front Range of the Rocky Mountains in order to ship signals west toward the mountain communities. "We have 1,027,000 potential customers," says Roznoy. "That's not a pipe dream...it's very attainable."

And, he says, his system can cover the entire Denver metro area with an investment of less than $5 million, significantly less than the amount spent to hard-cable the area.

Presently, TVCN (which stands for TV Communications Network) offers eight channels of programming. Plans for the co-location of seven channels from the University of Colorado and the addition of eight more channels before the calendar turns to 1991. The price for "basic" presently stands at $11.95 per month and Starion, the one premium channel that is offered, is priced at $7.95. "We're not running yet, but we're not crawling, either,"

says Roznoy.

Programmers easing up

Another operator who doesn't have much problem getting programming is Greg Oswald, president and CEO of Capital Wireless, which serves the Albany, N.Y. area. This system offers 27 channels of programs, including premiums like Disney, Showtime and Starion. He serves an area covered by nine or 10 cable operators and "response has been great," with 22,000 phone calls last year alone.

Oswald is one who bristles at the notion that wireless technology isn't reliable. "That's one of the things we feel most proud of," he says, noting that his system has yet to experience its first outage—after 13 months of operation.

Capital Wireless has identified niche markets to attack and preaches customer service as a way of life. The first day the system was turned on, the system received 780 telephone calls only two were abandoned. "How many cable operators can say the same thing?" asks Oswald, who has 12 incoming lines and enough CSRs to man the phones at all times.

In addition to rural areas where cable has yet to wire and fringe areas of cable franchises where amplifier cascades can get extremely long, wireless technology has given Oswald an opportunity to serve educational markets, business locations, nursing homes and other locations where penetration rates would never be attractive to CATV.

Despite Oswald's CATV background (he worked for GE Cable Corp. and then United Artists up until UA was sold to Tele-Communications Inc. in 1986), he believes wireless has a future and has a lot to offer. In many ways, he says this stage of wireless' development reminds him of when CATV was going through the franchise process and growing by leaps and bounds. "This was an apportunity to start fresh," he says.

Looking for deals?

In years past, many wireless operators openly asked for help from cable operators. Use the technology as an adjunct to your wired service to fill in uncabled pockets, they said. Now, Oswald and the other operators believe they don't need any help—at least not until systems get more complex.

"I haven't found an area where I need their cooperation," Oswald says. "We're not doing commercial insertion yet, but we will within the next year. That may be the common ground we could share." In the meantime, there's a "peaceful coexistence" between him and the CATV operators in and around Albany.

In fact, "tolerance" of wireless operators may be the new buzzwords in many cable camps, as a healthy wireless industry can be looked upon as effective competition—a necessary ingredient to keep federal regulators off CATV's back.

"Cable operators have realized that (proposed) rate regulation won't affect the wireless industry," says Oswald. "If wireless gets stronger, it may help cable survive the regulatory concerns. Our presence certainly has helped them."

So, although wireless will likely never grow to the size of the cable industry, it can present a new standard in operations and customer service. It's a challenge the cable industry will have to meet or exceed if it plans to keep its customer base. ■

—Roger Brown

BUSS remote switching system

The serious challenges to the cable industry of complying with the Federal Communication Commission's (FCC) requirement for Cumulative Leakage Index (CLI) and of eliminating the loss of revenue from converter theft of service can be met by supplementing existing CATV with enclaves of advanced technology known as BUSS (Bidirectional Unicable Switching System, patent #4,077,006). Systems enhanced by BUSS will then be capable of tapping into lucrative new markets—governmental and commercial office—and of delivering social and municipal services that will provide a strong public image for cable.

Adding the BUSS remote switching system to CATV will solve the CLI crisis, eliminate theft of service, simplify delivery of high definition television (HDTV) pictures, reduce converter obsolescence, provide a greater choice of impulse pay-per-view (IPPV) and enable low cost, two-way private video services between subscribers.

These threats can be eliminated by supplementing existing cable plant with the BUSS remote distribution system. This star network uses coaxial or fiber cable for transmission and does not obsolete existing plant. Just as local audio exchanges require hubs for private telephone service, BUSS needs switching centers for impluse pay one-way television and private information retrieval services. Remote centers are also the key for delivering low cost two-way video between subscribers.

BUSS provides the added bonanza of advanced technology for modern telecommunication applications such as multi-channel IPPV, electronic facsimile or newspaper delivery in color with fine definition, HDTV and high-speed computer time-shared interaction.

CLI elimination

BUSS protects cable operators against penalties and loss of service to subscribers by ensuring compliance with FCC rules on CLI to prevent aircraft, navigation or radio communication signal interference.

The FCC and Federal Aviation Administration (FAA) concerns about aeronautical interference from cable systems can be solved by eliminating the entire aircraft/navigation A/N spectra (108 MHz to 137 MHz, 156.8 MHz, 225 MHz to 400 MHz) from CATV feeders without reducing the subscriber's choice of programs. These switched system feeders can be substituted and could even be transmitted at higher signal levels and still meet CLI standards.

By Victor Nicholson, President, Buss Inc.

Cable theft of service

It is estimated that cable operators lose $1 billion a year from cable piracy (selling illegal descrambling converters), theft of service (bypassing converter management functions) and illegal hookups.

BUSS overcomes theft of service problems by removing addressable converters in or near the home and mounting them in a remote, secure, switching center. Each subscriber, then, is provided a private channel for reception of programs and deliverance of pay programs only upon request—the request automatically triggering the billing process.

HDTV delivery

HDTV signal delivery, with picture definition four times that of NTSC standards, will become increasingly important to cable TV operators for theater quality TV reception. With existing systems, cable operators would not have transmission capacity to deliver 30 MHz HDTV, 12 MHz EDTV or the various alphabetical MAC systems. A single subscriber's choice of HDTV would require duplicating that service to all subscribers and cause a demand for additional channels of wider bandwidth.

BUSS personalized service for these applications merely requires duplication of the requesting subscriber's tuner bandwidth at the remote station and the assignment to the subscriber of a wider bandwidth spectrum. Existing converters would not become obsolete, merely supplemented with additional modules.

Two-way interaction

Two-way video/audio/data between subscribers requires a system design that provides privacy, remote switching, fine definition pictures, high speed computer interaction and low cost service. Prevention of summation of noise and interference in the return direction is essential.

Unfortunately, present CATV design is incapable of providingpersonalized service to subscribers as channels are transmitted on a broadband basis to allsubscriber terminals and are interdicted by scrambling, filters or traps. Dedicating personal channels would require tremendous channel capacity. In addition, each two-way service would tie up four channels on the system to carry the signals to and from the headend via two-way trunk cables.

BUSS distribution system features, designed to supplement CATV, include the advanced communication capabilities of a remote switched system. It uses the existing CATV trunk and headend for one-way program input while requiring coaxial or fiber cable for transmissions from switching centers to subscribers.

Major BUSS features include: "Inverse Spectrum" (Figure 1); the dedication of a private wide band of frequencies to each subscriber; one- and two-way capability; transmission of program control signals on the same cable; and use of a remote station for switching programs to subscribers on request.

Inverse Spectrum assigns to the most distant subscriber from a Switching Control Center (SCC) the lowest frequency bandwidth (54 MHz to 66 MHz). This eliminates the need for line extender amplifiers that often introduce intermodulation distortions. It also enables two-way communication between subscribers and allows feeders in low household density areas (10 homes per mile) to extend for more than 1.5 miles without amplification (Tables 1 and 2).

BUSS design interconnects subscribers with full-time two-way service using RSPCs (Remote Switching and Processing Centers). A cable between hubs expands two-way to more distant users without requiring signals to be routed through major trunks and the headend (Figure 2). A private 12 MHz bandwidth in the 54 MHz to 890 MHz spectrum is allocated to each of 48 users per feeder cable for transmission and reception of NTSC signals or for reception of enhanced quality TV.

Program and switching signals are sent by a subscriber's hand-held control unit to an assigned RSPC located at an SCC. Digital signals, transmitted on subcarriers for accessing and switching of programs, eliminate the need for

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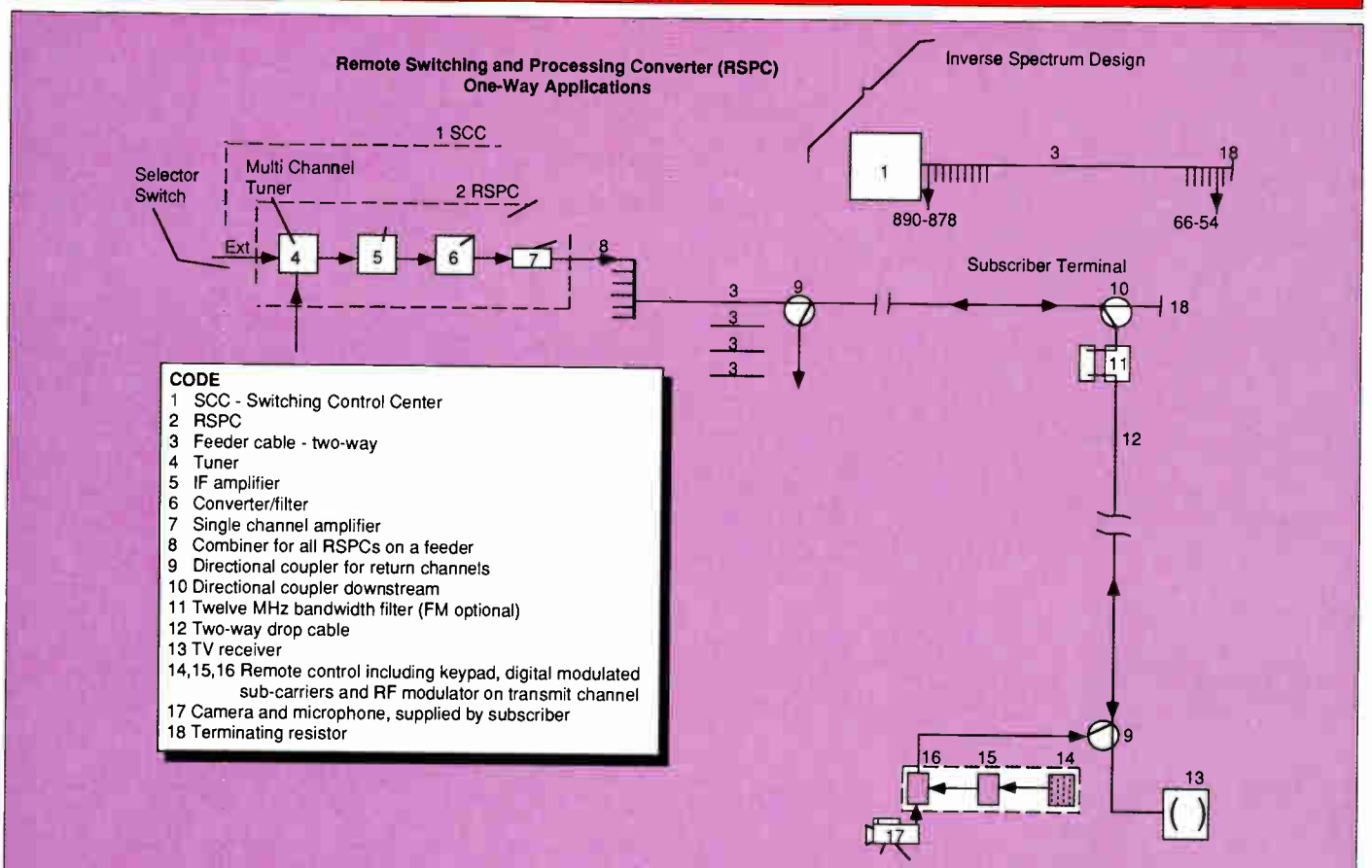

Figure 1

telco service. Switching Control Centers for reception, switching, processing and transmission of television signals are a prerequisite to two-way communication between subscribers. SCCs prevent the need to route all two-way services via the trunk and headend, a procedure that uses four channels of system spectrum. Instead, all subscribers on a given hub can be directly interconnected.

Cable communications with RSPC

Whether a distribution network uses coaxial cable today or fiber optics tommorrow, it will need the patented RSPC for one- and two-way video functions (Figure 3). The novel design avoids the need to assign multiple cables to interconnect subscribers and eliminates the accompanying video crosstalk.

RSPCs, mounted at the remote switching center in a secure temperature-controlled environment, give users a choice of many programs and prevents theft of service. Functions include channel switching, selection, filtering, amplifying and conversion with precise frequency control. RSPCs also switch signals to other subscribers.

System analysis

A guiding principle to ensure success of a communications system is to understand both its strengths and weaknesses. This is especially true when dealing with the architecture of a telecommunication remote switched network that introduces a myriad of new applications.

The BUSS distribution system is a concept designed to supplement CATV by adding private one-way impulse pay and information retrieval services plus two-way applications to subscribers. Each SCC receives programs from the cable system's headend, trunk and feeders but requires a separate cable to interconnnect hubs for intra-city functions.

SCCs, generally located in public and commercial buildings, will also serve subscribers within about a half mile radius from the SCC. These hubs can be located in schools to mainstream disabled or sick students and for video internal and external security; in nursing and senior citizen homes to improve nursing care and the well-being of

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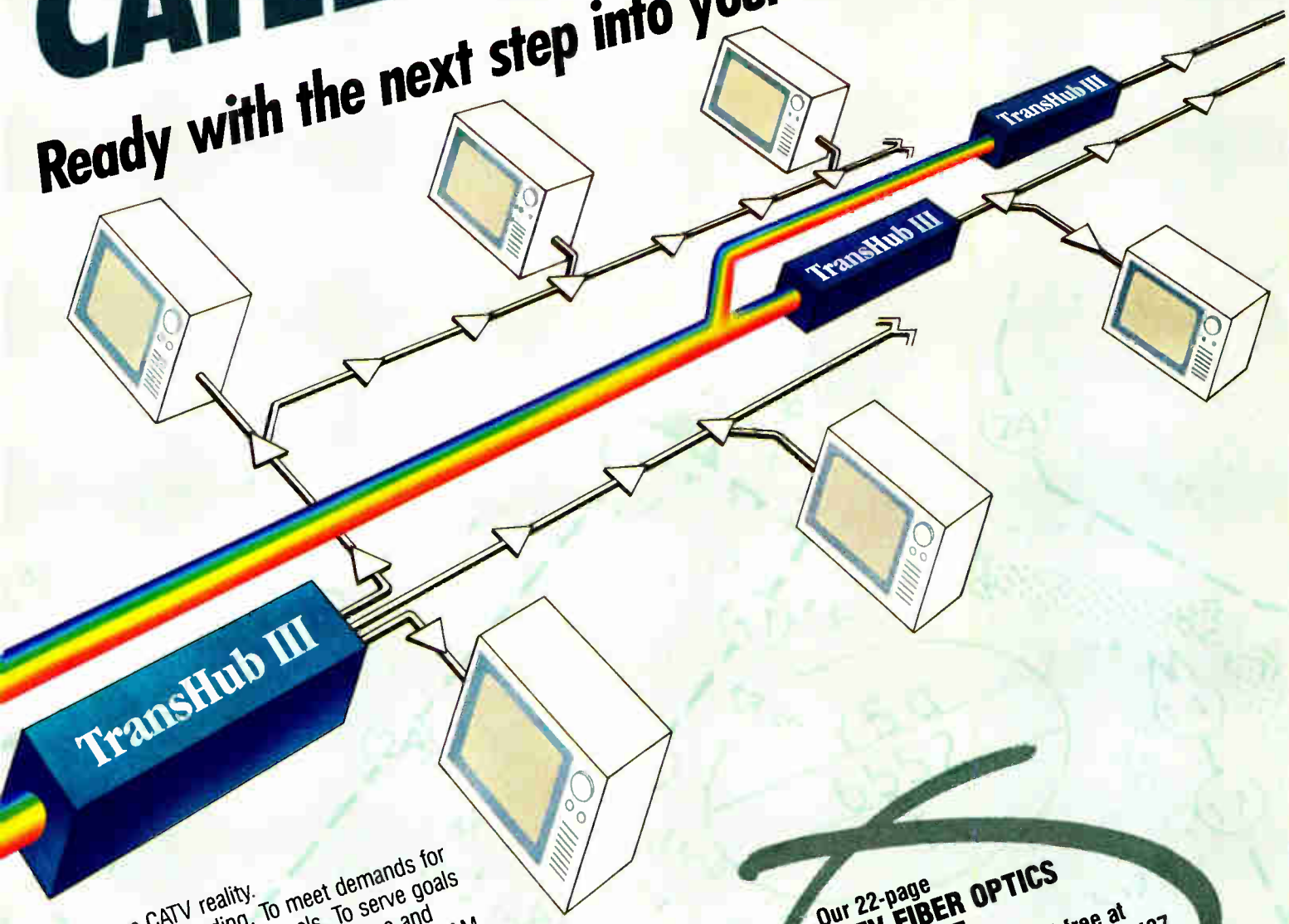

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interconnected distant hubs. These connections (Figure 2) will be switched and billed from the cable headend on a time-shared basis.

Separate subscriber drops, independent of CATV, are made for BUSS to ensure privacy of service and two-way capability.

For one-way applications, they include a directional coupler, 12 MHz bandwidth filter and an FM filter for certain applications. For two-way applications, the subscriber provides the camera and microphone while the cable operator provides a high output channel modulator and a directional coupler to prevent interference from the transmit onto the incoming receive signal.

Each subscriber will be provided a hand-held remote control with digitally modulated subcarriers on an RF carrier in the assigned spectrum for program selection and switching functions.

Integrating BUSS into CATV

Upgrading CATV to incorporate BUSS generally can be accomplished without disruption of existing service. An exception could occur when a system is unable to comply with CLI and required to immediately eliminate the A/N frequency bands from feeders. The disruption of some service until the bumped channels are transferred is more than compensated by the operator avoiding CLI penalties and program loss.

While CATV is a unified tree design, BUSS is a conglomerate of interconnected local area networks. CATV is unsurpassed in the delivery of basic and monthly one-way pay services to an unlimited number of subscribers, but BUSS provides for the delivery of unlimited PPV programs, two-way applications, office communications and social services to subscribers.

A hub (SCC) is needed at each enclave of this BUSS network to store the RSPCs serving the immediate project and surrounding homes. Programs are received at each hub from CATV and BUSS cables and from subscribers connected to the hub. Hubs are interconnected to extend two-way capability throughout the community and at that time, all PPV programs will be delivered via BUSS.

Feeder extensions

Low cost feeder extensions offer significant benefits and can be effected immediately by using BUSS for existing single- or dual-cable systems. CATV service is often not provided to household densities of less than 30 homes per mile as dual feeder cables and associated amplifiers are not cost effective.

In contrast, BUSS can profitably serve areas of 10 homes per mile using a single feeder cable to deliver existing services and provide two-way applications between subscribers. The assignment of low VHF frequencies to the most distant subscriber enables use of unamplified feeders that extend for more than a mile (Table 2). For shorter distances, smaller diameter cables are used.

To implement the extension, a hub will be installed in a facility near the extremity of a feeder. All channels from both cables, including FM, feed the SCC with programs for delivery on a single cable. Since the A/N spectrum will not be used on these feeders, their SCC signal output level can be 60 dBmV using feeder cables with a solid aluminum outer conductor. Cable shielding of better than 100 dB will enable 60 dBmV to easily meet FCC Part 15-H new standard of 200 μV/m at 10 feet where the A/N frequencies are not transported.

Initially, two-way applications will be available only between subscribers from the same SCC. Later this range will be extended as other SCCs are interconnected.

BUSS could bring two-way low cost installation to rural America with feeders extending more than a mile in areas of low density households (Table 1). Broadband microwave or fiber cables could transmit entertainment and pay programs to SCCs located in rural communities. Delivery of one- and two-way educational, social, security and medical applications in addition to a full complement of entertainment programs would add a new dimension to the industry's maxim, "Cable Cares."

Projected case study

A study of an existing system is presented below as a blueprint of how BUSS can independently supplement an existing CATV system and how it will generate added revenue from a greater choice of programs, videophone, video security, social service and office interconnection applications.

Greenbelt, Md., has a population of 19,700 with 9,232 dwelling units and two cable systems. Multivision, the larger system, has 3,300 subscribers

BUSS layout for 10 homes per mile

System extension for 1/2 mile @ 10 homes/mile, F 412 cable

Channel allocations @ 12 MHz, 60 dBmV output,

Distance Feet	Spectrum	Attenuation, dB Cable	Attenuation, dB Insertion	Tap	Tap Output
500	198-186	6.5	0	23	30 dBmV
1000	186-174	13	0.5	23	23 dBmV
1500	174-162	18	1.0	23	18 dBmV
2000	156-144	23	1.5	23	12 dBmV
2500	88-76	21	2.0	23	14 dBmV
3000	72-60	23	2.5	23	11 dBmV
System extension for 1 mile @ 10 homes/mile. F-750 cable					
500	446-434	5.5	0	23	31 dBmV
1000	434-422	11	0.7	23	25 dBmV
1500	422-410	16	1.4	23	19 dBmV
2000	222-210	15	2.1	23	20 dBmV
2500	210-198	17.5	2.6	23	20 dBmV
3500	198-186	21	3.1	23	13 dBmV
4000	186-174	27	3.6	20	9 dBmV
4500	174-162	29	4.3	17	10 dBmV
5000	156-144	31	5.0	14	10 dBmV
5500	88-76	25	6.0	17	12 dBmV
6000	72-60	24	6.7	17	12 dBmV

Note that in feeders of four homes per 100 feet, the limitation of 48 12-MHz channels would limit coverage to 1,200 feet per feeder cable. Using multiple feeders in these higher density areas, lengths will be up to 2,400 feet.

Table 2

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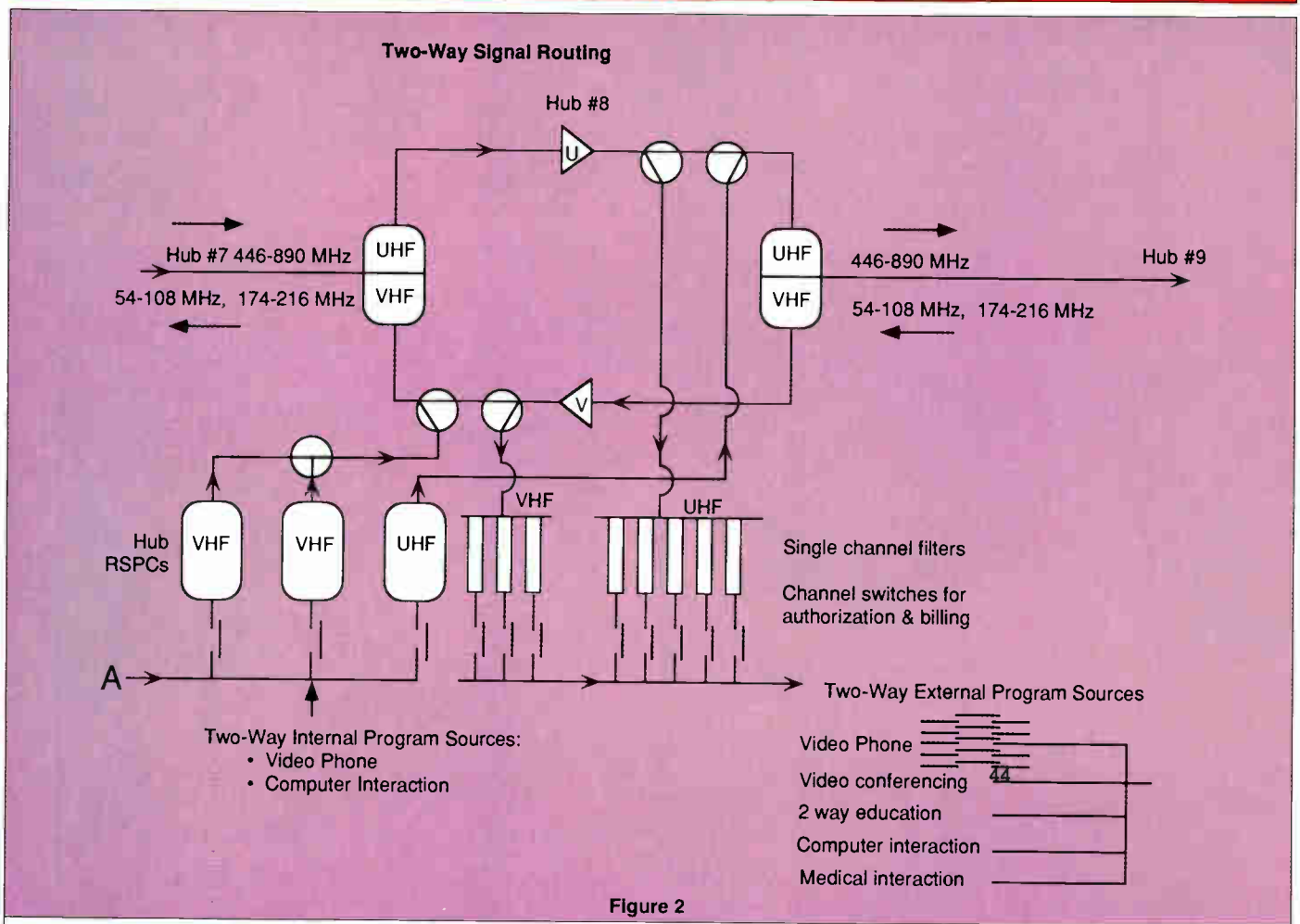


Figure 2

in 6,500 dwellings on 23 miles of streets using a dual-trunk, dual-feeder system. Mid-Atlantic serves the 2,900-unit Springhill Lake apartments. Neither system serves some 4 million square feet of potentially lucrative hotel, retail and office space in the the city.

An official of the company that predated Multivision observed that the 108 channel capacity, installed to comply with franchise demands, was excessive. "Delivering 54 channels on the single cable 'A' would eliminate the power and maintenance costs of duplicate line extenders," he noted. Ideally, then BUSS would use cable 'B' to supplement the existing system.

However, since Greenbelt is part of the Multivision system that covers the Northern half of Prince Georges County, changes that involve the transfer of channels from cable 'B' to 'A' could not be made just in Greenbelt. Consequently, to add BUSS, the present Greenbelt CATV system should remain unchanged until the entire Multivision system in the country is upgraded.

To supplement the existing system with BUSS in Greenbelt, certain criteria should be met. These include assurance of sufficient programming to make the system economically viable; access to facilities for installing SCCs; and assurance that the SCC at each location would provide functionally desirable services to the space provider.

Projected applications to generate sufficient added revenue, for example, would include the impulse pay equivalent of a 10 theater complex, video security in drug and crime areas, private college credit courses from the University of Maryland and Prince Georges' Community College, advanced video communications between offices, home shopping from local stores and electronic printing and delivery of the weekly newspaper, *The Greenbelt News Review*.

Copyright arrangements will be made by the cable operator to generate PPV movies using VCRs to transmit them throughout the city system. Billing information for pay applications and switching of two-way video between hubs will be controlled from the county headend.

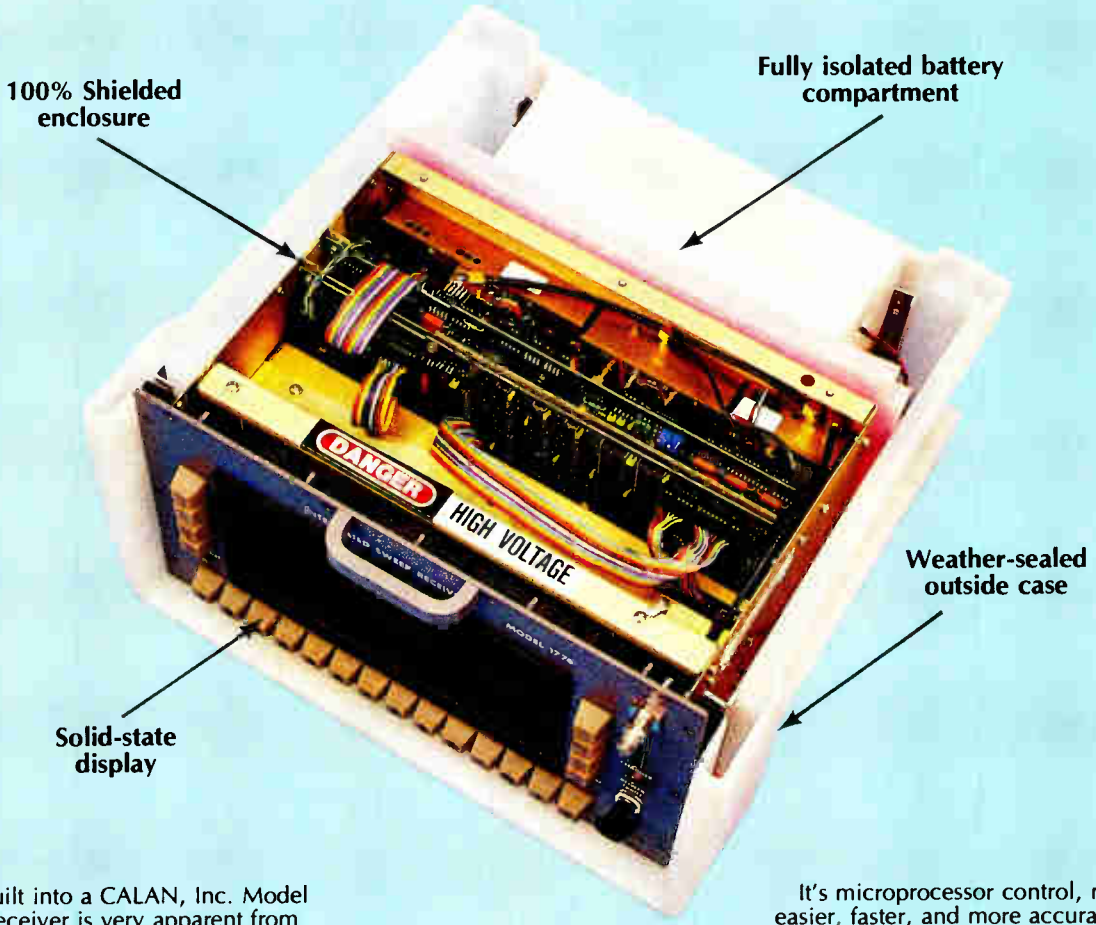
Channels will be accessed from the nearest CATV feeder or trunk cable. Scrambled channels will be descrambled at the hubs. A cable will emanate in each direction from each hub to adjacent hubs to provide programs (Figure 2).

Feeder cables from hubs will transmit 48 channels of 12 MHz each, of which 40 include frequencies higher than 400 MHz. To use these frequencies in populated areas, usable cable attenuation must be maximized. Therefore, signal inputs to feeders can be 60 dBmV (authorized by the FCC if no signals in the A/N bands are transmitted and the 200 μuV/m standard is met) to deliver a 10 dBmV tap output.

The first hub, serving the central city citizenry, would be placed at the municipal building where programs such as Greenbelt City Council meetings and hearings would originate as well as social service programs by Greenbelt CARES. Programs from the nearby recreation center and the public library will feed into this hub for distribution throughout the city.

Hubs would be installed at the city's

The Inside Story on Reliability



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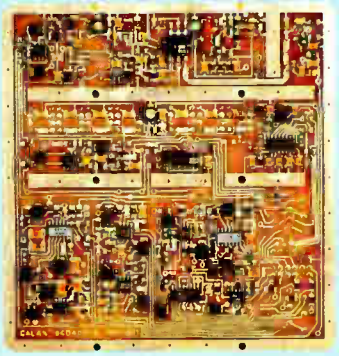

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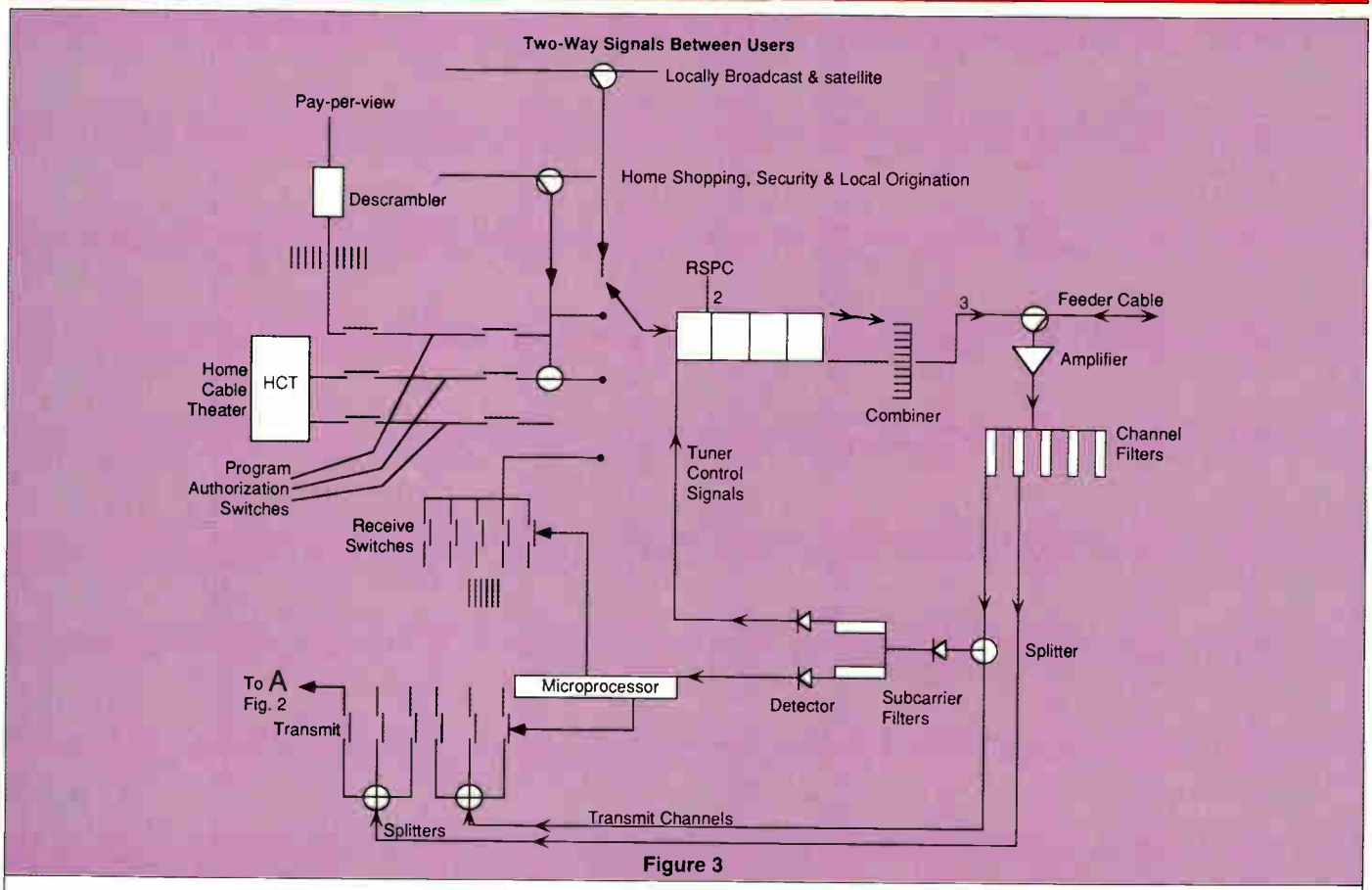

Figure 3

two elementary schools, middle school and senior high school to support the U.S. Department of Education's goal of mainstreaming disabled homebound students with their classmates via interactive video and audio; to interconnect schools for high-technology and other unique programs; and to deliver adult education and other programming to residents.

SCCs would also be located in the large Greenbriar/Glen Oaks and Hunting Ridge apartment developments, Windsor Green Townhouses and the Green Ridge House, a senior residential facility. These residents and others in the city would welcome private video-telephone, video-security and adult education applications at low cost. Movies of choice would be available without the need for VCRs and picking up and returning videocassettes.

A hub installed at the Greenbelt Nursing Center will improve nursing care and reduce the isolation of patients confined to their room. The Greenbelt Nursing Center administrator had expressed interest in installing an SCC in the facility to provide interactive video between room-bound patients, nursing station, dining and other rooms. When connected to other hubs, patients could interact with family and friends living in the city.

Hubs would be installed at the police and fire stations to interconnect with the city manager and city staff at the municipal building. Police would visually monitor drug and crime-problem areas in the city and electronically support neighborhood crime watches from the station.

A lucrative revenue source for cable operators would be the office telecommunications market, a revolutionary concept in high technology communications that adds vision. Hubs will be installed at three major complexes; Capital Office Park, Maryland Trade Center Park, and the Greenbelt Triangle. Each SCC will not only serve offices within the complex but will have the capability to interconnect offices and homes.

In our time-pressed and traffic gridlocked society, executives and employees living and working in the city could communicate visually with their offices from their homes. Revenues will be enhanced as working parents and couples depend more and more on cable for entertainment, medical, social and educational applications. The system provides each user with a private channel for two-way video-phone, video-security and computer interaction at a reasonable cost.

After hubs are installed and interconnected to serve the entire city, all PPV CATV applications can be diverted to the BUSS counterpart. In this way, service theft can be eliminated and the capability added to deliver HDTV programs to subscribers with large screen, fine definition TV sets.

After the entire municipality is interconnected with BUSS, cable systems in other cities in the county would be similarly upgraded. Then the existing dual cable one-way county-wide subscriber trunks would be supplemented with increased bandwidth two-way fiber capability. One method would be to install a backbone of optical fibers between a node in each city using amplitude modulation (as described by ATC engineers). This would add the dimension of two-way video communications and high-speed computer interaction between subscribers living in distant cities.

A cable operator interested in supplementing an existing system with BUSS would secure a license from an authorized cable equipment supplier. The per subscriber estimated cost of a license fee, RSPC and associated equipment will be $200. ■

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Lightguide cable placing in underground plant

The first applications of lightwave transmission systems, more than 10 years ago, were for high bit-rate digital trunking in congested metropolitan areas. The outside plant cables often had to be installed through crowded old manholes connected by nearly-exhausted conduit systems of indeterminate age and condition. This situation gave rise to serious concerns about the ability to place the apparently fragile new fiber-optic medium successfully. Experience has failed to bear out these original misgivings.

Nevertheless, there are significant differences between fiber cables and their metallic counterparts which must be recognized in installation planning. First of all, the fiber cables are much longer than field forces are accustomed to working with—sometimes by a factor of 10 or more. Second, the force that can be applied to the cable is limited. Third, the fiber cables are normally installed in a duct liner, a small-diameter plastic pipe placed in the underground conduit beforehand. Finally, because unplanned splices add loss, the options available to field forces for dealing with unexpected situations are severely limited. There are other differences to be sure, but the four listed here are the principal ones.

Today, experienced crews routinely install one or two reels of fiber cable, each about 10,000 feet in length, in a normal shift. This article reviews modern fiber optics cable placing operations in underground plant as they have evolved during the last decade.

Route engineering

Normally, some network facility planning organization has preliminary responsibility for fiber cable installation. Their work includes economic studies, identification of the facilities involved, tentative site selections and the development of a preliminary route layout based on transmission-design guidelines.

A detailed route-engineering and installation-planning study begins after the preliminary plan is approved. This effort involves the work of both engineering and construction forces to refine the preliminary recommendations. Equipment locations are verified, potential field problems are iden-

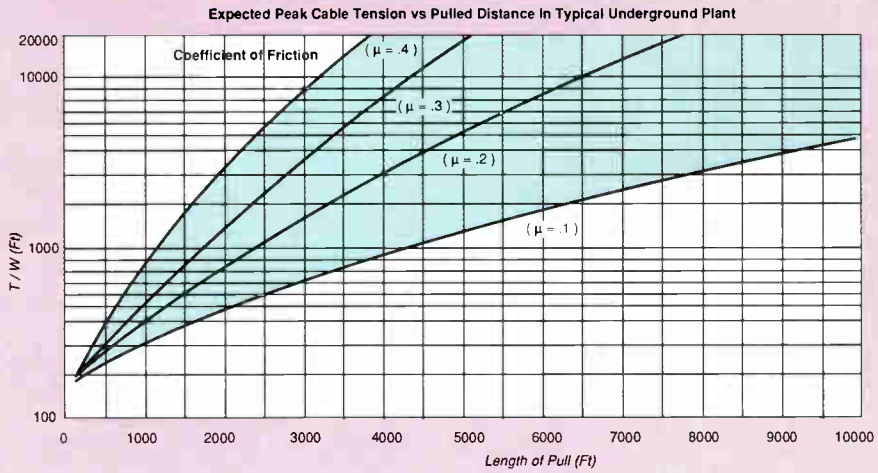

Figure 1

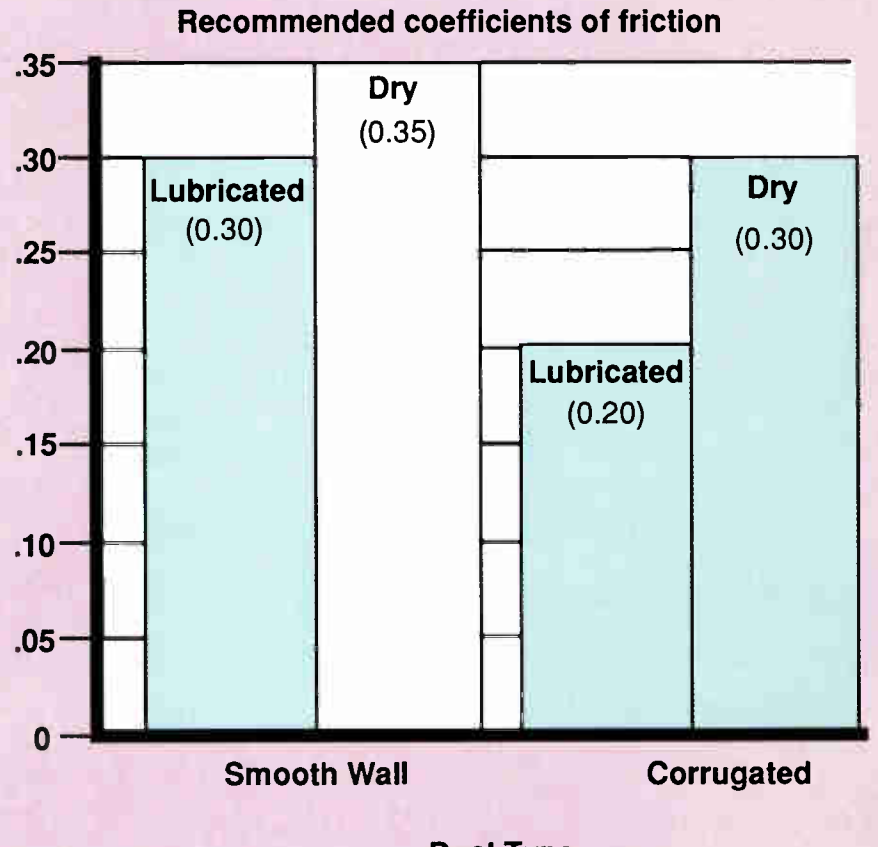

Table 1

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tified, orders for new construction, maintenance or rearrangement are written, and a schedule is developed. Splice manholes are chosen and the first estimates of cable order lengths and material quantities are generated.

The selection of splice manholes is a critically important step in the planning of a new fiber route. Manholes in which an abrupt change in the direction of the route occurs are prime candidates. The geometry of the conduit sections along the route must also be taken into account. It is important to realize that in each section there is a preferred direction of pull unless the duct is perfectly straight and horizontal. Conduit bends are tension multipliers, and the separation of feed and pull manholes must be consistent with cable-tension limitations.

Figure 1 can be used to estimate expected peak cable tension or maximum expected pulling distance. It is based on an empirical model generated from the results of dozens of actual installations. The parameters of the model are either the length of the conduit section of interest or the pulling-tension limit of the cable, the weight of the cable per unit length and an effective coefficient of friction. Reasonable estimates have been obtained using the values given in Table 1.

The empirical model incorporates a duct curvature representative of a typical urban duct run. No allowance is made, however, for abrupt changes in route direction at an intermediate manhole, severe offsets in conduit geometry or high tail loads during placing. If conditions in the field depart from the assumptions of the model, estimates must be modified accordingly. For example, an abrupt change of direction in an intermediate manhole is assumed to be equivalent to a section of conduit 500 feet long.

Additional constraints on splice-manhole location include congestion, access limitations, unfavorable duct alignment and manhole conditions where setups would be hazardous, awkward or unusually difficult. The choice of splice locations determines cable lengths and affects the transmission design of the route. It is of little benefit to minimize the number of splices if the cables between them cannot be placed without heroic efforts by installation forces. Furthermore, the introduction of unplanned splices to overcome placing difficulties in the field may seriously jeopardize the transmission performance of the system.

Duct liner

The term duct liner is a generic expression used to describe small-diameter plastic tubing placed inside underground ducts in preparation for the installation of fiber cable. Duct liner is not intended to protect the lightguide cable, except perhaps in manholes. Its purpose is to provide a clean, continuous path with known frictional characteristics for the fiber cable. Furthermore, the installation of the duct liner effectively proves in the conduit run, alerting construction forces to possible problems.

Often, more than one duct liner is placed in a duct. Multiple duct liners provide space for future installations, thus effectively increasing available underground space. Table 2 lists the maximum recommended capacity of various types of conduit for each nominal duct-liner size. Sizes can be mixed.

Duct liner is available in both corrugated and smooth-wall designs, made from either PE or PVC, in a range of diameters. Duct liner can be ordered with a fish line already installed. Generally, the product is shipped on

Capacity of Duct

Duct Liner	Conduit Cross Section			
Nominal i.d.	4" Round	4" Square	3 - 1/2" Round	3 - 1/2" Square
1"	3	4	3	3
1 - 1/4"	2	3	1	2
1 - 1/2"	1	2	1	1

Table 2

nonreturnable reels in continuous lengths of 1,000 feet or more.

For typical pulls, experience has shown that the diameter of the duct liner should be at least 50 percent larger than the diameter of the cable that will occupy it. Although the guideline is only approximate, placing difficulties often arise if this rule of thumb is disregarded.

Installation of duct liner(s) is similar to the installation of small-diameter conventional cable and should present no difficulties for experienced installation forces.

The first step in the placing operation is to install a fish line in the duct liner if one is not already there. This is usually done with pneumatic equipment. Normally, 600 pound or 1,000 pound test line is used for this purpose.

In intermediate manholes, the duct liner should be rigged in a direct route from duct face to duct face. Unless the section is very short, pulling fiber cable into racked duct liner should not be attempted. If the duct offset in a manhole is large, the duct liner transition should be replaced by two properly rigged sheaves.

Generally, the fish line is used to pull in the winch line, although it can be used to pull in the cable directly under appropriate circumstances. A small-diameter, torque-balanced, lightweight Kevlar winch line is popular for pulling fiber-optic cable. If it breaks, however, the Kevlar winch line must be spliced according to the manufacturer's instructions.

The use of suitable lubricants to ease the passage of both winch line and cable has proved to be effective. The only obvious exceptions are short pulls which are normally done by hand, such as the pull into a building. Best results are generally obtained with a lubricant recommended for use with lightguide cables. Usually, lubricant is applied at several points along the pull. Special hardware is available to simplify the task and reduce the mess.

After the winch line has been pulled in, installation forces attach it to the cable, using either a pulling eye on the cable or a Kellems grip. A swivel is normally installed between the cable and the winch line to eliminate torsional coupling.

At the feed manhole, cable is fed by hand to minimize the tail load. Capstan winches are commonly used to pull in the cable. Depending on the manufacturer, these tools are electrically, hydraulically or mechanically driven. They must have the capability to sense

the load, to limit it and to hold the limit load without taking up winch line.

The load at the winch at any time during placing depends on a large number of variables; some of them are random and some unknown. To ensure that the placing operation will not expose the cable to unacceptably high loads, most lightguide cable-placing systems include a load cell, a relief valve or a slip clutch to limit the delivered torque to some preset value.

Pulling cable

The nature of cable pulling is that the winch-line tension at the winch is greater than the winch-line tension at the exit duct face, which is, in turn, greater than the tension at the leading end of the cable. The difference between the tensions at the winch and at the duct face is due to friction losses in rigging elements in the pull manhole and is usually negligible.

The difference between the winch-line tension at the winch and that at the pulling eye, however, can be substantial, and it varies during the pull. For example, the tension at the pulling eye as the cable enters the duct in the feed manhole should be very low, while the tension at the winch is the force required to move the winch line through the duct liner.

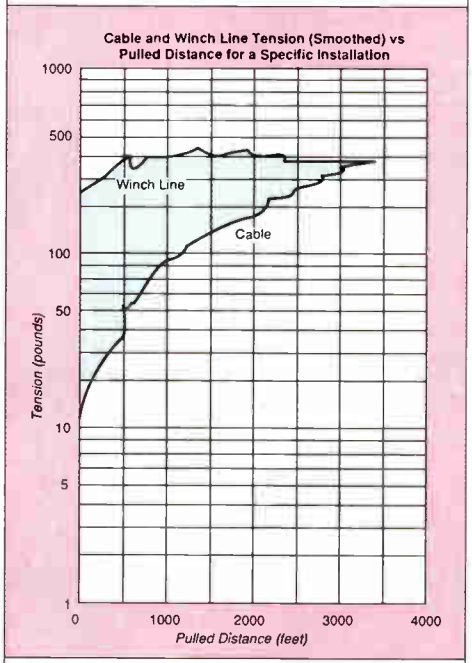
Figure 2 illustrates the relationship of the tensions at the winch and at the cable end (the maximum tensions, at any time, in the winch line and the cable, respectively) during a specific installation. Note that the two traces converge at the end of the pull.

Note also that the highest tension at the winch may occur early in the pull. If this effect is pronounced, limiting the winch pulling force at the maximum allowable tension of the cable is decidedly conservative. Unfortunately, there is no simple, reliable means to predict the pointwise difference between the two variables during a pull. Fortunately, even the conservative limit is adequate for most situations.

At the cost of considerable added complexity, some winches have a load cell at the pulling eye, conductors in the winch line, and a tension readout at the winch to keep track of the load on the cable. With such tools, somewhat longer pulls can be undertaken with confidence.

Another way to protect the cable from inadvertent overload is to use a break-away swivel between the cable and the winch line. Although such fail-safe devices effectively isolate the cable from excessive loads, their failure sometimes confronts placing forces with awkward and risky recovery operations.

Should the limiting load of the winch be reached during a pull, the winch must stop pulling but must hold the cutoff load on the winch line. To get the cable moving again, installation forces enter an intermediate manhole and manually assist by pulling on the cable. This effort is reflected as a reduced load at the winch, which immediately begins to take up winch line again. In the intermediate manhole, duct liner can be cut away to expose the cable if necessary. Manual intermediate assist of a lubricated cable is a messy, tiresome, tedious and potentially hazardous task. Nevertheless, as an alternative of last resort, it is an effective means to complete an unexpectedly difficult pull.



In unusually troublesome situations, it may be necessary to assist the pull at more than one location. Surprisingly, the synchronization of such multiple intermediate assists is not difficult.

Intermediate assistance can be mechanized. With pulling devices located at strategic points along the route, extremely long cables can be placed. There is no problem in passing the fiber-optic cable over a capstan as long as the radius of the device is large enough. Because the torque delivered by a capstan is proportional to the difference between the entry and exit tensions in the winch line at the capstan, it is not a good idea to use capstans in cascade unless their stall loads are reduced so the collective sum does not exceed the tension rating of the cable.

If, however, a slack loop is provided on the low-tension side of each unit (while sufficient draw-off tension is maintained between the machine and the loop), then the operation becomes a succession of isolated pulls in series. The limit on the length of cable that can be placed is then determined by the availability of equipment rather than by the cable's tension limit.

Another way to increase the reel length that can be successfully placed is to use an intermediate manhole as the feed manhole. After the cable is installed to the first splice location, the rest of the cable is removed from the reel to get at the inside end, which is then pulled toward the other splice location in the conventional manner. Usually, as the cable is removed from the reel, it is coiled on the ground in a figure-8 pattern to prevent the accumulation of twist. This method of placing, known as backfeed, calls for a lot of cable handling and attention to protecting the cable that has been removed from the reel, but the procedure is simple and does not require much additional equipment. Multiple backfeed operations, like multiple intermediate assists, extend—literally without bound—the limit on the maximum reel length that can be installed, but they are very time-consuming.

For raking, enough cable is pulled into the pull manhole to provide the slack needed in the manholes nearer that end of the cable section. Intermediate manholes nearer the feed end get racking slack from there. Pulling the slack for racking is normally done by hand and may require multiple intermediate assist. Slack is pulled into the manhole farthest from the source first, then the racking crews work their way toward the splice manholes.

The minimum bending radius of the cable, usually 10 times its diameter, should always be exceeded while cable is being racked. The cable should be secured, protected and tagged in each manhole. Excess cable is coiled and stored in the splice manholes, ready for the arrival of the splicing crews.

That the operations involved in successfully placing an underground lightguide cable bear a remarkable resemblance to those familiar in the installation of a metallic cable is no accident. Many of the methods and tools are directly interchangeable. ■

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External modulators for AM video transmission

Multichannel AM video transmission systems place stringent requirements on the linearity of optical sources. Nonlinearity in the transfer function of directly modulated DFB lasers and external optical modulators produces intermodulation distortion products which limit the modulation index M which can be used. Since the SNR is proportional to M^2 for shot-noise-limited AM video transmission, increasing M greatly improves system performance.

By Richard B. Childs and Vincent A. O'Byrne, GTE Laboratories Inc.

The DFB lasers are limited primarily by second-order distortion products, while Mach-Zehnder modulators are limited by third-order distortion products.[1] This paper describes predistortion techniques which reduce the dominant distortion of a DFB laser and external modulator by 12 dB and 14 dB, respectively, allowing a large increase in modulation index.

The predistortion circuit

A block diagram of the predistortion linearization apparatus[2] is shown in Figure 1. The predistortion circuit consists of a nonlinear device which generates distortion products which are equal in amplitude but opposite in phase with the distortion products produced in the device under test (DUT), which can be either a DFB laser or a Mach-Zehnder modulator coupled to a high power optical source.

For the DFB laser, the required predistortion circuit produces only second-order distortion. This is implemented using the square law transfer function of a FET. The Mach-Zehnder modulator requires a predistortion circuit which generates third-order distortion products with negligible second-order distortion. This is implemented using a balanced arrangement of Schottky diodes with exponential transfer functions. The input signal amplitude and gain following the predistortion circuit are adjusted to minimize the

Block Diagram of Predistortion linearization apparatus

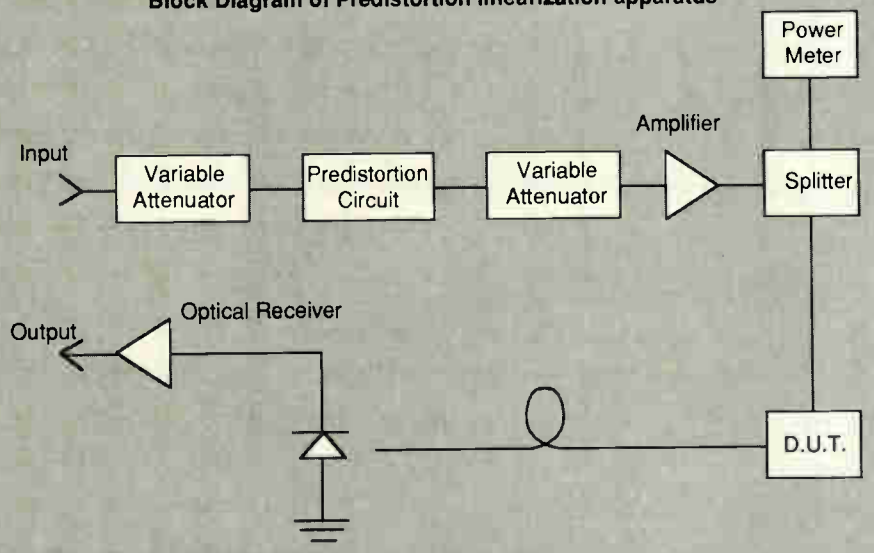

Figure 1

Table 1: Directly modulated DFB laser composite distortion products with and without predistortion

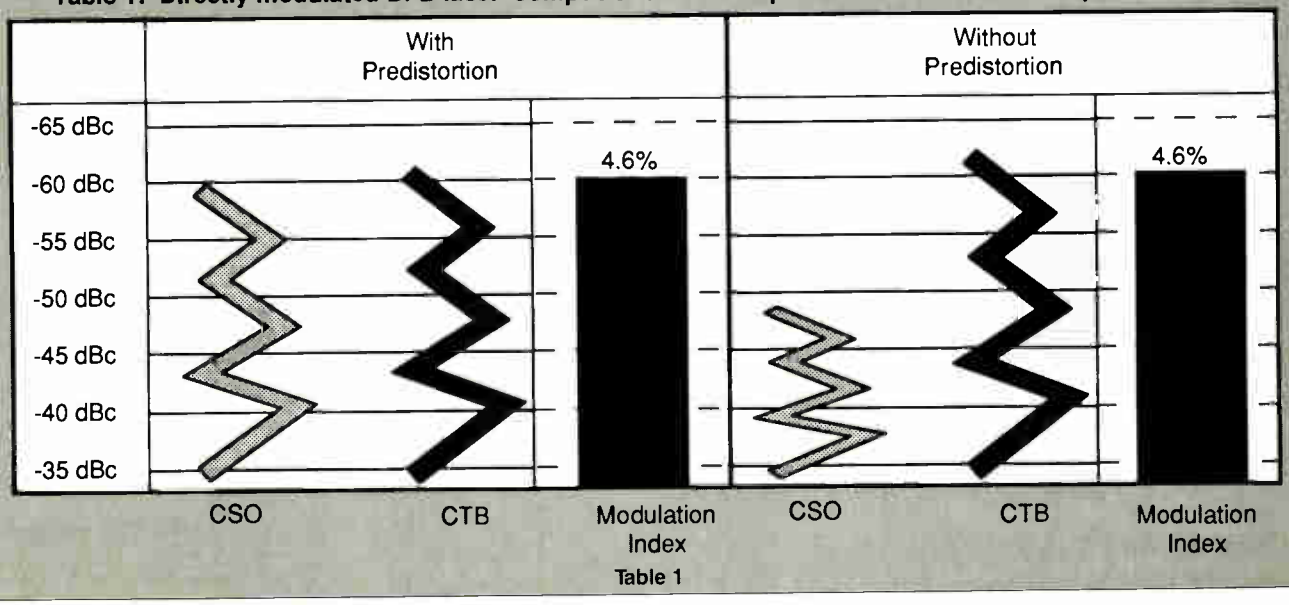

Table 1

Table 2: External modulator composite distortion products with and without predistortion

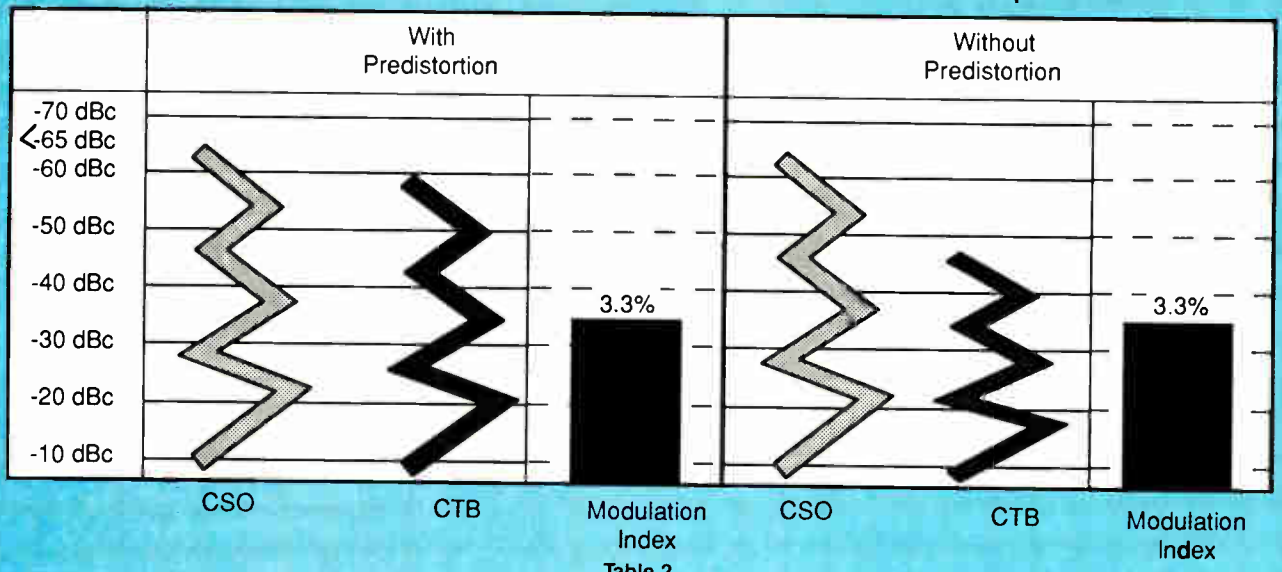

Table 2

distortion products of the detected optical signal.

The predistortion technique results in distortion characteristics which vary with frequency. This is caused by parasitic reactances in the predistortion components, frequency dependent distortion in the diode laser or external modulator, and variations in the gain and group delay characteristics of the drive amplifier.

Composite second-order (CSO) and composite triple beat (CTB) are measurements of the worst case sum of the second- and third-order distortion products produced over the entire video band.[3] Therefore, CTB and CSO provide a useful measure of distortion in systems with frequency dependent distortion products. Typical AM video transmission system requirements for CSO and CTB are −60 dBc.

CSO and CTB

Measurements of CSO and CTB were made with a live 53-channel cable signal[4] using notched filters to permit measurement of CTB near the center channel (223.25 MHz) and CSO at the band edges (48 MHz and 458.5 MHz). The measured CSO and CTB with and without predistortion for a DFB laser are shown in Table 1.

The DFB laser was a commercially available device (Mitsubishi FU-455DF-3) with fiber coupled power of 2 mW at 1320 nm. A 12 dB reduction in CSO was obtained using predistortion with the DFB laser, allowing a 12 dB increase in modulation index for a fixed CSO. The 4.6 percent channel modulation index with a CSO of less than −60 dBc obtained here represents a considerable improvement over the best results reported without predistortion.[3,5]

For example, at a 4.3 percent/channel modulation index, the lasers reported in Reference 3 have CSO = −48 dBc, which is equivalent to the results obtained here without predistortion. To obtain a CSO of < −60 dBc without predistortion, the maximum modulation index would be only 1.08 percent, resulting in a 12 dB less power budget for a system with shot-noise-limited detection.

The measured CSO and CTB for the external modulator with and without predistortion are shown in Table 2. The Mach-Zehnder modulator was a commercially available Ti:$LiNbO_3$ device

Continued on page 95

Employing an external modulator

The 1320 nm diode-pumped Nd:YAG laser is an attractive source for AM video transmission due to the high output power (>200 mW) and low RIN (< −170 dB/Hz) over the video bandwidth. When used in conjunction with a predistortion-linearized Mach-Zehnder modulator[1], a 13.5 dB optical power budget is obtained for 50 channel transmission with video carrier-to-noise ratios (CNR) of 52 dB and composite distortion products (CSO and CTB) less than −60 dBc. The demonstrated power budget is sufficient to allow four-way power splitting with the remaining margin comparable to the best results obtained with DFB laser-based AM transmission systems.

The multi-mode Nd:YAG laser (Amoco Laser Company ALC1320-175W4) provides −210 mW of linearly polarized output power at two distinct wavelengths, 1319 nm and 1338 nm, as shown in Figure 1. Each wavelength is composed of three to four longitudinal modes spaced −0.6nm apart. The laser output was coupled through a half wave plate and optical isolator into a polarization preserving fiber pigtailed Mach-Zehnder modulator, as shown in Figure 2.

This resulted in a mean optical output power of 11.5 mW at the modulator's half transmission point. No mode partition noise was observed after transmission through either 15 km of standard fiber or 1.2 km of dispersion shifted fiber with a dispersion of −20 ps/nm Km.

Although the RIN of the YAG laser is measured as less than −170 dB/Hz from 50 MHz to 450 MHz[2], a low frequency noise peak is present at −180 kHz due to a relaxation resonance. After external modulation, this peak is heterodyned to the video band, where it appears as sidebands around each optical subcarrier. The amplitude

By Richard B. Childs and Vincent A. O'Byrne, GTE Laboratories Inc.

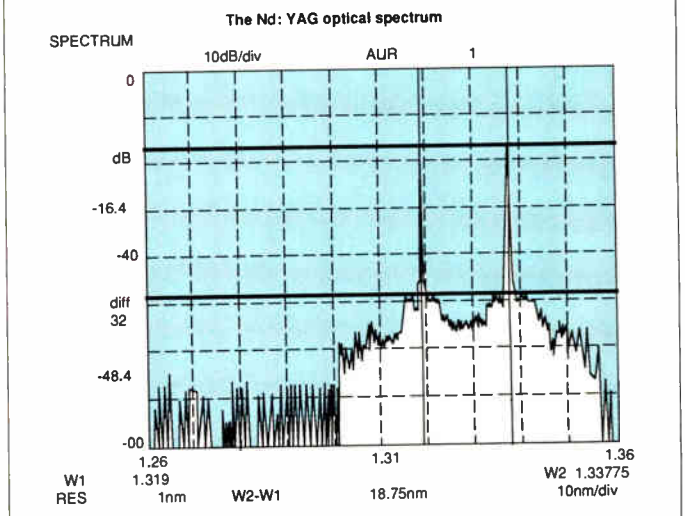

Figure 1

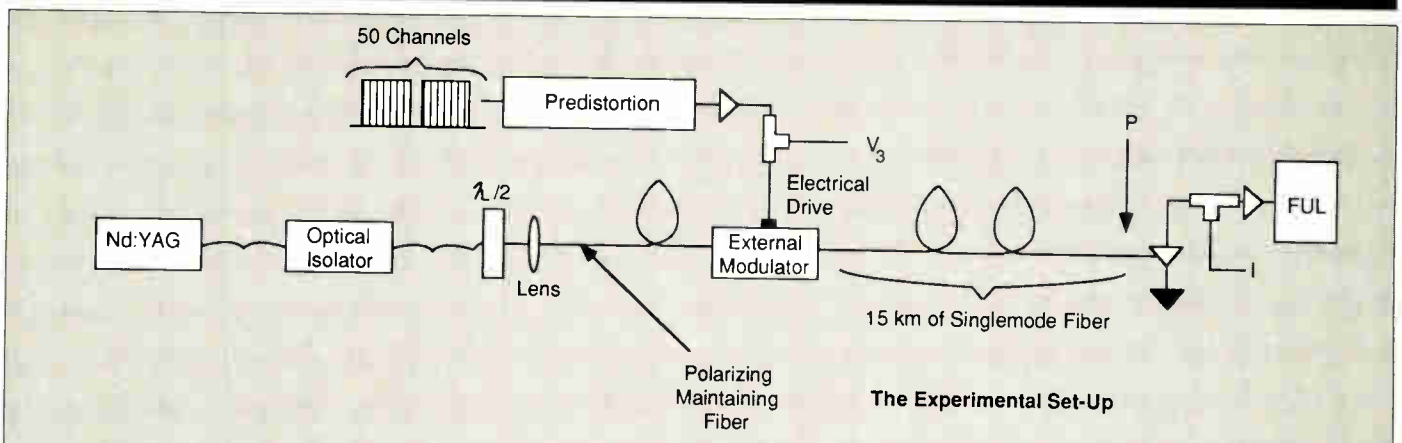

Figure 2

of this noise peak is independent of the Mach-Zehnder modulation index and was measured as −68 dBc for the Nd:YAG used here, as shown in Figure 3. At this level the upconverted noise has a negligible effect on the video carrier-to-noise ratio.

Completing the system

To complete the AM transmission system, an optical receiver consisting of a CATV hybrid with novel photodiode impedance matching circuit was employed. A balanced photodiode configuration with both series inductive tuning and a broadband 4:1 impedance transformation yields an average input noise current of 6.7 pA Hz. This represents the lowest noise current reported to date for a highly linear AM video receiver and allows sensitivity within 1 dB of the shot noise limit for a video CNR of 52 dB.

The system was characterized for transmission of 50 channels of AM video. The CNR vs. optical attenuation is shown in Figure 4. The system operates approximately 2 dB below the shot noise limit for attenuation between 13 dB and 18 dB. At higher optical attenuation the receiver noise becomes appreciable. At low optical attenuation, thermal noise in the amplifiers following the predistortion circuit dominates, limiting the maximum carrier-to-noise ratio to 58 dB. Although this thermal noise degrades the RIN of the modulated YAG laser to −157.6 dB/Hz at present, this value can be reduced through improved circuit design.

Measuring CSO and CTB

Composite distortion products (CSO and CTB) were measured following NCTA recommendations[3] for testing with modulated video and found to be less than −60 dBc at all measured frequencies (48 MHz, 49.25 MHz, 115.25 MHz, 223.25 MHz, 283.25 MHz, 433.25 MHz, 434.5 MHz, and 435.75 MHz). No increase in distortion due to the receiver was observed at received optical powers as high as 1 mW.

In conclusion, a novel YAG laser, linearized-modulator based AM video transmission system has been demonstrated which yields the largest power budgets for AM video transmission reported to date. ■

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2. Childs, R.B. and O'Byrne, V.A., "A Receiver Parameter Independent Technique for Measurement of Laser Relative Intensity Noise," Submitted to CLEO '90.
3. "NCTA Recommended Practices for Measurement on Cable Television Systems," *National Cable Television Association*, 1st Edition, 1983.

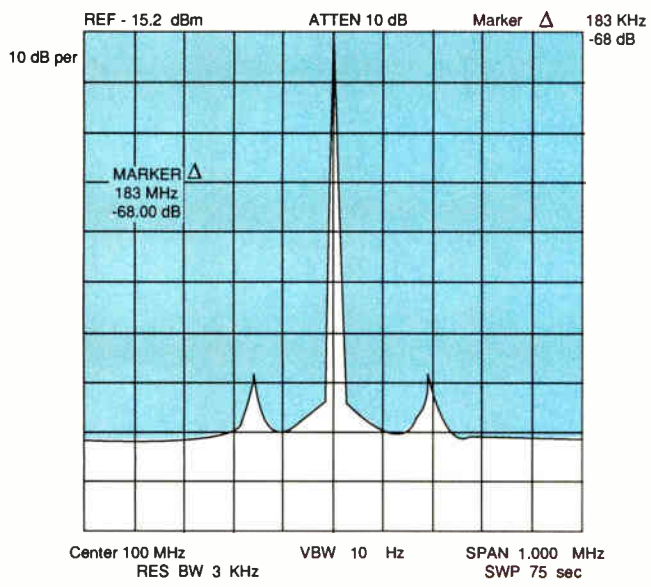

Figure 3

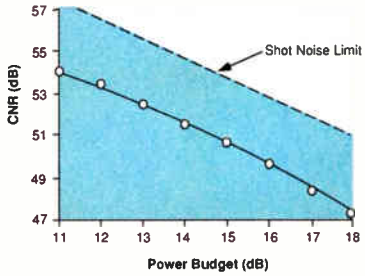

Figure 4

Continued from page 92

(Crystal Technology MZ315P). The CTB was reduced by 14 dB using predistortion, allowing a modulation index of 3.3 percent/channel. Although this is less than that achieved with the DFB laser, the external modulator allows use of a high power optical source. With a 150-mW diode pumped YAG laser source power, budgets significantly greater than that of the DFB based system are possible using the linearized external modulator.

Summarizing: A significant improvement in multichannel AM video transmission has been demonstrated by application of predistortion to both DFB lasers and Mach-Zehnder modulators. ■

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5. J. Chiddix, "Application of Optical Fiber Transmission Technology to Existing CATV Networks," in *Technical Digest, Twelfth International Fiber Optic Communications and Local Area Networks Conference and Exposition*, Atlanta (1988) pp. 98-105.

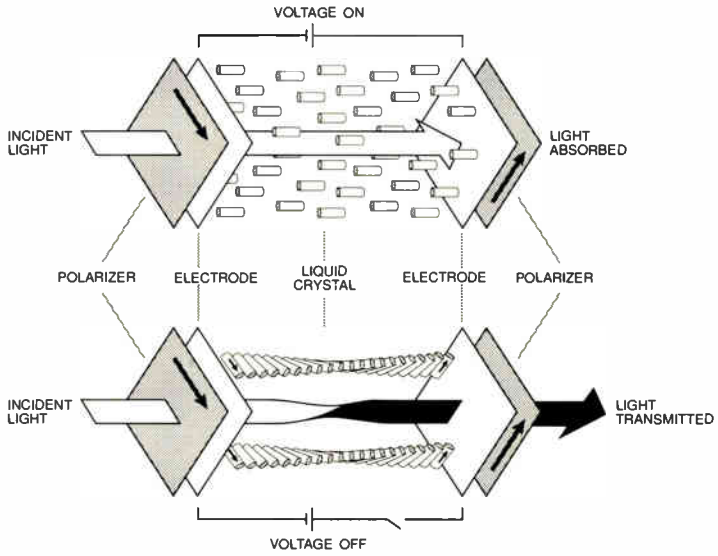
Large video display screens

Conventional wisdom has it that there is almost no apparent difference between HDTV pictures and NTSC when viewed on 19- or 20-inch screens, at the normal seven-to nine-foot viewing distance. Under these conditions, the 525 scanning lines are almost indistinguishable.

However, on a 45-inch screen (rear projection), NTSC pictures would appear to be as fuzzy, and the 525 scanning lines as far apart as if they were viewed at 3.5 feet on a 20-inch screen. Anything less than about 1,000 scanning lines per frame on a 45-inch screen would be clearly visible at eight feet, and probably annoying. The sharpness and fine-detail in HDTV becomes truly significant, even dramatic, when viewed on 3-foot high (or larger) screens at the seven- to nine-foot viewing distance in typical living rooms.

It is ironic to note that when viewed on the currently popular 20-inch screens, HDTV has little to offer (except arguably the wide aspect ratio). Yet, with large viewing screens, HDTV is needed just to stay even with the perception of sharpness to which we have become accustomed with NTSC on smaller screens. Doesn't this suggest that the National Television Systems Committee did a remarkably competent job of fashioning color television standards capable of exceeding the thresholds of human perception under the range of viewing conditions they could reasonably have anticipated 40 years ago?

Nearly half of all TV sets sold to dealers in 1989 were in the 19- and 20-inch viewing diagonal categories. Only about one-fourth were larger than 20-inch, and only 1.2 percent were projection type. History suggests that the trend toward larger screens will continue, as technical picture quality gets better and costs decrease. Following is a brief review of the principal large screen display technologies currently under consideration and development.



Twisted Nematic LCD — Off/On States

Figure 1

Cathode Ray Tube display (CRT)

Picture tube manufacturers are tooling up to provide conventional cathode ray picture tubes in 30- to 35-inch and even larger sizes. A natural limit to the size of the CRT is imposed by the necessity of getting it through the front door. Moreover, the sheer weight of the glass bottle and the scanning equipment associated with large CRTs is a rather significant deterrent for most residential applications.

Zenith is proceeding to develop and manufacture flat tension mask (FTM) CRT displays. The FTM tube is characterized by an absolutely flat face, with high resolution and contrast, and an almost complete absence of reflections. Instead of the shadow mask technique presently used for electronically depositing phosphors on the glass face, Zenith expects to be able to print phosphors on the flat face plate with extremely high precision, a process made possible by pretensioning. FTM technology is expected to reduce substantially the cost of producing large, high resolution color TV picture tubes.

Rear and front projection

Virtually all rear screen projection TV sets are housed in consoles. In general, rear projection displays, using mirrors and lenses, are better able to pass the "front door test" than direct view CRT displays, which require large, heavy, clumsy glass bottles.

Rear projection TV sets generally include a small, but very bright, CRT or LCD (liquid crystal display) screen, projected through a variety of optical systems onto a flat, translucent screen. Image brightness and contrast over a wide viewing angle are improving, but are still somewhat inferior to direct-view CRT displays.

The LCD image screen is generally used as a light valve, illuminated from behind. Crowding a million or so pixels, each of which includes a microscopic transistor and liquid crystal cell, onto each of the three color substrates is a neat exercise in integrated circuit engineering.

Texas Instruments has received a grant of more than $10 million to develop a rear projection system based on a "deformable mirror device spatial light modulator." This device com-

By Archer S. Taylor, Sr. VP, Engineering, Malarkey-Taylor Associates, Inc.

prises tiny rows of microscopic mirrors, each mirror representing a single pixel of one color. For HDTV in full color, three million mirrors would be produced on extremely small silicon sheets. The silicon backing includes an active matrix that causes the tiny mirrors to tilt, reflecting more, less, or no light from an external source to the screen, in accordance with the video signal information. TI believes this system will eventually be cheap enough to be used in consumer products, although first applications will be in high cost displays for computers and aircraft cockpits.

Screen size is almost unlimited for front projection, depending primarily on the intensity of the light source, screen reflectivity and the space required for projectors. This technique is useful for airplane movies, bars, hotels, sports arenas, movie theaters and even the entertainment centers of some affluent residences. It is not well-suited to the typical middle class home.

Flat panel displays

The most desirable large screen display for HDTV would seem to be a flat panel, that could be about 36 inches high, 48 inches wide (64 inches for wide aspect ratio), and not more than four inches deep. Such a display could be hung on the wall of most residences, covered with attractive drapery or framed artwork when not in use. Although the display screen could be much larger than practical CRT or rear projection displays, the intrusion into the living space would be far less.

Of the four major flat panel technologies, LCD is considered by some to offer more promise of overcoming the difficult obstacles imposed by HDTV than electroluminescent displays (ELD), or plasma, or vacuum fluorescent displays (VFD). However, ELD and plasma

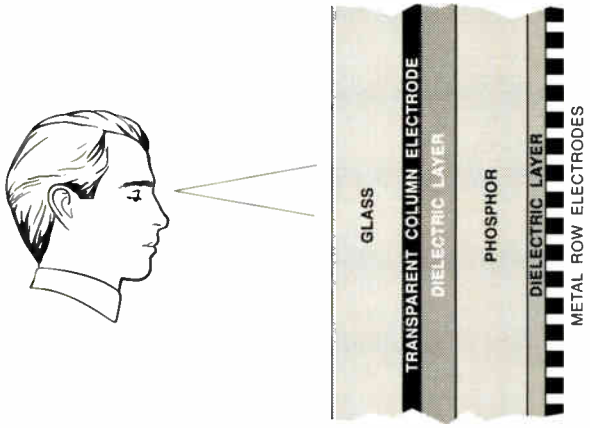
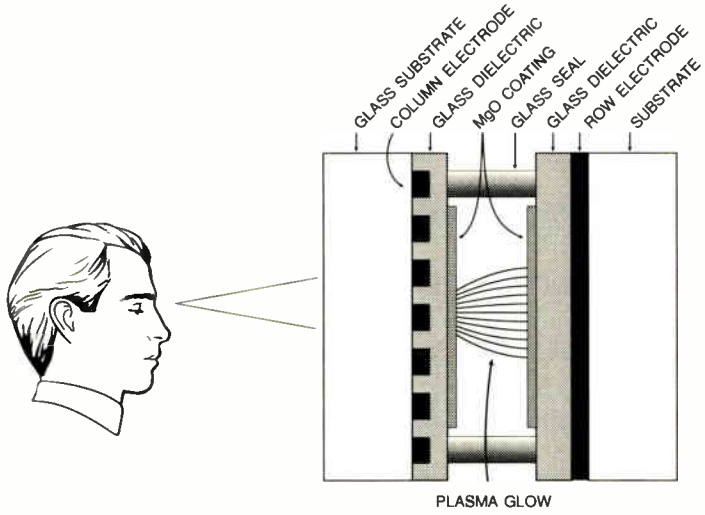


Figure 2



Plasma Display Structure

Figure 3

partisans are not willing to concede the future to liquid crystals.

There are many versions of the LCD, depending on the structure of the crystal, how the crystals are activated, nature of the polarizer, type of filtering for color reproduction and other considerations. In the active matrix LCD, tiny thin-film field-effect transistors (FET) are deposited at each pixel site, and covered with a liquid crystal sheet. By applying properly addressed voltages at the edges of the panel, each FET transistor can be activated in sequence, line-by-line and pixel-by-pixel. The activated transistor causes a current to flow in the liquid crystal, rotating the polarization so as to block some or all of the light transmitted from the backlighting source through the polarizing filters. (See Figure 1.) For color displays, appropriate filters are deposited over the liquid crystal sheet.

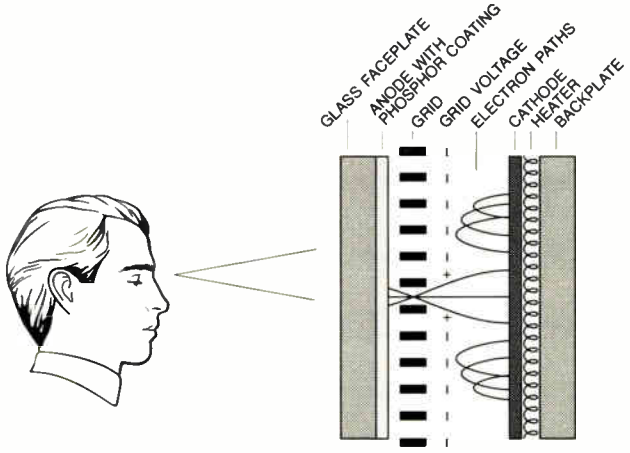
Several Japanese firms have recently announced plans to produce 10-inch LCD flat panels. Japan's Ministry of International Trade and Industry (MITI) has announced a goal for producing one-meter (39-inch) square active matrix LCD panels in commercial quantity by 1994, suitable for HDTV. Gary Stix, associate editor of IEEE's *Spectrum*, writes that the "...chief difficulty in making active matrices lies in depositing up to three million transistors on a large glass plate with a nearly perfect success rate. Early panel yields are said to be in the 15 to 30 percent range." Lionel Robbins, vice president for Ovonic Imaging Systems Inc., an LCD maker in Troy, Michigan, says: "Active matrix LCDs are the biggest integrated circuits in the world."

Electroluminescent displays (ELD) also use thin film technology. Whereas LCDs modulate the backlight transmission, the solid phosphor layer in the ELDs actually emits light in proportion to the electric field applied. (See Figure 2.) ELD matrices are easier to fabricate and have a wider viewing angle, and greater contrast ratio than active matrix LCDs. However, gray scales and full color are not easily provided. For workstation monitors, ELDs are quite satisfactory. Although they are not yet suited to HDTV display, great progress is being made.

Plasma displays, also called gas-discharge displays, are based on the same gas discharge effect used in neon and fluorescent lights, and in the old "nixie tubes" once used for alphanumeric indicators. (See Figure 3.) They are the fastest growing form of large flat panel display for portable workstations and other non-video applications. Like ELDs, however, they have poor gray scale performance, and full color is still experimental.

Each of these three flat panel technologies has advantages and disadvantages for HDTV applications. Thin film ELD technology produces a display that closely resembles the CRT in appearance and function, and the gap in gray scale and full color is being closed. The plasma display is the king of the flat panels in terms of large size and high resolution. But costs are higher, and a more diffuse appearing pixel is produced. LCD has put it all together for excellent high definition color video, but only in relatively small sizes and with expensively low yields. Leadership in flat-panel technology for HDTV has not yet clearly emerged.

The vacuum fluorescent device (VFD) is sometimes characterized as a "flat CRT." Like the CRT, it has a heated cathode, a grid to control the electron beam intensity and a phosphor coated anode. (See Figure 4.) Scanning and pixel identification are accomplished by means of a conductive matrix rather than by magnetic yokes and shadow masks, as in CRTs. Gray scale and color characteristics are as good as in conventional magnetically scanned CRTs, except the pixels have a more diffuse appearance. Cost is high, and few



Front Luminous Vacuum Fluorescent Display (FLVFD)

Figure 4

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SPECTRUM 2000

Amplifier System

Reader Service Number 58

manufacturers produce VFDs.

Still another technique for displaying an enlarged image of a small, bright CRT or LCD display uses a bundle of optical fibers. These are not at all comparable to the optical fibers used for voice, data and video transmission over long distances. They are larger (nearly 1 millimeter in diameter), plastic rather than glass, and operating in the visible spectrum at shorter wavelengths. In one case, 172,800 fibers were bundled into a rectangular package and the ends pressed against the face of a 12x16-inch CRT display. The fibers were then fanned out to form a coherent 6x8-foot rectangle for viewing.

The magnification achieved in this case was 6 diameters. It is reported that the apparent brightness of the enlarged image can be greatly increased by cutting the exit ends of the fibers at such an angle that the ratio of the elliptic axes is approximately equal to the linear magnification. The device is manufactured under patents issued to Dr. William E. Glenn, formerly associated with the proposed New York Institute of Technology HDTV system.

The prognosis

The scope of technology for large screen video display is broad and comprehensive. Many variations are being investigated within each of the general categories. Meeting the performance requirements for HDTV, as well as for NTSC, is difficult but critical. Cost reduction is probably the dominant criterion in manufacture. Weight and size are likely to be increasingly significant for marketing large screen displays.

Hundreds of millions of dollars are going into new plants for producing 30-to 35-inch, and larger, direct view CRT displays. Projection technology is already available for even larger screens. Nevertheless, the desirability of a 3x5-foot flat panel display that can be hung on the wall contrasts so sharply with the bulk and mass of the console required for large CRT and projection displays that the flat-panel must be considered essential for large scale entry of HDTV in the consumer marketplace. Without the large, flat panel screen it is hard to foresee more than a relatively small, elite market for true HDTV.

Recently published reports suggest a real possibility that large, flat panel displays could become technically feasible in the next 5 to 10 years. Costs will be high initially, but could drop sharply as yields increase and techniques improve. Meanwhile, improved definition TV (IDTV) and the continuing trend toward moderately larger CRT displays seem likely to soften the market for true HDTV until the convenient, low cost flat panel display becomes a reality. ■

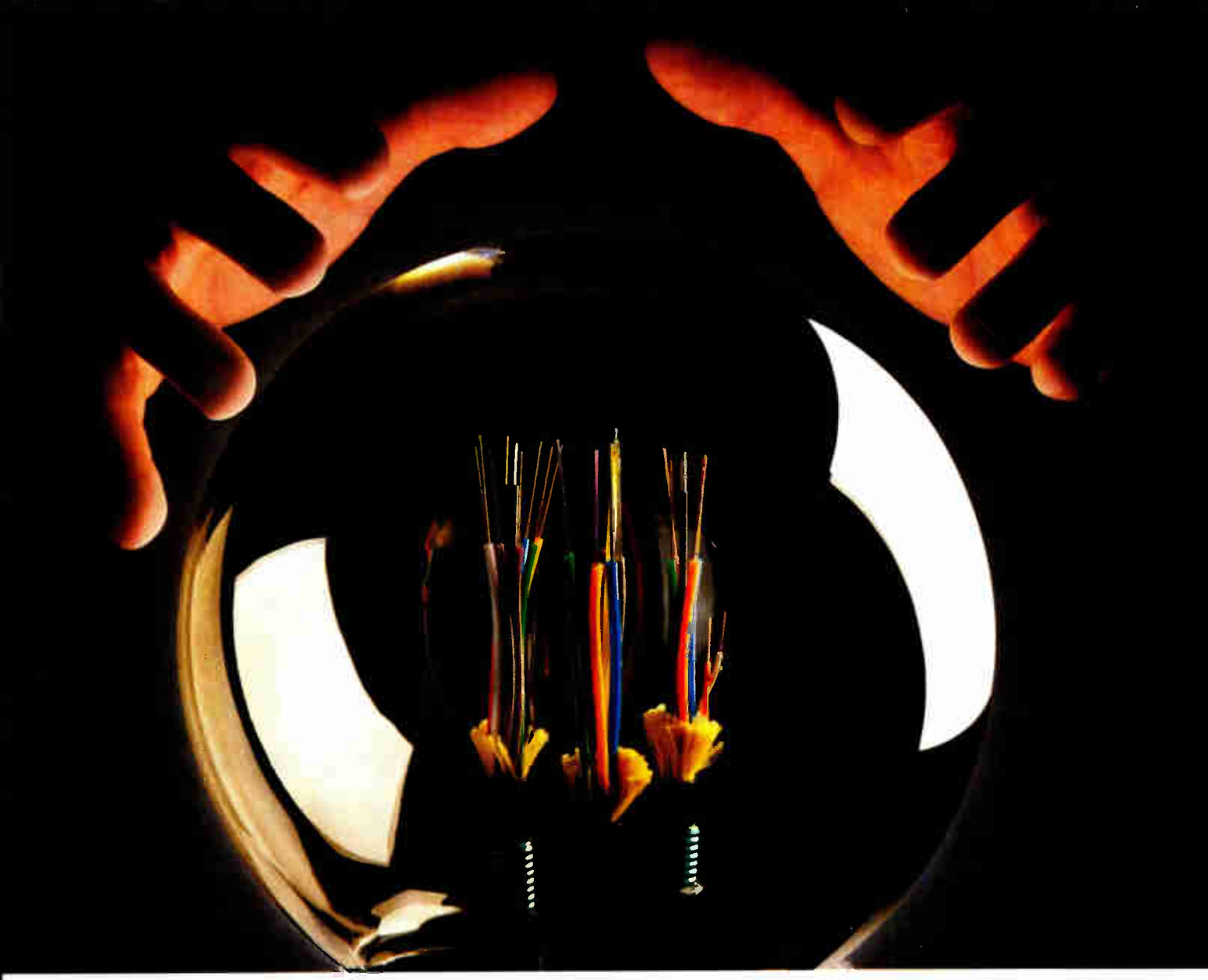
Note: For more detail on flat-panel displays, see:

(1) "Perfecting the Picture;" *IEEE Spectrum*, July 1985, pp. 60-66.

(2) "Flat-Panel Displays Displace Large, Heavy, Power-hungry CRTs;" and "How to Select a Flat-Panel Display" both in *IEEE Spectrum*, September 1989, pp. 34-45.

(3) Also, a book entitled "How to Select a Flat Panel Display" by Melvin F. Silverstein, published by Beta Review Inc., 19 Witchita Road, Medfield, Mass. 02052.

(4) The December 1989 issue of the monthly publication of the Society for Information Display (SID) has a roundup presentation on the status of LCD, ELD, plasma, and projection displays. 8055 Manchester Avenue, Playa del Rey, Calif. 90293; (213) 305-1502.



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SIECOR

Reader Service Number 60

How to complete Form 320

COMPLIANCE

What follows is a "primer" of sorts on how to fill out the Federal Communication Commission's Form 320 to prove your system is in compliance with the signal leakage rules. This document, which must be filed with the FCC by July 1, 1990, is the result of work done by the NCTA Engineering Committee's subcommittee on signal leakage and was spearheaded by Charles Cerino of Comcast, with input from Robert V.C. Dickinson of Dovetail Systems; Roy Ehman of Jones Intercable; Ted Hartson of Post-Newsweek Cable; and Dom Stasi of FlightTrac.

Most of the information on the Form 320 is straightforward and self-explanatory. See the instructions issued by the FCC for Form 320 for more details. As a note, a Form 320 is required for each and every cable community registered with the Commission. If a community's unit is not using aeronautical frequencies, simply write on the Form 320 "no aeronautical frequencies in use" and return to the Commission. Completed Form 320s should be returned to the following address:

Cable Television Branch
Federal Communication Commission
Washington, D.C. 20554

Section I—General information. You will need to supply a telephone number which is the main office number at the cable office which that community is served by. Name, address, community unit number, etc. should all be printed on the form. If, however, they are incomplete or incorrect, complete the form with the most accurate information presently being used by the system. The community code (CA1234) and physical system ID number (9876-01) can be found on the 325 Schedule 2. Do not white-out incorrect information—put a line through it and correct it above the line.

Section II—Local system information. This section requests that an Exhibit A be attached, which lists all aeronautical frequencies used or ones that will be used in the next 12 months.

In your 76.615 (b) notification to the Commission, frequencies which are not presently in use must also be listed in order for you to maintain your notification status. However, make sure you note which frequencies are not presently being used. All carriers which operate within the aeronautical bands above 38.75 dBmV must be listed. This includes all pilots, data, interdiction and leakage test signals.

It has also been requested that a copy of the formula used to compute your ground-based test (if used) be included as an Exhibit A-1. If an airspace test (commonly called a flyover) was conducted, note he calibration methods, parameters and techniques prescribed in Section 76.611 (a) (2) of the Rules were followed.

Record the test results in the proper blank. Do not mark the passed block unless you have actually passed a flyover.

Section III—Leakage performance criteria. This is a two-part section. The

What's your frequency?

Of equal concern to the Commission with CLI and leakage containment is the necessity to operate only on properly offset frequencies. Not only must a system be on a correctly offset frequency, but only after properly notifying the Commission.

The reason for this is, if leakage were to occur from a system it would not cause a signal to be placed directly on the channel which an aeronautical service might be in use.

Recently, the Commission has started to examine frequency utilization—and the probability of your getting a fine for being on the wrong frequency is very good.

You can get on the wrong frequency two ways:

First, if you haven't changed your equipment to a ±12.5 kHz or ±25 kHz offset, it is certainly on the wrong frequency. Any old offset or the original nominal frequency like channel A, 121.2500 MHz are not correct after July 1, 1990.

You should not rely on stickers, invoices or what the last chief tech told you. To be sure, you must measure the carriers with a counter of good calibration.

Secondly, once you get to the right frequency you have to stay on it. Temperature variation, mechanical shock or substitution of modules all can cause a frequency to drift away from where you put it.

Be especially careful if you have over-the-air signals on aeronautical channels. In these cases the offset frequency of the transmitting station, plus several independent crystals—as might occur in a UHF down conversion—can throw you out of the 5 kHz tolerance. It's a good idea to phase lock the output or even use a demodulator/modulator combination to assure that good frequency control is maintained.

Don't forget stand-by carrier and IF switching. Make sure they are on the right offsets too.

As you prepare the exhibit A for Form 320, make sure you include all signals greater than +38.75 dBmV anyplace in the system. This data shall include the nominal frequencies. Frequencies should be carried out to 100 Hz (that's the fourth place to the right of the decimal in MHz). Don't rely on published tables, check your FCC records and confirm by making actual measurements. It is not necessary to report the actual measured frequency.

This is not limited to just visual carriers. Some aural carriers, pilots, data channels and interfering carriers for positive trap systems also can exceed +38.75 dBmV and must be included. It's a good idea to look at the total spectrum with your analyzer to make sure you haven't missed something—the FCC won't!

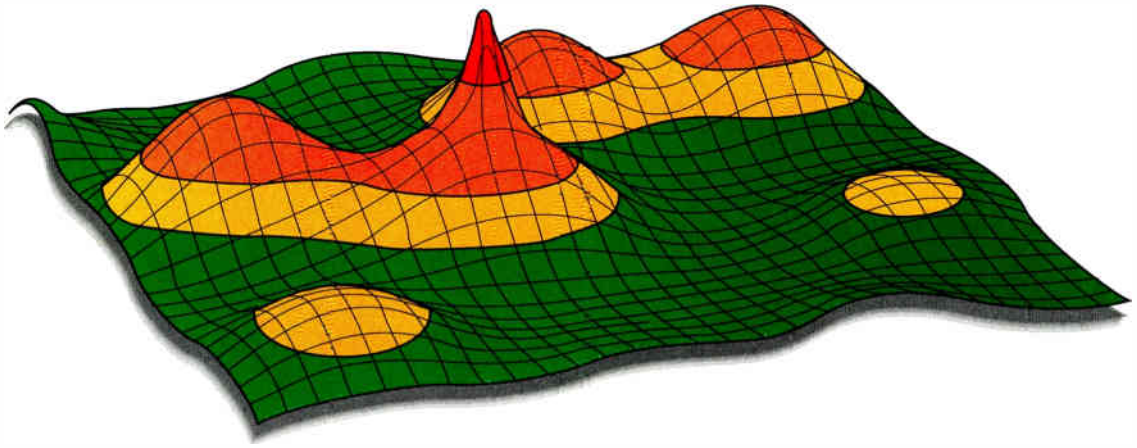
Once you're under control, remember—when doing maintenance, changing signals or channel configurations—you have a continuing obligation to be on the right frequencies and to provide the Commission with appropriate advance notification.

Complete compliance with the new rules is more than just hunting for "rat killers," it requires a comprehensive tune-up of the headend. ■

By Ted Hartson, Vice President of Engineering, Post-Newsweek Cable

ComSonics

CLI FLYOVER



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first part is for systems which used ground-based testing and the second part is for those which used airspace measurements. Complete only the section which represents the test your system performed.

Again, most of the information requested is straightforward and simple to follow.

The time period of the test can be as long as three months, which correlates directly with a quarterly patrol. However, it does not have to be synchronized to a quarter on the calendar—it could be March, April, May, etc.

The preferred time to perform the test is to complete it in as short a time period as possible. This will provide the best "snapshot" as to the condition of the system.

Remember that at least 75 percent of the system must be tested and the results must be extrapolated to represent 100 percent of the system. The area tested shall include the sections of the system that are suspected to contribute most to a leakage problem.

The equipment used to perform the test must have the capability of measuring leaks of 20 μV/m at 3 meters and the test frequency should fall somewhere inside the 108 MHz to 137 MHz band. If an alternative frequency is used, the results must be correlated to that band. Test made in the band, say 137 MHz to 141 MHz, for example, would be expected to be virtually the same as 108 MHz to 137 MHz. The level of the test frequency shall be at the same level as the highest level frequency in the 108 MHz to 137 MHz band.

Exhibit B does not require that every leak be listed with address, date, level, etc. However, it does require that the leak be accounted for. For example: If you have three leaks at 62 μv, four at 78 μv and five at 150 μv, they can be listed as follows:

Quantity	Level	Location
5	150	(Listed in km from
4	78	center of system if
3	62	CLI_{3000} is used).

Quantity Level Location (Listed in km from 4 78 center of system if 3 62 CLI3000 is used.)

Leaks that were found and repaired should be listed separately showing the location of the leak and the date it was repaired. Your leakage logs are required to be maintained for two years and should support the information you submit. The Commission may ask to review this information, so it is suggested that it be well marked and easily accessed.

Section IV—Certification. *All* Form 320's filed must be signed by the owner, partners or an officer of the corporation; NOT a chief tech or system manager.

All exhibits should be clearly labeled with reference to the filing it is associated with and be in the proper order.

Common questions

Some commonly asked questions about Form 320:

What is a "CLI area"?

The FCC does not clearly define a CLI area. In previous meetings, cable industry representatives were told that any system which is fed by separate headends, AML hubs, fiber optic hubs and supertrunks which operate below 38.75 dBmV were allowed to be treated as separate CLI areas. AML and other frequency-locked signals fed from the same headend when the boundaries physically touch one another are considered as a single CLI area. Any deviation from this interpretation should be consistent with good engineering practices.

We suggest that if a system has some unique physical attributes, such as a river or mountain, which separates two hubs, that a system map be used to show how your CLI area boundaries were derived.

Can I use a computer-generated Form 320?

Yes, but the form generated by a PC must be an exact replica of the FCC's printed form or it should be cleared by the Commission prior to filing.

Can the same technician find, record and fix a leak for CLI?

Yes, this practice is allowable. Remember, you must log this leak as repaired and not factored into the CLI formula. All leaks over 150 μV/m at 3 meters should be repaired as soon as possible. If it is necessary to fix leaks to pass the CLI test, good engineering practices dictate that 100 percent of the system be patrolled.

If I have multiple CLI areas and I choose to perform a flyover which covers the entire area at once, can I submit just one set of documentation or do I need to perform multiple flyovers?

Provided the system passes the test, one flyover documentation submission will be satisfactory. However, a separate Form 320 is needed for each community unit.

What do I do if I don't receive a Form 320 for some of my communities?

Blank forms can be created, completed and submitted (or the adjoining reproduced form can be used). One form for each community served is required.

Do I have to submit copies of all exhibits for each Form 320?

No. One set of supporting documentation is all that is required. A reference to the key community that has the information, along with the community ID, will suffice. Type the reference ID code in Section III in the space next to the bracketed words, "(if used)". When the test results cover several community units it would be helpful to provide a listing of all community's units covered by the test.

What do I do when I have a community which falls into two different CLI areas?

A system map could be used to help define how you correlated the data. A clarifying statement in Exhibit B would also be beneficial, however, remember to reference the communities which have the supporting exhibits.

How often may I submit CLI test results?

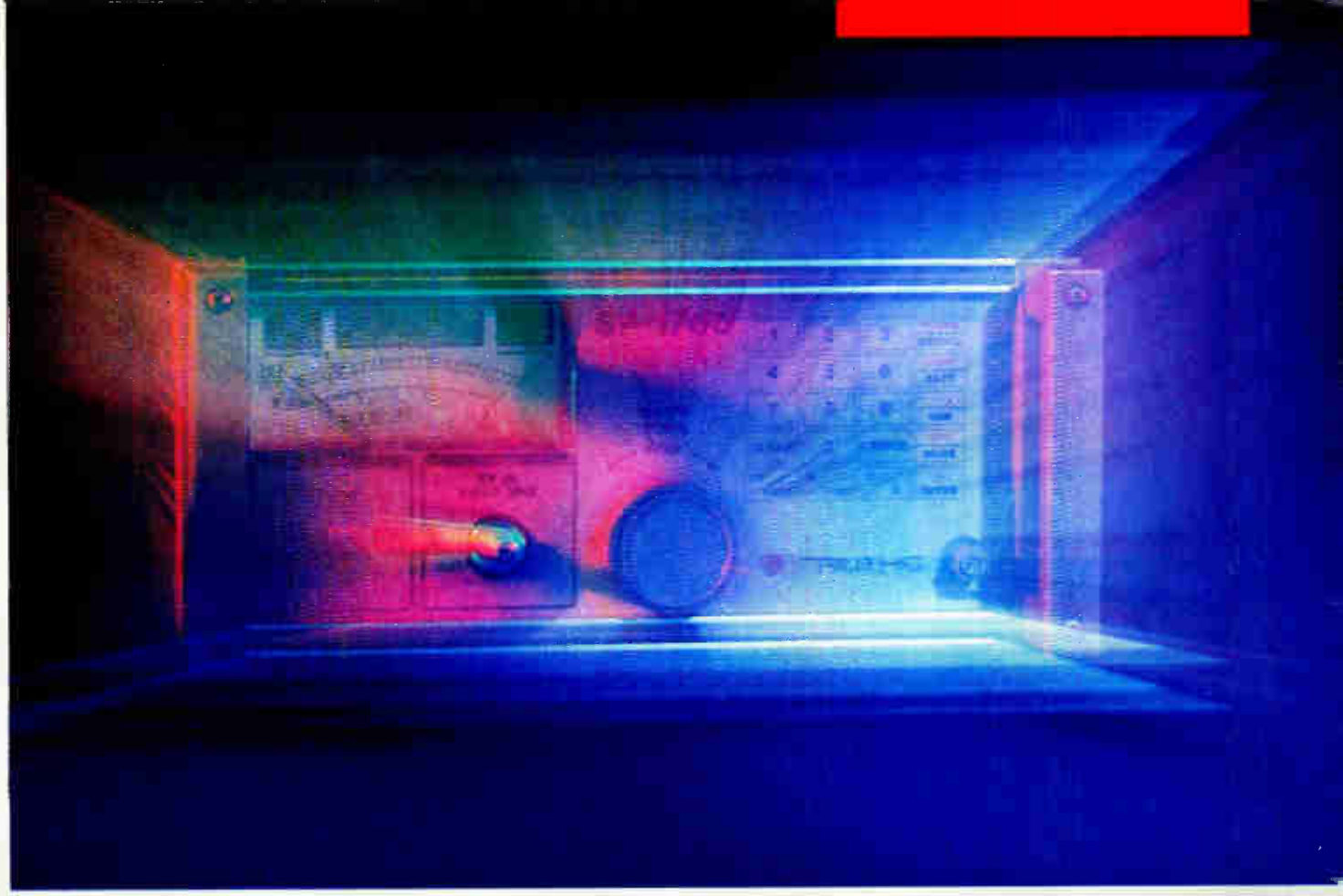
The test must be completed once every calendar year, not to exceed 12 months. Data can be submitted in shorter intervals in order to shift the test period into a more favorable time of year. We suggest you make copies of the Form 320 as you receive them (prior to completing the first submission) so you have an accurate set of forms for future submissions. The date the test was completed marks the beginning of the 12-month clock—except for initial filing, where tests completed in December '89 are acceptable.

How long do I have to perform my CLI test?

Any 90-day period used to perform quarterly patrolling may be used for the CLI test. Large systems will require enough manpower to conduct the test inside the 90-day window. The test should be conducted in the shortest amount of time possible.

If I patrol 100 percent of my

Continued on page 110



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TRILITHIC

Reader Service Number 62

INSTRUCTIONS

Federal Communications Commission
Washington, D.C. 20554

Approved by OMB
3060-0433
Expires 11/30/92

FCC 320
BASIC SIGNAL LEAKAGE PERFORMANCE REPORT
INSTRUCTIONS

In accordance with 47 C.F.R. Section 76.615, this report should be submitted prior to July 1, 1990. Thereafter, a basic signal leakage performance report (FCC Form 320) is required to be filed once each calendar year.

Section I—General Information
The information in this Section is preprinted based on the most current data on file with the Commission. The information should be reviewed and revised, if not accurate and complete.

Section II—Local System Information
1. Provide the name, address and telephone number of the person(s) at the local system by whom or under whose direction the report was prepared.
2. Include as an attachment and identify as **Exhibit A**, a list of all the precisely offsetted aeronautical frequencies used by this community unit.
3. Test Results—Show compliance with one of the following basic signal leakage criteria:
   a) For ground-based measurements, the determination of $10\text{Log}I^{\infty}$ and $10\text{Log}I_{3000}$ shall be based upon methods, parameters and formulae as prescribed in 47 C.F.R. Section 76.611(a)(1). Provide the results here.
   Note: If $10\text{Log}I^{\infty}$ is equal to or less than 64 or if $10\text{Log}I_{3000}$ is equal to or less than -7, the system has passed the signal leakage test.
   b) If airspace measurements are used, use calibration methods, parameters and techniques as prescribed in 47 C.F.R. Section 76.611(a)(2). Indicate whether the system passed or failed the signal leakage test.

Section III—Leakage Performance Criteria
For operators electing to conduct measurements on geographical areas that contain more than one community unit, fill in the requested measurement information on this form. However, the submission of the accompanying exhibits, either B or C, may be incorporated by reference to the filing of another community unit that had undergone the same measurement tests as this community unit, identify that community unit by its community unit code number.

1. **Ground-Based Measurements** (if used)
   a) Provide the name and telephone number of person(s), who is responsible for conducting the ground-based measurements.
   b) Indicate the number of miles of cable plant tested for signal leakage and calculate the percentage of overall cable plant that was tested for signal leakage.
   Note: A minimum of 75% of cable plant, which includes the oldest portion of the system, must be sampled for this test.
   c) Show the time period of the test, including the actual starting and ending dates.
   d) Provide the name and make of the leakage measurement equipment used and the test frequency used. As an alternative, provide information as to the sensitivity and accuracy of the leakage measurement equipment and the test frequency used.
   Note: The equipment used must be capable of measuring leaks of 20 μV/m at 3m or its equivalent, and the test frequency must be within the VHF aeronautical band 108-137 MHz or a frequency in which the results can be correlated to that band. Additionally, the test signal used shall have an average power equal to the average power level of the strongest carrier on the system.
   e) Attach as **Exhibit B**, the actual calculations performed in accordance with 47 C.F.R. Section 76.611(aX1) for the entire geographical area tested. Identify in this Exhibit all leaks 50 μV/m or greater that were detected during the test and include their repair dates, if any. The geographical area tested may include more than one community unit. Use the same information and results for each community unit.
2. **Airspace Measurements** (if used)
   a) Provide the name and telephone number of person/company performing the airspace measurements.
   b) Indicate the date(s) that the airspace tests were performed and the test frequency used during these airspace measurements.
   c) Attach as **Exhibit C**, a full description of the airspace measurement procedure, a list of the equipment used and a detailed description of the geographical area covered by these airspace measurements. Additionally, include the graph or chart of the data points collected and the associated technical analysis for these measurements. Use the same results for each community unit included in this test. For all leaks detected during the airspace measurements that were subsequently repaired, specify the date of repair.
   d) Recorded data and its analysis.
      (i) If analog recordings are used, include a graph of the curves and the result (in μV/m) of the analysis of the peak values of these curves when smoothed out, in accordance with good engineering practices.
      Note: This smoothed curve must be below 10 μV/m.
      (ii) If digitized data is used, indicate the percentage of these digitized points below 10 μV/m.

Section IV—Certification
This report must be certified by the individual owning the reporting cable system, if individually owned; by a partner, if a partnership; by an officer of the corporation, if a corporation; or by a member who is an officer, if an unincorporated association. It may also be signed by the cable system owner's attorney in case of the owner's physical disability or absence from the United States. The attorney shall, in that event, separately set forth the reasons why the report was not signed by the owner. In addition, if any matter is stated on the basis of the attorney's belief only (rather than

Approved by OMB
3060-0433
Expires 11/30/92

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

BASIC SIGNAL LEAKAGE PERFORMANCE REPORT
FCC FORM 320

SECTION I -- GENERAL INFORMATION

(1) Cable System Owner: _____
Phone Number: (____)_____
Address: _____
_____ _____ _____-____
(City) (State) (ZIP)

(2) Community Served : _____

(3) Community Unit No.: _____ (4) Physical System Id: _____

SECTION II -- LOCAL SYSTEM INFORMATION

(1) Person(s) Responsible for report:
Name: _____ _____ ___
(Last) (First) (M)
Phone Number: (____)_____
Address: _____
_____ _____ _____-____
(City) (State) (ZIP)

(2) Identify in Exhibit A, all precisely offsetted aeronautical frequencies used by this Community Unit.

(3) TEST RESULTS: CLI: 10LogIoo: _____.____; 10LogI3000: _____.____
Airspace: Passed: ___ Failed: ___

SECTION III -- LEAKAGE PERFORMANCE CRITERIA

For operators electing to conduct measurements on geographical areas that contain more than one Community Unit, fill in the measurement information below. However, the submission of the accompanying exhibits, either B or C, may be incorporated by reference to another Community Unit filing that had undergone the same measurement tests as this Community Unit. Identify that Community Unit by its Community Unit Code Number.

(1) GROUND-BASED MEASUREMENTS: (if used)

(a) Person(s) Responsible for test:
Name: _____ _____ ___
(Last) (First) (M)
Phone Number: (____)_____

(b) Miles of plant tested & % of total plant tested: _____m;_____.__%

(c) Time period of test: From: __/__/____ To: __/__/____
(MM DD YR) (MM DD YR)

(d) Equipment Used: _____ _____ _____.____(MHz)
(Make) (Model) (Test Frequency)

(e) Attach as Exhibit B, the CLI calculation & result including all parameters used. (Identify in this Exhibit all leaks ≥ 50 uV/m, and show their repaired dates, if any.)

BASIC SIGNAL LEAKAGE PERFORMANCE REPORT

SECTION III -- LEAKAGE PERFORMANCE CRITERIA

(Continued)

(2) AIRSPACE MEASUREMENTS: (if used)

(a) Person/Company Responsible for test:

Name: _____
(Last, First, M, or Company Name)

Phone Number: (____)_____

(b) Dates of Test-From: ___/___/___ To: ___/___/___
(MM DD YR) (MM DD YR)

Test Freq.: _____._____(MHz)

(c) Attach as Exhibit C, a full description of the test procedure, a list of the equipment used for the airspace measurements and a detailed description of the area covered by these airspace measurements. (Set forth in this Exhibit all leaks detected during these airspace measurements that were subsequently repaired and their repair dates, if any.)

(d) Recorded data and its analysis:

(i) If analog recordings, include in Exhibit C, a graph of the results and indicate the value of the smoothed out peak values _____uV/m.

(ii) If digitized recordings, include in Exhibit C, a plot of the results and indicate % of points recorded digitally below 10 uV/m: _____.___%

SECTION IV -- CERTIFICATION

I certify that I am _____(Official Title), of _____(Legal Name of Cable System Owner), that I have examined this Report and that, to the best of my knowledge and belief, all statements in the Report are true, correct and complete, and are made in good faith.

_____(Signature) _____, 19____(Date)

WILLFUL FALSE STATEMENTS ON THIS FORM ARE PUNISHABLE BY FINE AND IMPRISONMENT. 18 U.S.C. § 1001

FCC NOTICE TO INDIVIDUALS REQUIRED BY THE PRIVACY ACT AND THE PAPERWORK REDUCTION ACT

The solicitation of personal information requested in this Report is authorized by the Communications Act of 1934, as amended. The principal purpose for which the information will be used is to determine eligibility to use the aeronautical frequency spectrum in the provision of Cable Television Service. The staff, consisting variously of Engineers, Communication Industry Analysts, and Cable Technicians, will use the information to determine such compliance. If all the information requested is not provided, processing may be delayed while a request is made to provide the missing information. Accordingly, every effort should be made to provide all necessary information. Your response is required to obtain or to retain the requested benefit.

THE FOREGOING NOTICE IS REQUIRED BY THE PRIVACY ACT OF 1974, P.L. 93-579, DECEMBER 31, 1974, 5 U.S.C. 552a(e)(3), AND THE PAPERWORK REDUCTION ACT OF 1980, P.L. 96-511, DECEMBER 11, 1980, 44 U.S.C. 3507

Why CLIDE for CLI?

Easy to install.

CLIDE's installation process is a breeze. Color prompts ask you a few quick questions about your computer. Answer the prompts, re-boot your machine, and you're done! CLIDE runs on any IBM PC/XT/AT or compatible with 640K RAM, DOS 2.1 or higher, and a hard and floppy disk drive.

Easy to operate.

CLIDE provides an easy method of monitoring RF signal leakage levels. It is completely menu-driven, with on-line help available at the touch of a key. All leakage data and subsequent leak repair data is stored and printed to form your FCC leakage report log. A wide variety of reports provide you with the information you need to show the FCC. Data entry is quick... data output is quick... because we know you're busy!

Easy on the budget.

CLIDE is designed for low-cost, ground-based inspection rather than costly aerial flyovers. Also, three price structures are available to match your budget: CLIDE alone, CLIDE with the PSION remote data collector, or the COMPLETE CLIDE KIT, which includes CLIDE, PSION, and a handy RANGE FINDER, which tells you in a glimpse how far you are from the pole or leak source.

Control Leakage Index Data Easily

By July of 1990,
we want you to feel as relaxed as CLIDE looks. Buy CLIDE now. Don't settle for less.

TELECOMMUNICATION PRODUCTS CORP.
1331 S. 7th Street, Chambersburg, PA 17201
(717) 267-3939
HAVE YOU SEEN US LATELY?

system and fail the CLI test, can I repair enough leaks to make me pass?

Yes, as long as they are logged as not calculated into the CLI in Exhibit B. After repairs are made, check the area to confirm that no other leaks exist that may have been masked by the repaired leak. It is recommended that all leaks be repaired within a reasonable period of time.

Can I turn in a CLI of zero?

Yes. Under Part 76.611 of the Rules, all leaks in the aeronautical bands over 20 μv/m at 3 meters must be fixed. Therefore, if a CATV system is in total compliance, it will have no leaks over 50 μv/m and a CLI of zero. Caution: this could trigger a "red flag" at the Commission.

Is there any equivalent to the repair of large leaks to pass a flyover that would otherwise fail?

Yes, but substantial analytical work should be done to confirm that the leaks repaired could have been expected to have caused the original failure.

In a flyover of uneven terrain, what altitude must be maintained?

The rule calls for an altitude of 1,500 feet above the average terrain. Changes in this parameter must be based on good engineering judgment recorded for FCC substantiation. Where Air Traffic Control will not allow flights in an area below a certain altitude, use the lowest altitude allowed and note this on the report.

Are there factors to consider when choosing a test frequency?

The frequency 1) must be offset as prescribed in the Rules and 2) must be free of interference when observed from the air. Not all frequencies which appear free of interference on the ground prove to be usable when observed 1,500 feet above ground.

What are the consequences if my system fails to pass the CLI test by July 1, 1990?

The system must voluntarily reduce signal levels to less than 38.75 dBmV or discontinue use of all frequencies in the aeronautical bands until the test can be successfully completed. Only the most compelling circumstances will be continued for waiver (e.g. recent natural disasters). ■

Signal Leakage Update...

LES V1.31 Shipping - Long Systems is now shipping version 1.31 of it's industry standard signal leakage software, the LES - Leakage Evaluation System. The latest edition includes automatic generation of support documentation for FCC Form 320.

ATC Kansas City Turns 51 - When American Cablevision KC purchased LES in Sept. 1989, they became the 51st Cablevision Magazine Top 100 system to use the LES - Leakage Evaluation System. Currently almost two thirds of the Top 100 use LES.

RDT1 Sales BOOM - The RDT1 Remote Data Terminal is an electronic leakage logsheet. Data collected in the field can be transferred directly to a personal computer. Many hours of PC keyboard data entry can be eliminated and CLI results made available immediately. Hundreds of RDT1's have been shipped including 8 to Cox Cable San Diego and 8 to Manhattan Cable.

North Dakota Gives In - LES was the first commercially available signal leakage software back in 1987. But it was not until Cable Services in Jamestown, ND ordered LES this February that a unique milestone was reached. LES is now in all FIFTY STATES in over 850 systems (in Puerto Rico, Virgin Is., & Guam too).

Ron's a PaPa - Ron Wolfe, Manager of the ATC National Training Center, recently became the father of a bouncing baby boy. Ron has contributed ideas to LES since the early days; his latest is the I of 3,000 calculation. Congrats to Ron and his wife!!

Long Systems Sales Soar - 1989 sales were up over 400% from the previous year. 1990 sales continue strong with two new family members; VIC - Vehicle Information Center and MOM - Monthly Outage Management. Sales of LES software and RDT1 remote data terminals still lead the way.

All You Need to Know - For further information on how you can get the industry standard software for controlling signal leakage and our other CATV products, call Long Systems in San Diego CA at 800-669-LONG, 619-584-2400 or by fax 619-584-2667.

Long Systems, Inc.

A New Tradition In Cable Software

CLI: flyover vs driveout

COMPLIANCE

The "Basic Signal Leakage Performance" is the annual measurement of leakage from a cable system. In July of this year, Form 320 will be filed with the FCC showing the results of leakage tests. A system must "pass" to continue carriage of channels in the aeronautical band.

The FCC allows two methods of determining a systems performance: flyovers and driveouts. In 1989, the two methods were compared side-by-side on Viacom's Salem, Oregon system. Two sets of tests using both methods were performed and attempts were made to determine the effect of a single leak on the airspace measurement. The methods were compared for accuracy, costs and usefulness. Both methods proved to be acceptable and produced comparable results.

Basic Signal Leakage Performance

	Flyover % of Compliance		Driveout I_{3000}	Driveout I_{00}
FCC Standard	90.0%		−7.0	64.0
May	70.1%		2.6	77.3
September	99.8%		−4.3	71.0
September divided into 3 areas		North East	−5.0	67.2
		North West	−14.0	55.7
		South	−7.1	63.8

A typical system

The Salem system was selected for several reasons. The system is typical for Viacom. It is a 500-mile system with a mix of new and old plant. It has an AML microwave system with three receive hubs. The system is unique in that there are no other adjacent cable systems which could produce stray leakage.

The driveouts (ground-based measurement resulting in a CLI), were done in-house and the flyovers (aerial surveys) were contracted. Two sets of tests were made, one in May and one in September. The driveouts took three and two days, respectively, to complete, while both flyovers took only an afternoon each.

The driveouts were performed at the same time as the flyovers. Six vehicles with two-man crews were used, covering 40 miles per day per vehicle. Each vehicle was equipped with a dipole antenna and a leakage detector. Channel D was used as the test carrier. All leaks were recorded by location of leak, the level measured and the distance to plant. Leaks were converted to μV/m and corrected to a 3m distance. All leaks above 50 μV/m were used in the CLI calculation. An in-house computer program facilitated the conversions and calculations.

The flyovers used a dipole, a LORAN C locator, automated level detector and a recorder. A 115.275 MHz carrier was added to the cable system and used for level detection. The flight path made north and south passes in half-mile increments at an altitude of 450 meters above average ground elevation. Several thousand points were recorded.

The digitally recorded information was used later to produce the computer generated flyover report. This report lists the number of data points collected, the number of points exceeding the FCC threshold, the aerial location with a plot of these points, the calculation of percent of points with passing levels, and a statement of pass or fail.

Comparing methods

After the completion of the May tests the two methods were compared for efficiency and accuracy. The results showed CLI "failures" determined by both methods.

However, labor costs were lower for the contracted aerial survey than for the ground crews and there was a lack of correspondence between airspace leakage measurement location and driveout determination of leakage sources.

Flyover	Driveout
500 miles of plant	
1 day	2 days
1 plane	6 crews
115.275 MHz	Channel D
Less expensive	More information

Airspace measurements indicated high leakage over some areas that showed little leakage on the ground or were non-cabled areas. This led to concern and speculation over the source of signals measured in the flyover. To understand the issues better, a second comparison test was planned.

Before the second set of tests were performed, leakage found in the first driveout was repaired. The first driveout allowed techs to identify specific locations for repair. The repairs were done to improve the CLI result and to make a comparison of driveouts vs. flyover on a system that would pass CLI—not just a severely leaky system. Hopefully, "passing" will be the norm for future CLI tests.

The results of the September surveys were a "pass" by the flyover and a "just barely fail" by the driveout. Again, labor costs were lower for the contracted flyover than the driveout and there was still some lack of correspondence between airspace measurement location and driveout determination of leakage sources.

This cable system actually has three distinct service areas, divided by physical boundaries, each with its own AML receiver. As such, three CLI's could be calculated from the set of data used to calculate the first CLI. With I_{3000} and I_{∞} as options, there are then eight ways to calculate a CLI for this system with a single driveout. With this approach, two of the areas pass. This brings the driveout results closer to the flyover survey results.

With this test we were also able to take time to make a direct comparison between aerial measurements and the actual leakage source. To insure the accuracy of the flyover measurements, the aerial test signal generator, portions of the plant and drops were turned off or disconnected to isolate the source of the aerial measurements. In all cases, the measurements were re-

By Brent Bayon, Regional Engineering Manager, Viacom Cablevision

sults of plant leakage but often from unexpected ground locations.

Difference in leak measurements

The most notable leak studied was the cause of one of the highest flyover measurements. In the driveout it was an average leak. The leak was from a residence and from the street it measured 30 μV/m (probably greater than 10 feet from the leak). Inside the house it measured 200 μV/m (possibly less than 10 feet from the leak). It was caused by a "house" cable system, which consisted of an amplifier feeding 25 outlets. This leak had an antenna pattern that apparently was broadcasting upwards. In the ground measurements it was not a notable leak, but in the flyover it was severe.

> The driveout and repair is a separate program from the routine monitoring.

While investigating the "house" system leak, the cumulative effect of leakage was also measured. The house leak and three other leaks had been found in a subdivision, which was an "island" of cable plant and surrounded by empty lots and farmland. By turning on and off portions of plant, the airspace measurement of the house leak was compared to additive effect of the net level from the other three leaks. All four leaks measured the same in the driveout, but the single house leak produced 10 dB more signal in the airspace than the three leaks combined. Again, this is probably because of the broadcast patterns of the leaks involved.

As a footnote, the CLI test is difficult for a large system to pass. A 500-mile cable system with one leak per mile is comparable to a 100-mile cable system with five leaks per mile. To pass a CLI, the larger system must be five times tighter than the small system. This is because of the cumulative calculation in the CLI formula.

A large Viacom system has completed six CLI driveouts in the last five years. Between each driveout, which were spaced between three months and a year apart, all recorded leaks were repaired. The system has recorded three passing and three failing CLIs in a random order. Typically, the failure is because of a few large leaks, around 500 μV/m, which are quickly repaired. It is important to know that the driveout and repair is a separate program from the routine monitoring. Routine monitoring finds and repairs leakage in addition to the driveout program and was on-going during this period. At any time, even with a diligent approach to leakage, CLI is a challenge to meet.

In this comparison, driveouts and aerial surveys were technically comparable and it was shown there were no inherent errors in either technique. Although the aerial survey was less costly, the driveout produced useful information when repairing leaks later. One method is not better than the other; each has its appropriate application. ■

Do the right thing—choose the right clip

Who thinks about what type of cable clip to use when installing CATV systems? The smart cable company will if it wants to save money by avoiding expensive callbacks.

Selecting the right clip is a function of the substrate into which the clip is to be installed, the size and number of cables to be secured, and whether the clip is for interior or exterior applications.

This article will focus on selecting the right clip for exterior building materials.

Quality is the key

The high quality cable clips should be constructed of high-impact, cold weather resistant, ultraviolet (UV) stable materials. Plastic clips that don't meet these criteria may break during installation, smash the cable, crack or break in cold weather, or deteriorate when exposed to the UV radiation found in sunlight.

Pointing to the importance of UV stability, an estimated 30 to 40 percent of non-UV stable clips break within the first year, and between 55 to 70 percent of all non-UV clips will break by the end of the second year.

Impact resistant clips

UV stable, high-impact clips will fasten easily into a variety of substrates, including poured concrete, cement block, brick and mortar, wood, aluminum and vinyl siding, and asphalt composition insulation board.

Clips that use pins for installation avoid the need to drill holes prior to fastening. It is estimated that drilling holes every 10 inches to 24 inches prior to fastening clips costs approximately $0.50 per hole.

Significant cost savings are achieved by using nail-in clips. The installer attaches the clip to the cable as he progresses and then pounds the pin into the building surface with a common two- to three-pound ground rod (lineman's or drilling) hammer.

By Gregory R. Hayward, Sales Manager, ITW Linx

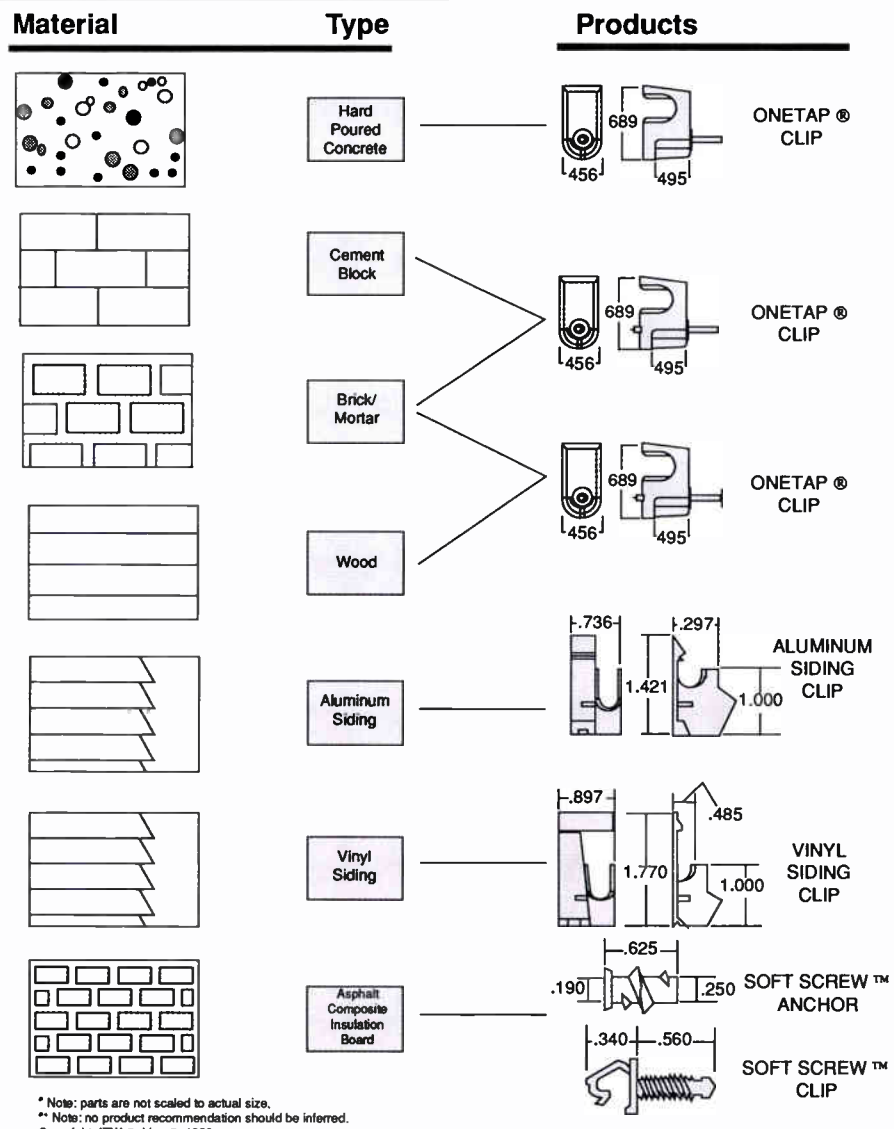
BACK TO BASICS

In an age where high tech is a common buzzword, many in the industry give scant thought to the "little" products that are so important in a cable system. In this month's Back to Basics, Gregory Hayward, with ITW Linx, looks at the cable clip—a small, but significant piece of hardware.

Clips typically have one pin, but models are available with two pins. One-pin clips are faster to install and are ideal for corner mount applications. Two-pin clips provide the extra benefit of non-rotation and typically hold more securely. All pins should be made of tempered, rust-proofed steel.

Special clips

Homes with aluminum or vinyl siding require a special clip for each siding type to hold cable either vertically or



* Note: parts are not scaled to actual size.
** Note: no product recommendation should be inferred.

horizontally. Each clip has a barb that is pushed into position between the overlap of the siding joint. Each clip securely snaps into the overlap seam to effectively resist pull out forces while maintaining the integrity of the siding's weather seal.

These single-piece clips have a unique universal design that represent an advance over previous siding clip installations that require several clips to anchor the cable. Horizontally, the clip holds cable securely beneath the siding lip. Vertically, the clip encloses the cable in an angled channel around the edge of the siding overlap and holds the cable snugly against the wall surface.

Installed with just a push of a screwdriver, the clip designs provide an attractive alternative for aluminum or vinyl sided buildings.

Don't forget aesthetics

Customers want clips to blend in with the building and be as unnoticeable as possible. While clips are typically available in black, white and clear colors, cable companies can reduce inventories by stocking clear clips that blend with all backgrounds.

Selecting the right manufacturer

In an era when companies are trying to reduce their supplier base, cable companies should select clip suppliers based both on the quality of the clips produced, as well as the breadth of product line.

> The high quality cable clips should be constructed of high-impact cold weather resistant, ultraviolet (UV) stable materials.

In addition to manufacturing different clip designs for different applications, suppliers should make each clip design available in a variety of sizes. Also, clip manufacturers should be able to supply clips with longer pin lengths for extra holding power in porous building material applications.

Selecting the right exterior clip—one made of high impact, UV stable plastic—is only part of the battle. Selecting a manufacturer that offers a variety of clips designs and sizes as well as multiple pins lengths will ensure that cable companies hold the line on call-back costs by specifying the right clip, the first time, from one manufacturer. ■

Any ideas?

Each month, CED *publishes a "Back to Basics" piece in an attempt to provide the basics on a topic long forgotten, or as a refresher to everyday technological activities. If you feel a topic needs to be addressed, or would like to contribute an article for publication in "Back to Basics," please call or write, Managing Editor,* CED, *600 S. Cherry, Suite 400, Denver, CO 80222. (303) 393-7449, Fax: (303) 393-6654.*

SCTE

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

May 2 *North Country Chapter* on BCT/E Category II, "Video and Audio Signals and Systems" at the Sheraton Midway in St. Paul, Minn. Contact Douglas Ceballos, (612) 522-5200, ext. 705.

May 8 *Central Illinois Chapter* on "Preventive Maintenance" at the Sheraton Normal Hotel in Normal, Ill. Contact Ralph Duff, (217) 424-8478.

May 8 *Chattahoochee Chapter* at the Perimeter North Inn and Conference Center in Atlanta, Ga. Contact Richard Amell, (404) 394-8837.

May 9 *Mount Rainier Chapter* on "Outage Control." Contact Sally Kinsman, (206) 821-7233.

May 23 *Piedmont Chapter* on "Signal Processing Center." Contact Rick Hollowell, (919) 968-9661.

May 24 *Special Live Uplink* "CLI Conference—Live from the NCTA Convention in Atlanta, Ga." An exlusive live uplink to feature technical presentations and discussions by an impressive array of industry leaders. Actual time and satellite transponder to be announced.

May 29 *Satellite Tele-Seminar Program* "High Definition Television (Part One)" with Walt Ciciora, Ph.D. of ATC, Wayne Luplow of Zenith Electronics Corp. and Norman Hurst of the David Sarnoff Research Center. Videotaped at Cable-Tec Expo '89 in Orlando, Fla., the program will air from noon to 1 p.m. Eastern time on Galaxy III, transponder 2.

May 6-7 *Old Dominion Chapter* at the Holiday Inn in Richmond, Va. Contact Margaret Davidson-Harvey, (703) 248-3400.

May 8 *Central Illinois Chapter* "Preventive Maintenance" at the Sheraton Normal Hotel, Normal, Ill. Contact Ralph Duff, (217) 424-8478.

May 10 *Big Sky Meeting Group* "Distribution" with Mike McCracken of Scientific-Atlanta at the Colonial Inn Best Western, Helena, Mt. Contact Marla DeShaw, (406) 632-4300.

May 10 *Big Country Meeting Group* in San Angelo, Texas. Contact Albert Scarborough, (915) 698-3585.

May 10 *Sierra Meeting Group* "Introduction to Data and Local Area Networks" presented by Hewlett-Packard at the Oxford Suites Hotel, Roseville, Calif. Contact Steve Allen, (916) 786-2469.

May 13-14 *Old Dominion Chapter* Contact Margaret Harvey, (703) 248-3400.

May 17 *Golden Gate Chapter* "Transportation Systems" with Dave Large and Pete Petrovich, preparation for BCT/E Category III in San Ramon, Calif. Contact Wayne Sheldon, (408) 436-2912 or Al Johnson (415) 588-1325.

May 19 *Golden Gate Chapter* BCT/E Testing, Categories II, III, V and VI in Pleasanton, Calif. Contact Wayne Sheldon, (408) 436-2912.

June 21-24 *SCTE Cable-Tec Expo '90* at the Nashville Convention Center in Nashville, Tenn. Contact: SCTE National Headquarters, (215) 363-6888.

C-COR® ELECTRONICS INC

C-COR Electronics "state of the art" seminars are three-day events designed to instruct relatively new technicians in basic theory, installation and maintenance of cable TV systems. Attendance is limited to a maximum of three persons from one system. The fee is $245. Call Kelly Jo Kerstetter, (800) 233-2267, ext. 422 to register or for additional info on any of the following 1990 seminars.

May 22-24
Allentown, Pa.

June 19-21
Indianapolis, Ind.
September 18-20
Dallas, Texas
October 16-18
Los Angeles, Calif.
November 13-15
Orlando, Fla.

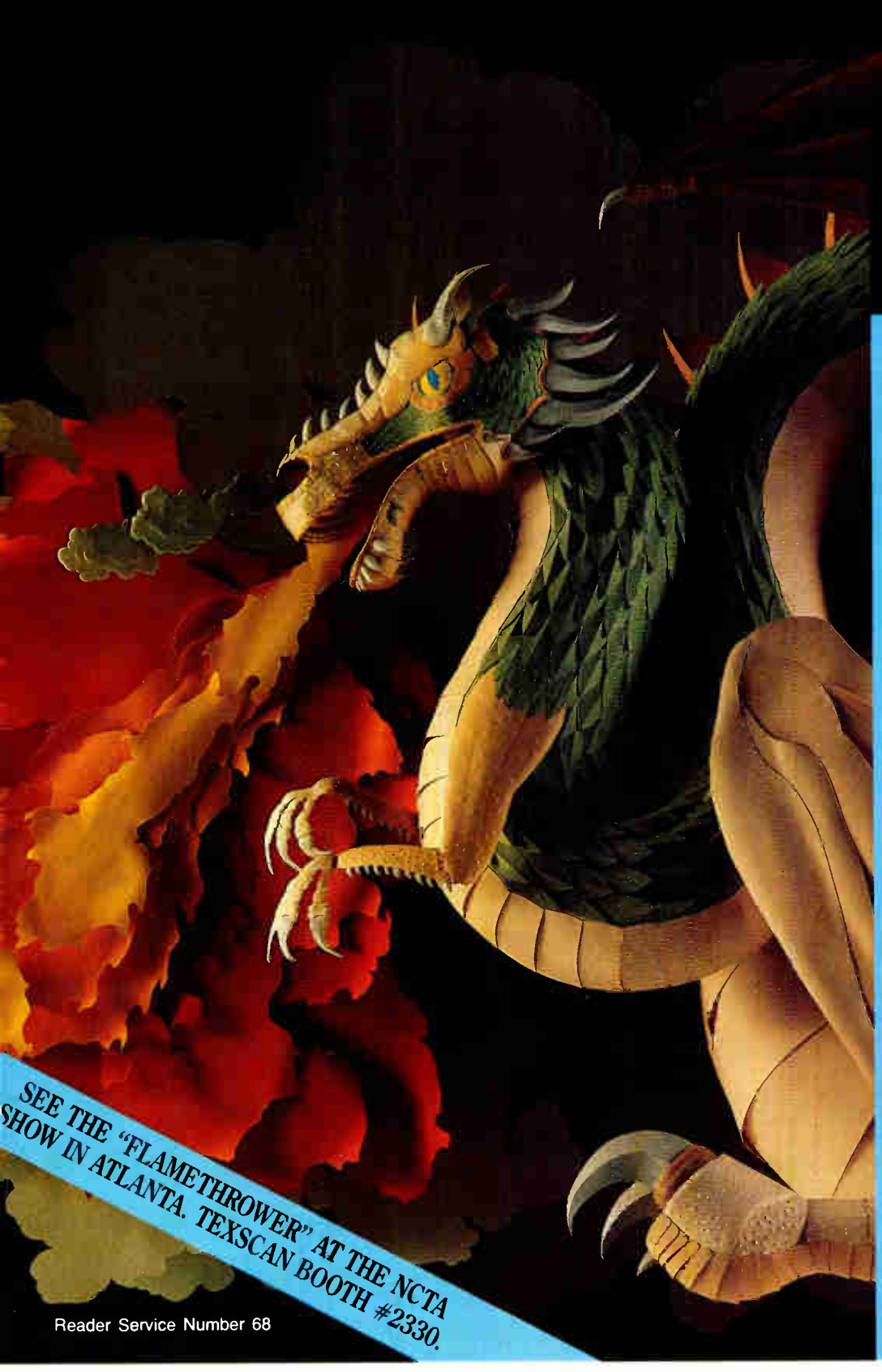
MAGNAVOX CATV SYSTEMS CO.

The Magnavox CATV Systems mobile training center is a fully-equipped laboratory on wheels for CATV, fiber optic and LAN training. The three-day seminars combine instruction in theory and practical hands-on training. The fee is $350. Call Amy Costello Haube at (800) 448-5171 (in N.Y., (800) 522-7464) for information and reservations.

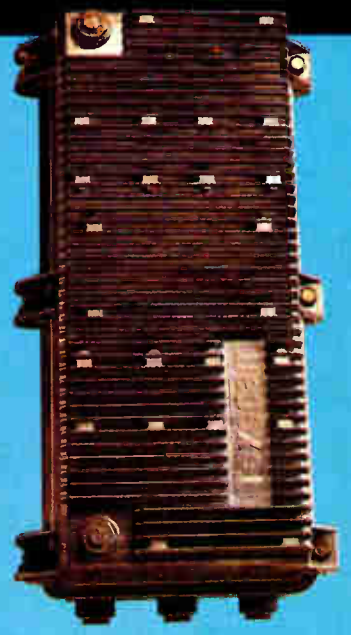
May 1-3
San Antonio, Texas

May 8-10
Orlando, Fla.
September 11-13
Detroit, Mich.
September 18-20
Detroit, Mich.
September 25-27
Indianapolis, Ind.

It's Not Always This Easy To See The Power And Reach That Legends Are Made Of.



Sometimes It Takes A Closer Look.



Fiber to bridger (FTB) among your goals? Meet **"FLAMETHROWER"**, newest member of Texscan's PATHMAKER PLUS + Opto/RF family. Features include a high performance, low noise, dual or single LASER LINK detector, and a high-powered RF distribution amplifier. Typical FTB system performance is nothing short of impressive.* **"Node-to-node"** RF REACH> 3.0 km.
Subscriber tap performance: CTB > 53 db, CSO > 53 db, C/N > 50 db
Make sure your goals are in REACH.

*10 db optical loss budget, 77 channels, .625 inch coax, with up to 4 ports and 3 LE's.

Texscan
PATHMAKERS IN TECHNOLOGY

SEE THE "FLAMETHROWER" AT THE NCTA SHOW IN ATLANTA. TEXSCAN BOOTH #2330.

Reader Service Number 68

WHAT'S AHEAD

Scientific Atlanta

Scientific-Atlanta offers technical training for subscriber products for customers as well as advanced training for the industry. The following seminars will be held at the Holiday Inn Crowne Plaza/ LAX in Los Angeles, Calif. Contact Sylvia Rogers at (800) 722-2009 (Press 1, then 2) to register or for additional information.

May 8 Headend and Earth Station Systems Training

May 9 Distribution Systems Training

May 10 Fiber Optic Systems Training

SIECOR

Siecor Corp. will sponsor fiber optic training programs designed to meet the needs of installers and users of fiber optic products. Following are dates for the program "Fiber Optic Installation and Splicing for Outside Plant Applications." For information on classes, pricing and registration call, (800) 634-9064.

August 13-16
December 3-6

ComNet

May 30-31 *ComNet Co.* is offering a two day seminar on RF Broadband LAN to provide practical insight and application know-how. The seminar is interactive and vendor independent. The fee is $795 per person, a 10 percent discount will be applied for three or more from the same company. The seminar will be held in Arlington, Texas. For info call, (512) 892-2085.

Interference Control Technologies

Interference Control Technologies is sponsoring several electronics short courses for engineers and technicians. For more information contact Elizabeth Price, (703) 347-0030.

May 7-11 "Practical EMI Fixes," San Francisco, Calif.

May 16 "Product Design to Ensure Immunity," Washington, D.C.

May 17 "EMC for Systems Engineers," Washington, D.C.

May 18 "EMC for Managers," Washington, D.C.

TRADE SHOWS

Canadian Cable Expo **June 3-6** Edmonton, Alberta. Contact Christiane Thompson, (613) 232-2631

BPME & BDA Seminar **June 10-14** Las Vegas, Nev. Contact Gregg Balko, (213) 465-3777

SCTE **June 21-24** Nashville, Tenn. Contact Anna Riker, (215) 363-6888

Colorado Show **July 12-14** Breckenridge, Colo. Contact Rebecca Scoggins, (303) 863-0084

CTAM **July 15-18** San Diego, Calif. Contact Christina Nelson, (703) 549-4200

NECTA **July 29-Aug 1** Newport, R.I. Contact Rosemary Vozzella, (617) 843-3418

Eastern Show **September 16-18** Washington, D.C. Contact SCTA, (404) 255-1608

Great Lakes Cable Expo **September 19-20** Indianapolis, Ind. Contact Dixie Russell, (614) 272-0860

Atlantic Show **October 2-4** Atlantic City, N.J. Contact Rhonda Moy, (609) 848-1000

Wireless Cable Association **October TBA** Location TBA. Contact Conifer Corp., (202) 452-7823

HUGHES AIRCRAFT COMPANY

Hughes Aircraft Company's microwave communications products has announced its 1990 schedule of technical training seminars on its AML microwave equipment for local signal distribution. The Broadband seminar focuses on the new family of AML broadband transmitters, amplifiers and repeaters, while the Channelized seminar emphasizes the traditional AML STX-141 and MTX-132 channelized transmitters. For more info call, (213) 517-5629 or (800) 227-7359, ext. 5629 outside Calif. and Alaska.

April 30-May 4 Channelized
July 23-26 Broadband
Sept. 10-14 Channelized
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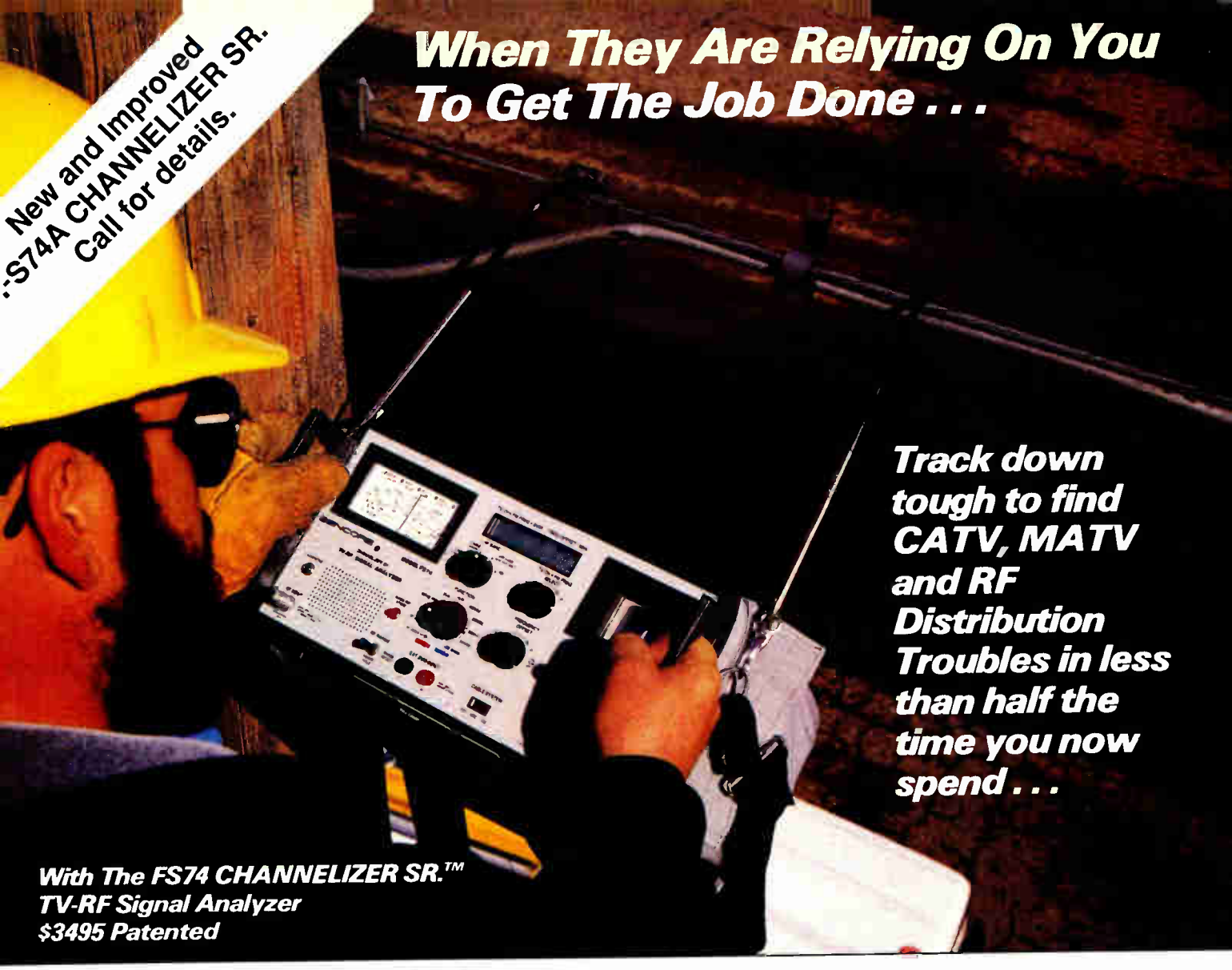

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The FS74 CHANNELIZER SR. gives you one integrated CATV and MATV troubleshooting and performance testing system that gets the job done right and fast.

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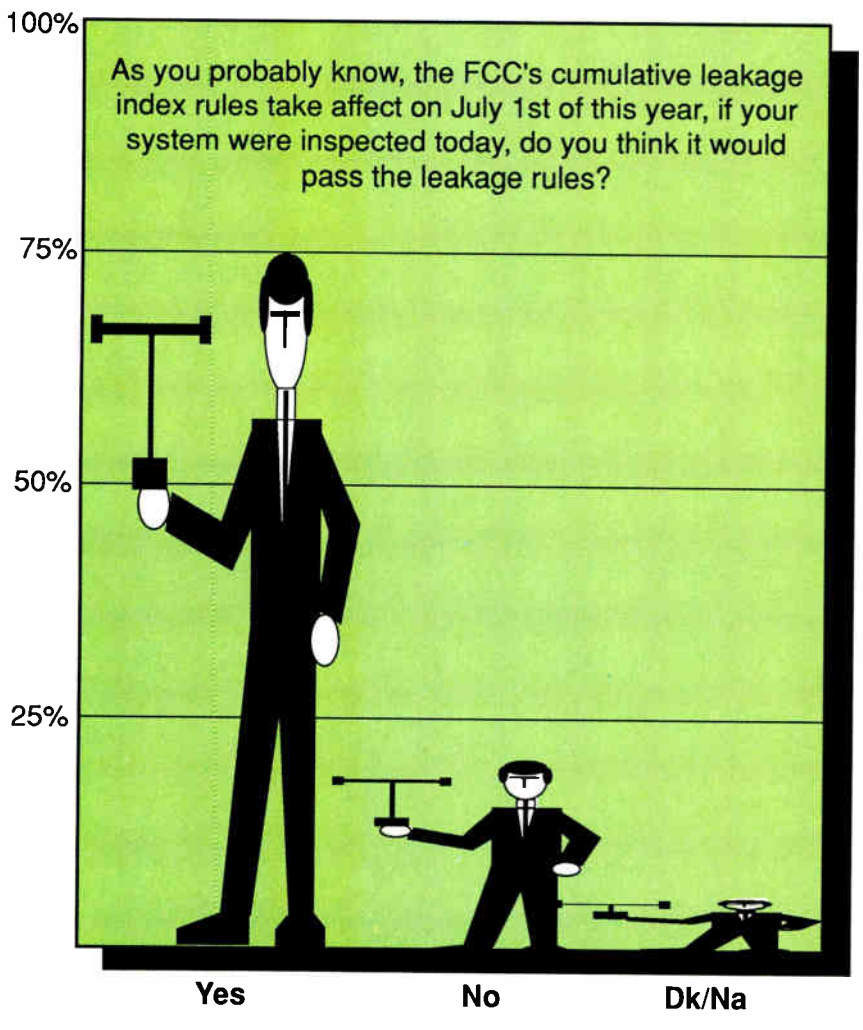
Cable operators implementing CLI compliance programs before July 1 FCC rules kick in



Despite a Federal Communications Commission official's forecast at the last Atlantic Cable Show that the agency expected about 60 percent of the country's cable systems to fail the agency's new cumulative leakage index rules, 76 percent of the respondents to The Cable Poll™ survey last August said they would pass the test.

In the latest survey commissioned by Midwest CATV, *CableVision* and *CED* maga zine conducted in February, 94 percent of the 396 reporting systems said they have developed a plan to correct leaks, and 95 percent said they presently own equipment to test signals to insure CLI compliance on an ongoing basis.

Fifty percent said they completed work on correcting leaks. That's interesting, considering that when the survey was last taken in August 1989, 81 percent said they completed work on correcting leaks, signifying that the cable industry has been well aware of the need to be prepared for the forthcoming CLI rules.

However, 67 percent of the respondents in the latest poll believed that the FCC did not have the authority to permanently take away a cable system's right to cablecast some channels. In fact, 6 percent said the FCC couldn't levy monetary fines for non-compliance, while 16 percent said the FCC couldn't temporarily remove some channels.

"That's their opinion," responds John Wong, assistant chief of the FCC's

cable branch. Apparently, those respondents weren't aware of the FCC ordering Paragon Cable of Graham, Texas to close down an unprecedented three mid-band channels and pay a $4,000 fine last November.

Wong can't estimate how many systems would fail today because the FCC's internal statistical reports won't be available before July or August.

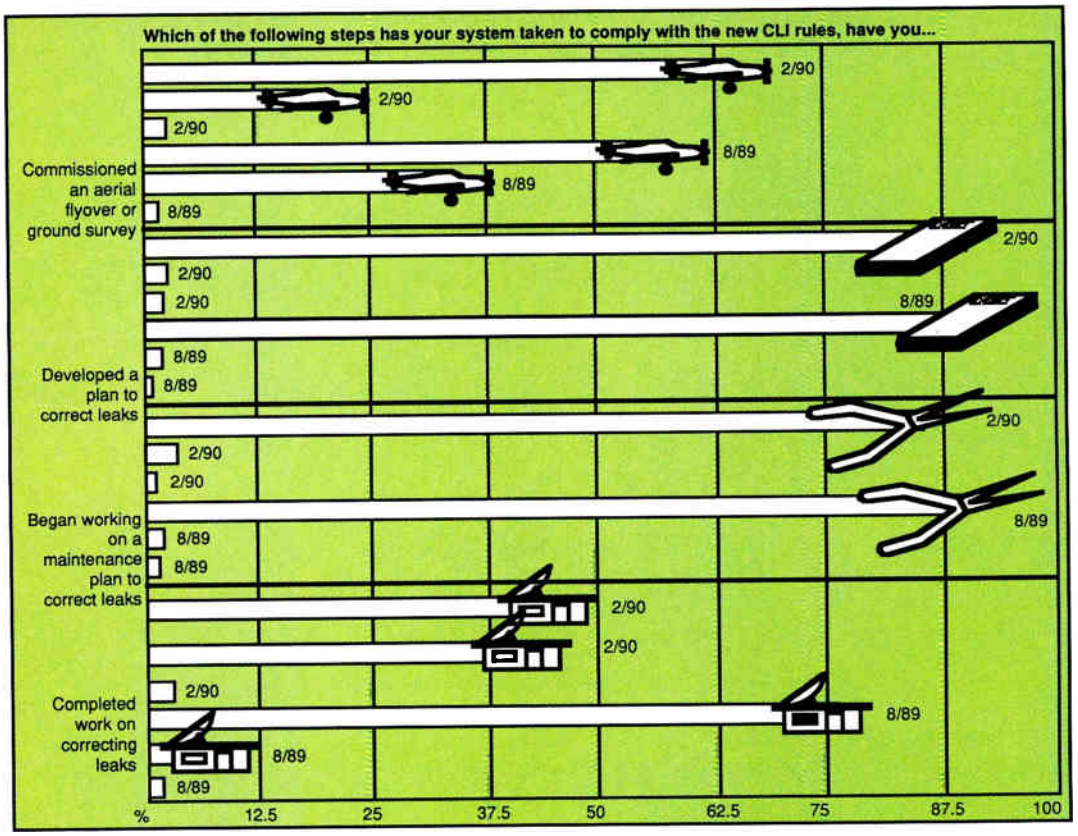
However, Wong senses that many operators "have gotten into high gear" since October.

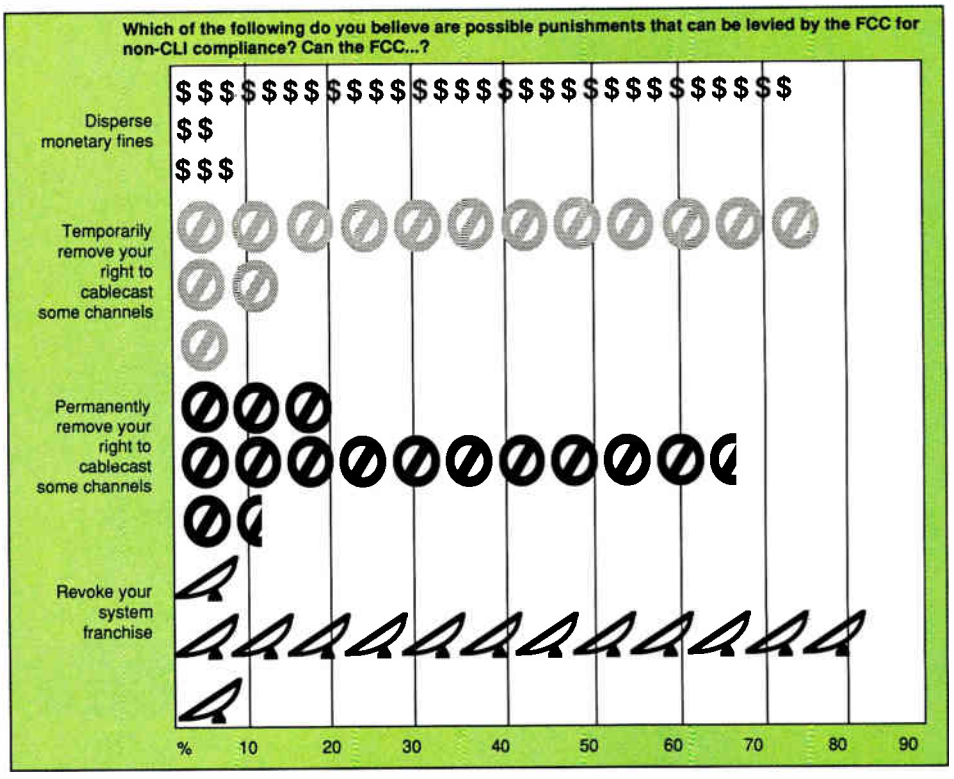
According to the Cable Poll™, the size of system doesn't figure heavily in whether operators are making investments to insure CLI compliance, since 92 percent of the respondents with less than 10,000 subscribers and 94 percent with more than 50,000 subs said they own equipment to test signals on an ongoing basis.

But the size of MSO apparently does make a difference. Ninety-nine percent of both the MSOs in the top 25, and those that rank from 26-100, reported that they own the CLI equipment. However, once past the top 100 into mom-and-pop cable land, those operators with the equipment dips to 85 percent.

Also showing that the cable industry is getting ready for the rules is that percentage of systems that commissioned an aerial flyover or ground survey jumped from 61 percent in August 1989 to 72 percent in Feburary 1990.

Wong says the key for operators is continuous monitoring. "Systems can't be fixed overnight. Even though you fix a leak, a new bunch can crop up the next day. It could be squirrel season," he sums up. ■





Using cable's 'radar'

The following article on TDRs has been presented at numerous SCTE chapter meetings throughout the country.

The Time Domain Reflectometer or 'TDR' is kind of a big name for 'cable radar.' But simply put, the TDR sends a radar pulse through the cable and displays the reflection. How you analyze this information is just as important as the information itself. The following is a conventional example and an unconventional example of how these little electronic boxes can be very accurate in locating faults in your system.

The first thing we need to do is read the operators manual for the specific model you are using. Get familiar with all of the controls and be sure to check for safety precautions.

By J.R. Johnston, Outside Plant Manager, TCI Cablevision of Wyoming

The conventional method

1. You need to know the velocity of propagation of the wire you are dealing with. This information is in the manufacturer's catalog for the wire. Set the controls for the number in the book—most newer coax has a propagation of around 85 percent.

2. Disconnect the wire under test from any active system, you don't want RF or AC on the line. Having RF on the line can only injure accuracy, but AC on the line may be a hazard to you and damage the TDR.

3. Connect the TDR to the line under test. Use the controls on the set to determine the distance to the fault.

The unconventional method

1. Set the propagation on the TDR in any locked propagation setting. (Some have a variable switch and for this test we want locked mode.)

2. Locate the line to be tested with a underground locator (visually if an aerial line of course).

3. Accurately measure the length of the cable to be tested. This needs to be done with a wheel or measuring tape. We will call the full length of the cable 'Distance C' in the formula we will crunch after we make other measurements.

4. Disconnect the wire under test from any active system.

5. Connect the TDR to the line under test. Use the controls on the set to determine the distance it says to the fault. We will call this 'Distance A' for the formula.

6. Now go to the other end of the coax and measure back to the fault. This is 'Distance B' for the formula.

7. The magic formula (Distance A*X) + (Distance B*X) = Distance C.

Example:
'Distance A' is 120 feet
'Distance B' is 150 feet
'Distance C' is 300 feet
(120*X) + (150*X) = 300

THANKS BRAD!

N.S.C. **N.S.C. Communications Contractors Inc.**

26941 Cabot Drive, Suite #130, Laguna Hills, CA 92653 (714) 582-2070

February 8, 1990

Riser-Bond Instruments
505 16th Street
P.O. Box 188
Aurora, Nebraska 68818

Gentlemen,

I am writing to express my appreciation and admiration for a TDR we recently purchased from your firm. We have been involved in CATV Construction since 1974 and have utilized various types of test equipment during that span. The last five years, however, has found us devoting more and more of our energy to retrofitting and the upgrading of existing plant, necessitating the purchase of several TDR's.

Recently, one of the larger MSO's decided to TDR their plant prior to retrofitting, an idea with which we were in complete concurrence. The time constraints for this project, and the requirement of tape back up, convinced us that an additional TDR was mandatory, and we decided on your model #1210.

We have consistantly been using this TDR seven hours a day or more during the four months of the project and have not been disappointed. This unit alone has identified good and bad cable of appproximately 75 miles in the most adverse weather conditions. We have printed over 50 rolls of paper, and to our pleasant surprise, the TDR functions with the same competance now as when it first arrived.

We believe the model 1210 is ideally suited to our industries needs, and that you should be commended for it.

Respectfully yours,

Brad Majoskey
President

BM/bm

Model 1210
TIME DOMAIN REFLECTOMETER
CABLE FAULT LOCATOR

$4,395 Complete

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402-694-5201

RISER-BOND
INSTRUMENTS

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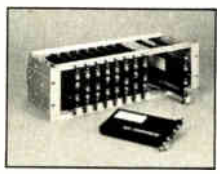

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INSTRUMENTS

270*X = 300
X = 300 / 270
X = 1.1111

Now put X back in the formula and see how they add up.

(120*1.1111) + (150*1.1111) = 300
133.332 + 166.665 = 300
229.997 = 300

As you can see it is very close and is certainly close enough to start actually looking for the problem.

Let's compare the advantages and disadvantages of both methods.

First the conventional method.

Advantages: Faster, fewer steps in the process; very accurate if all information is correct; can pinpoint 21 major problems from each direction.

Disadvantages: If the propagation of the cable has changed or the TDR is out of calibration, the final reading will be wrong.

Now the unconventional method:

Advantages: The formula corrects for any ERR in propagation or the TDR being out of calibration.

Disadvantages: If more than one major problem exists in the line, the formula is not accurate; requires measuring wheel and calculator.

Both methods work very well and if you are accurate, the measurement will be also. The key is to be precise with your informatioin and that way you will only have to dig that cable up once. ■

Fiber technology changing rapidly

Further signs that research into fiber optic technology is advancing at a very rapid pace and cable system operators are moving ever closer to a wholesale acceptance of the technology were clearly evident during the three-day SCTE Fiber Optics 1990 seminar, held in Monterey, Calif. in late March.

More than 400 attendees registered for the seminar and heard 19 speakers address a wide variety of subjects—from how to install fiber to what to expect in future product developments. But most of the attention was centered around a new architecture proposed by ATC and development of a digital fiber system by Jerrold Communications.

Perhaps the most noteworthy presentation was made by Jim Chiddix, senior vice president of engineering and technology at American Television and Communications. Chiddix proposed a new fiber architecture, dubbed "Fiber Trunk and Feeder" (or FTF), that could be used in systems that need total rebuilds. (ATC's "backbone" architecture was designed to be used in systems that only need electronic upgrades to expand channel capacity.)

In essence, FTF would run fiber from the headend to several repeater stations, where the signal would be boosted, and then sent out over more fiber to secondary nodes, where it is converted to RF and sent to the subscribers' homes. (For complete details on this architecture, see page 28.)

Eliminates amplifiers

According to Chiddix, this design eliminates all trunk and bridger amps and creates a maximum cascade of only three bridger amps. Although he concedes the concept will utilize more fiber cable, which costs more than traditional coaxial construction, Chiddix

says the additional cost can be absorbed because far fewer amplifiers need to be purchased. Additionally, Chiddix says FTF prepares systems for the eventual integration of optical amplifiers (which he says are "not far away") and could allow for optical redundancy by tying the repeater sites together.

Although it's not yet been developed, Chiddix says the repeater sites could be built using today's technology. Because they don't transport signals very far, low-grade distributed feedback lasers or perhaps inexpensive Fabry-Perot lasers could be used, he says.

Cost projections made by ATC engineers call for the cost of the optical repeater to be about $23,000, while secondary nodes cost $500 and each line extender prices out at $166 each. Plugging those numbers into a 250-mile system would result in the expense of $575,000 for all fiber, construction and active components. This compares well with a capital expense of $717,000 using traditional coaxial means. "And you get a system that's progressive and easier to maintain," Chiddix says.

The FTF system would be able to provide a 46 dB carrier-to-noise ratio at the tap with composite triple beat at -54 and composite second order at -60 dB. The link budget is 10 dB to the repeater site (10 to 12 miles) and 1.75 dB to the secondary hub. These numbers are not as progressive as the "backbone" architecture but because signals are sent via fiber deeper in the plant with FTF, performance is not as critical.

"This is not the final answer on how to build fiber plant," says Chiddix, "but fiber breaks the rules (of architecture). Maybe those old rules don't make sense anymore."

While some industry experts expressed initial skepticism about ATC's cost forecast for the project, others were genuinely excited about the possibilities it presents. Several manufacturers have looked at the proposal and some have already begun product development, *CED* has learned.

FTF is designed for systems which don't exceed a distance of 16 miles in radius from the headend. This new architecture is being used in a 250-mile portion of a total rebuild of ATC's Marion, Ind. system, Chiddix concluded.

As an aside, Chiddix proposed new definitions for the words "supertrunking" and "trunking" or "backbone." In order to clear up a lot of misunderstanding, Chiddix says any link serving an area with eight or more amplifiers in cascade should be called a supertrunk while anything serving an area of fewer than eight amps in cascade should be referred to as a trunk or backbone.

Digital supertrunking

Despite the excitement created by proponents of AM transmission, significant work is being performed on digital systems designed specifically for point-to-point supertrunking applications. John Griffin, manager of digital programs at Jerrold's Applied Media Lab, presented the sum of his work on a 16-channel, nine-bit system which utilizes time division multiplexing to distribute baseband signals for multiple channels.

Although Griffin quickly pointed out that the system is not yet a "product," he did point out that significant progress has been made technologically that takes advantage of recent developments made in the semiconductor and optical component industries. His presentation consisted of photographs of bench prototypes of logic boards, GaAs multiplexer as well as the comb filter the system uses for clock recovery.

But much of the seminar focused on the more practical issues surrounding fiber optics. Discussions on how to determine if fiber optics makes economic sense for specific systems took place, as well as tutorials on how to actually install fiber cable for both aerial and underground applications.

Much of the doom and gloom surrounding the issue of who will wire America first with fiber was dispelled by Gary Kim, senior editor of *Multichannel News*, who presented a paper on fiber architectures used by telephone companies. Kim says telcos discovered that fiber to the home cost much more than the companies originally thought it would and most, if not all, of the Regional Bell Operating Companies have abandoned plans for widespread deployment of fiber to the home, opting instead to develop "fiber to the curb" technology which takes fiber to a neighborhood location and uses coax for the final drop.

Because of this, Kim concluded that cable operators were in the advantageous position of being able to deploy these networks first, without legal barrier. Kim urged the operators to prepare for competition in this area and suggested MSOs begin installing fiber wherever they can as soon as they can.

—Roger Brown

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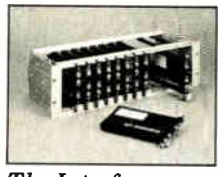

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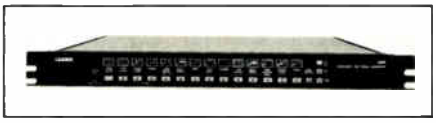
is also available with 1, 2, 4, 8 or 16 output connectors to be used to launch into cables containing many fibers. The FLS-220 series offers stability better than 0.01 dB over one hour, very fast stabilization time, high output power and an optional RS-232 and IEEE-488 computer interface. Call (418) 683-0211 for details.

Videotape editing system

Channelmatic, Inc. is now offering a complete line of automated videotape editing systems. The systems can be purchased as individual components or completely racked, wired and installed by individual studios. The Comp/Editor series includes: the low end product, ECU-300, a full-featured 3 VCR A/B roll system; the mid-range product, the ECU-400, a full-featured four VCR control editor with continous roll capability; and the high end product, the ECU-600, capable of controlling six VCRs and has continuous roll, fit and fill variable speed calculations, slow motion learn/replay reported to EDL and E-MEM effects for switcher, upload/download. Software and hardware modules can be added to provide CATV spot-reel compiling capability and tape location marker encoding. For additional info call, (619) 445-2691.

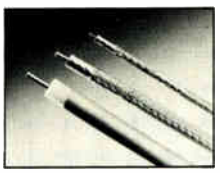
Channelmatic's Comp/Editor Series



Leader's Model 425 component video test signal generator

Available from **Leader Instruments Corp.** is the Component Video Test Signal Generator, the Model 425. The 425 features a patent pending special timing signal, called a "shark fin" pattern, that improves observation of relative timing over a wide range of frequency. The 425 complies with RS-170A and generates 23 kinds of component test signals, including color bars, 100 percent line sweep, 5T, 2T pulse and bar and nine kinds of composite test signals including 100 percent multiburst, red raster and five-step staircase. For details call, (516) 742-2022.

Comm/Scope Inc. has announced an improved Plenumax plenum coaxial CATV cables to meet stringent NEC Article 820 standards for smoke and flame propagation. The CATVP rated cables are available as RG59, RG6 and RG11 drop cables as well as 0.500 inch and 0.625 inch aluminum sheathed trunk cables. Because of Plenumax's CATVP rating, conduit is not necessary. With the Kynar jacket, Plenumax is abrasion-resistant and FEP (fluorinated ethylene propylene)/dielectric Kynar jacket construction lets Plenumax pass all critical UL fire tests, including the Steiner Tunnel flame test. For more info call, (800) 982-1708 or (704) 324-2200 in N.C.



Comm/Scope's plenumax cable

A new solid state microwave repeater has been introduced by **Hughes Aircraft Company's** microwave products division. The Model IBBR-124, an AML broadband repeater, is designed to permit cable operators to extend existing signal paths farther than was previously possible, and to implement paths where direct line-of-sight transmission is obstructed. The on-frequency

active repeater amplifies signals received from the primary microwave transmitter and retransmits them to new or secondary cable hub sites. The IBBR-124 provides 8.5 dB higher output capability than the FFR-123 repeater and 18 dB higher output than the MWB-122 repeater, allowing extension of microwave path lengths. For additional details call (213) 517-6233 or (800) 227-7359, ext. 6233 outside of Calif. and Alaska.

Biddle Instruments has announced two new digital ground testers, the DET/3 and DET/5. Both testers provide greater resolution in three resistance ranges from 0.01-1999 ohms for applications ranging from single-driven rod systems to complex grids. Measurements are displayed on a 3½ digit LCD. The instruments provide accuracies of ±2 percent of reading, ±1 digit at -23 degrees centigrade and also warn of excessive input noise or high current probe resistance that could interfere with the measurement.

Biddle's DET3/5 ground testers

A four-range, battery-powered, handheld time domain reflectometer (TDR) cable fault locator is also now available from Biddle Instruments. The pushbutton operated tester provides a cable trace up to 9,500 feet in length. The instrument will identify and locate opens, shorts, taps, splits and resplits, along with water saturation on cable. Accuracy is better than three percent of selected range.

In a final announcement from Biddle is the telecommunications/multipurpose digital TDR/radar cable test set with memory. Featuring a new splashproof control panel with membrane-type keypad, the Model 535 is a battery-powered, long-range test set with CRT display and will confirm and locate faults. For further info on Biddle products call, (215) 646-9200.

First lifeline tier trap

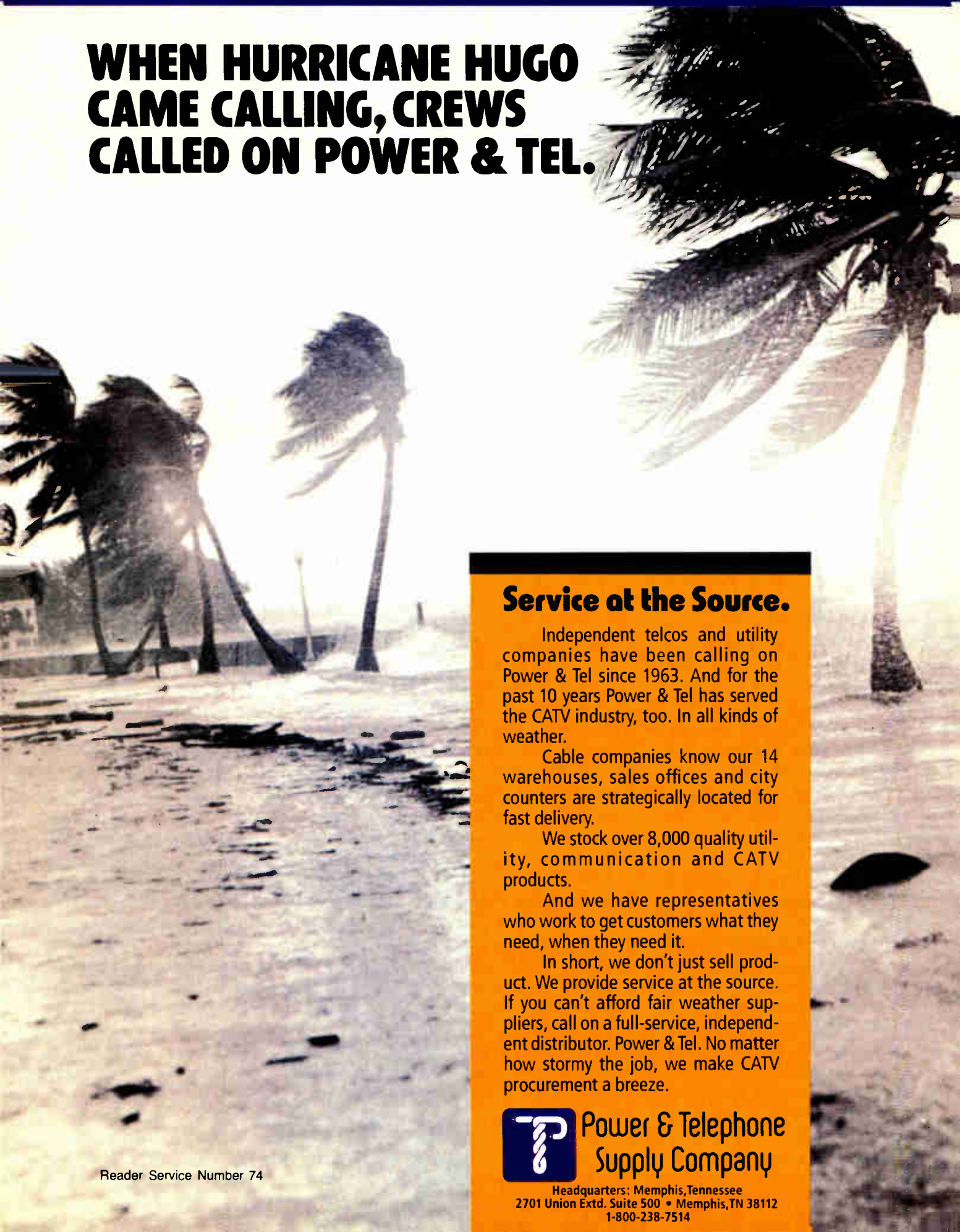
Pico Products Inc. has developed a lifeline tier trap to pass channels 2 through 6 and channels 7 through 13 with no appreciable attenuation, while eliminating all other channels. The trap is the latest in Pico's new series of PT traps, all of which incorporate patent pending temperature stability technology and welded hermetic sealing. For more info call, (800) 822-7420 or (315) 451-7700 in N.Y.

A connector insertion tool from Ripley

Ripley Company, Inc. has introduced an 'F' connector insertion tool. The IT-F59, 6, and 11 is designed to facilitate inserting 'F' connectors into drop cable. The tool is made of plastic and heat treated hardened steel and is currently available through Ripley Cablematic distributors. For additional info call, (203) 635-2200.

Andrew Corp. has announced the availability of several new products. Both its Radiax® slotted and Heliax®

WHEN HURRICANE HUGO CAME CALLING, CREWS CALLED ON POWER & TEL.



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IN THE NEWS

HELIAX® cable from Andrew.

Upgrade from Andrew Corp.

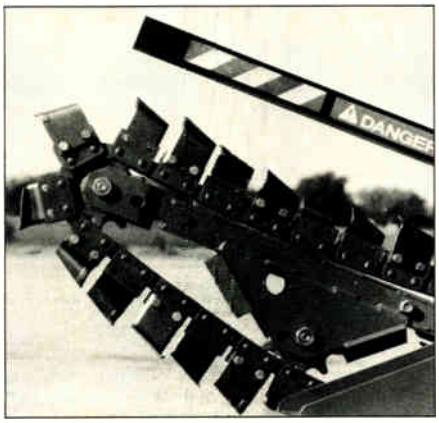
coaxial cables are now available in riser-rated, fire-retardant versions. The cables are permitted by the National Electrical Code to be installed anywhere within a building except in ducts, plenums and other air-handling spaces. They are UL listed as Type CATVR and so labeled. Radiax cables are available in CATVR versions in sizes from ¼ inch to 1⅝ inches. Heliax cables are available in sizes from ⅜ inches to 1 ⅝ inches for foam dielectric types and ½ inch to 2¼ inch for air dielectric types. Call (800) 255-1479 and request Bulletin SP30-08.

Also from Andrew is the ASC2000 system controller, deigned to monitor and control the operation of a complete satellite earth station, including antenna positioning, plus associated VCR's station alarms, and STL microwave equipment. Up to five operator consoles can be installed on the basic multi-user system. The system is controlled through a series of pop-up windows. Call, (800) 255-1479.

For Andrew TVRO earth station antennas is a new four-week availability, from order acceptance to shipping date, for standard configurations of both the 4.5 meter and 7.3 meter antennas. Both operate in either single or dual band and include either the ASR200 or ASR300 rack mountable video receivers. Andrew is also offering the upgrade of dual reflector earth station antennas to four port or six port feeds operating in both C- and Ku-bands. The upgrade includes the 7.3 meter and 10 meter antennas, non-Andrew antennas can be upgraded on a case-by-case basis. Call (708) 349-5929.

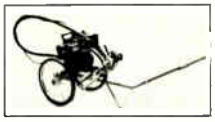
In a final announcement, Andrew Corp. is now providing higher gain omnidirectional antennas in its HMD series for point-to-multipoint transmission in the 2.5 GHz to 2.7 GHz band. The antennas, type number HMD24HO or VO and HMD32HO or VO, provide nominal gains of 16 dBi and 17 dBi respectively with VSWR less than 1.24:1 in any frequency group. Wide band versions are also available. The antennas come in top mounted horizontally polarized (HO) or vertically polarized (VO) configurations. For info call, (708) 349-3300.

A new trencher tooth and chain



The Charles Machine Works ditch witch tough tooth 90 digging assembly

digging assembly is now available from **The Charles Machine Works, Inc.** The Tough Tooth 90 digging assembly is a tooth and chain design that can dig up to twice as much trench, as much as 30 percent faster than the original Ditch Witch Tough Tooth. The assembly is available in two sizes, to fit 30-HP-class to 75-HP-class trenchers. It consists of the Tough Tooth 90 teeth and a special raised-rivet chain. For more details call, (800) 654-6481.



The Rick-Sha earth drill from Little Beaver

A fully portable earth drill has been introduced by **Little Beaver Inc.** Intended for use on rocky, difficult ground, the Rick-Sha earth drill is mounted on 20 inch hard rubber tires in order to support a 5 HP or 7 HP engine weighing approximately 150 pounds. The carrier features a pull handle for operator convenience when moving the drill from site to site. The drill has been designed for use with a large variety of auger lengths, sizes and attachments. For details call, (409) 327-3121.

Performance Technologie's Model 1200

New from **Performance Technologies** is the Performance Universal 12 volt battery tester to determine the condition of deep cycle, high capacity lead acid batteries used in standby, uninterruptable and back-up power supplies. Included in the types of batteries tested are wet cells, sealed recombination types and gel cells. Pin jacks on the tester accommodate an auxiliary voltmeter which allows precise measure-

ments during testing. An automatic timer provides a repeatable reference for the tests. The Model 1200 measures 7.47 inches by 4.33 inches by 2.24 inches and weighs 2.5 pounds. For info call, (404) 475-3192.

Scientific-Atlanta Inc. has introduced third-generation software for its Model 7670 satellite earth station control system. The Version 3.0 software adds expanded capabilities and functions to the PC-based control systm for single or multiple earth stations. For more info call, (404) 441-4000.

ComNet Company has announced an AutoCAD application drawing software package to its BSE-Pro CATV design software called BSE-Pro CAD. The software translates the design file created by BSE-Pro into user defined drawing symbols that can be overlaid onto a strand map or building drawing. BSE-Pro CAD symbol table is user defined for any system design, including amplifier title blocks that display visible attributes about the amplifier. BSE-Pro CAD requires AutoCAD Rel. 10. For details call, (512) 892-2085.

New Compulink product features have been announced by **Cable Systems Group**, a business unit of American Express Information Services Company. The new enhancements include: automatic help screens, automatic log fill, automatic make good resheduling, multiple reprints of invoices, interface with different insertion software within a single headend, verification process, enhanced pre-billing audit report and schedules which can be viewed and adjusted on screen. Call (402) 399-7341 for more details.

A new proprietary cumulative leakage index (CLI) software package is available from **CNG Energy Company**. The software is designed to interface with CARDS, a computer-aided radio dispatch system. The package makes CLI measuring, correcting and reporting more efficient—field personnel directly input CLI measurements into mobile data terminals. For additional info call, (412) 471-2463.

Also available for CLI is an illustrated training manual *Monitoring and Measuring Signal Leakage from* **Orion Business Services Inc.** The manual covers all aspects of ground-based signal leakage monitoring. The text describes and explains FCC signal leakage regulations, causes of leaks, specific leakage-detection equipment, exact leakage measuring techniques and procedures, use of maps and logs, safety practices and more. The price is $59 (plus $3 shipping and handling). For copies of the manual, call (800) 627-4123.

New promotional program

Hewlett-Packard Company has announced a worldwide promotional program under which certain HP digital oscilloscopes will be discounted by 20 percent. The discount program will apply to orders received between March 1 and August 31, 1990, for all HP 54100, 54120 and 54500 series of digitizing oscilloscopes purchased in quantities of 15 or more. Call (415) 857-1501 for info.

Rapid Systems Inc. has introduced the R4 waveform creation, generation, editing software. Users can translate mental images of waveforms into electrical signals, save the waveform in a file format compatible with a variety of arbitrary function generators (AFG). The waveform can be downloaded to an AFG to output the signal. For additional details call, (206) 547-8311.

Optoelectronics Inc. has announced the Model 2210-A, a personal frequency finder/counter. The Model 2210-A specifies an operating range from 10 Hz to 2.4 GHz and is useful to 2.8 GHz.

New personal frequency counter from Optoelectronics

It measures 4 inches by 3.5 inches by 1 inch and weighs nine ounces. It detects and displays two overlappinbg frequency ranges, from 10 Hz to 12 MHz, and from 10 MHz to 2.4 GHz; resolution is 1 Hz and 100 Hz respectively. Accuracy is ±1 PPM. Call (305) 771-2050 for info.

BK Precision's Model 377

A pocket-size test instrument with the capabilities of five separate instruments is available from **B&K Precision**. Called the Test Bench® Jr., the Model 377 is a smaller line addition to the Test Bench®. The Model 377 is a 39-range voltmeter/ammeter/ohmmeter/frequency counter/capacitance tester/logic tester/transistor tester/diode tester/continuity tester. It measures 5 inches by 2⅞ inches by 1⅜ inches and features the triple protection of reverse polarity protection, overload protection and high-energy fusing. For more info call, (312) 889-9087.

Available from **Graycor Laser Systems** is a pay-per-view and event controlling device for use in hotels and similar applications. The system has been designed to allow a subscriber to "impulse buy" or request television programming delivered via coax to the TV. The system is configured to allow for its operation as an "upstream" controller or a "downstream" controller. The computer summarizes the

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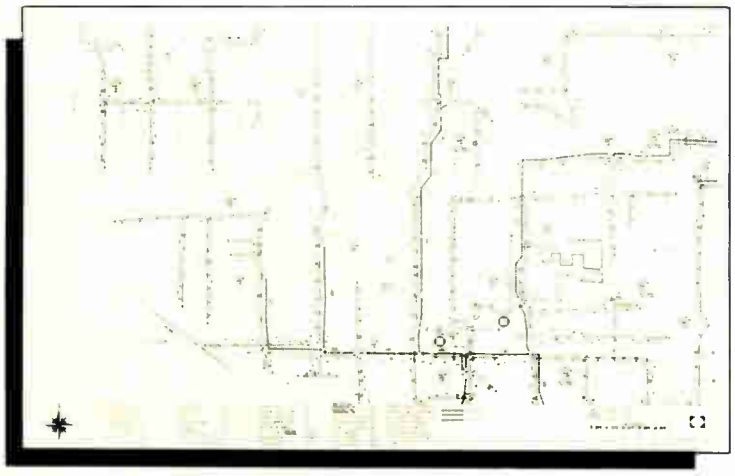

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billing totals when asked for the presentation of a "television" bill to a guest or a tenant. The upstream system requires that a return path at 10.7 MHz be available in the coax system for the transmission to the computer. The system consists of the subscriber port, a controlling program that can be run on virtually any mini or micro computer. For more info call, (602) 842-2872.

Moving up

Anixter Cable TV has named **Ed Callahan** as vice president of technology for its Denver office. Callahan will investigate new technologies for potential applications to the cable television industry and follow developments in fiber optics as well as in fields with long-term opportunities for product development. Callahan previously served as vice president of research and development for United Cable in Denver.

Ed Callahan

Arthur Sando has joined **Comsat Video Enterprises** as vice president of marketing and communications. Sando leaves a similar position at Turner Broadcasting System Inc. where he was employed for nine years.

Arthur Sando

North American Philips Corp. announced that **Dennis J. Horowitz**, formerly president of Magnavox CATV Systems, Inc. has been appointed President of Philips Components Discrete Products Division. Succeeding Horowitz as president of Magnavox is **Dieter B. Brauer**, formerly vice president of engineering for Magnavox. Horowitz joined North American Philips in 1980 and was appointed president of Magnavox in 1987. Brauer, a 20-year veteran of the cable industry, joined Magnavox in 1987 as vice president of engineering.

Cencom Cable Associates Vice President for Technology and Planning, **Larry N. Lehman** has been named chairman of the Technologies for New Business Subcommittee on the **Cable TV Laboratories Inc.** (CableLabs) Technical Advisory Committee (TAC). The charter for the committee is to identify and study the potential new technologies have for fostering new business opportunities for cable companies.

CableLabs has also named **Dr. Aleksander T. Futro** to serve as director of technology assessment. In this capacity, Futro will be responsible for identifying, evaluating and assessing new technologies for its applicability to the CATV industry. Futro's experience covers more than 15 years of applied research and development work in research institute and academia environments.

Stephen Dukes was named by CableLabs as the project manager for advanced network development. In that capacity, Dukes will work with the TAC Network Development Subcommittee and with the Labs Business Development and Technology Transfer office in evaluating cable industry network architectures.

In a final announcement, CableLabs has hired **Suzanne Nielson** to work as a technical writer in the Labs Clearinghouse.

—Kathy Berlin

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BUSINESS DIRECTORY

A gradual move to Mood Guides

Last month we discussed the motivations for an Electronic Program Guide and hinted that there was an interesting potential to make TV more enjoyable via cable than any other way. This month we'll explore that further.

The concept behind the Electronic Program Guide involves a data stream which carries program guide information to the subscriber. This can be accomplished in the vertical blanking interval or possibly on a separate carrier. The advantage of the latter approach is that it is continuously present. Doing this in the vertical blanking interval would require either that all channels carry the information (expensive) or that the subscriber's device tune to specified channels when data is required. It has been pointed out that a further advantage to the subcarrier approach is that cable's competitors may not have a subcarrier available to them.

Electronics generate the video at the subscriber's premises. This saves a valuable channel on the cable system. This also permits a better display if the television can be driven at baseband through RGB ports or a Y/C plug. This, of course, is MultiPort compatible.

The subscriber uses a menu structure to quickly locate the desired information, bypassing all that is of little interest. Once the information is put on the screen, it stays there as long as the subscriber wishes. Supplementary information giving details of the programs' content can be added almost without limit. Cross referencing other programs, even on other channels, that may be of interest to the viewer can be easily accommodated. The correct time and date would be continuously available. Parental advisory information regarding content can be offered.

A business decision is required regarding fees for the service. If it is intended that this be a service for which charges are made, then the usual addressability and encryption issues arise. If, on the other hand, this is viewed as a retention tool with no separate fees, the hardware becomes much simpler. The potential for cooperation from the consumer electronics industry also increases. Hardware ownership issues are simplified as well. Implementation options then include 1) a separate box, 2) building the circuits into the cable box, 3) inclusion in the TV receiver, and 4) incorporation into the VCR.

While this sounds a bit like Teletext, implementation can be done in many ways. An advantage of a Teletext implementation is the availability of inexpensive, off-the-shelf integrated circuits and origination equipment.

Information age service

This is an "Information Age" service which is useful, available when consumers want it and available at the point of use. The subscriber benefits by obtaining maximum utility from his TV, VCR and cable subscription. He no longer misses interesting programs. The cable operator benefits from a more satisfied subscriber, better retention, perhaps increased pay and pay-per-view sales, and eventually getting back the channel now lost to the program guide. Programmers benefit from increased viewership. Manufacturers benefit from hardware sales.

But the problem is still not completely solved. Operating the VCR is complex. This situation is much worse if there is a cable converter ahead of the VCR. The VCR's timer can't operate the converter. It can't turn it on and off. It can't change channels.

The next step is to electronically identify each channel, probably with a vertical blanking interval signal. This identification can include the program title and date, the scheduled start time and program duration, an indication if the program started late, the elapsed time and the time left. The subscriber should be able to display any or all of this information on-screen at any time.

The data can be organized in several different ways simultaneously. The subscriber who prefers channel numbers can have such a menu. Menus can also be constructed based on network names: HBO, CBS, CNN, etc. The listing can also be by program name without reference to channels or networks at all. For many subscribers, channel numbers and network names become obsolete concepts.

The channel information can be used to automatically set up the VCR for later recording. Most of us are familiar with the disk directory structure used with personal computer floppy disks. A similar record of contents can be placed at the beginning of VCR tapes. The VCR can now keep track of recordable time left on a tape to determine if there is enough time left to record a desired program.

While any of the implementation options described above are possible, the one that makes the most sense is to build it into the VCR. Because the turnover of VCRs is much higher than of TVs or cable boxes, the VCR roll-out strategy takes place much faster. Also, the subscriber, rather than the cable company, owns the hardware.

The Mood Guide

The ultimate evolution of this concept is the "Mood Guide." Consumer research should be implemented to determine the variety of moods subscribers bring to their viewing experience. Possible candidates include: adventure, comedy, education, sports, news, science fiction, etc. The program identification signal includes a characterization of the moods appropriate to that program. When the viewer turns on his equipment, a menu appears which requests that he indicate his current mood. He then is advised of what is available now to satisfy that mood and what might be recorded for later viewing. A personal program guide can be created by listing, separately for each family member, the programming that satisfies their individual tastes. Numerous opportunities for custom features exist.

While this may be an awful name, "The Mood Guide" is descriptive. Marketers are welcome to choose a better appellation. ■

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

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