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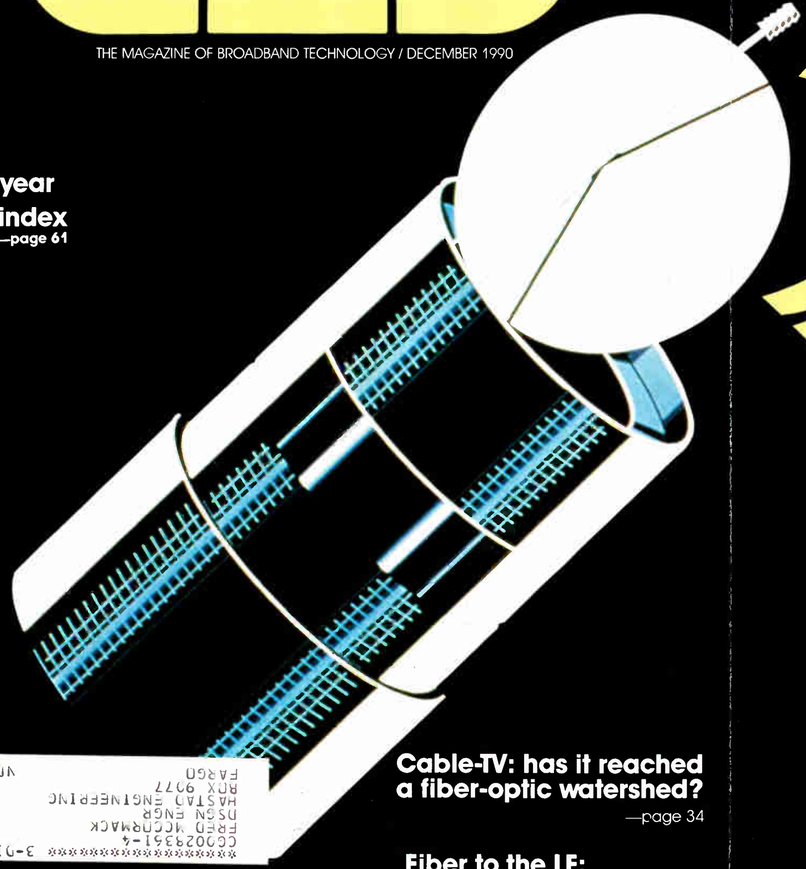

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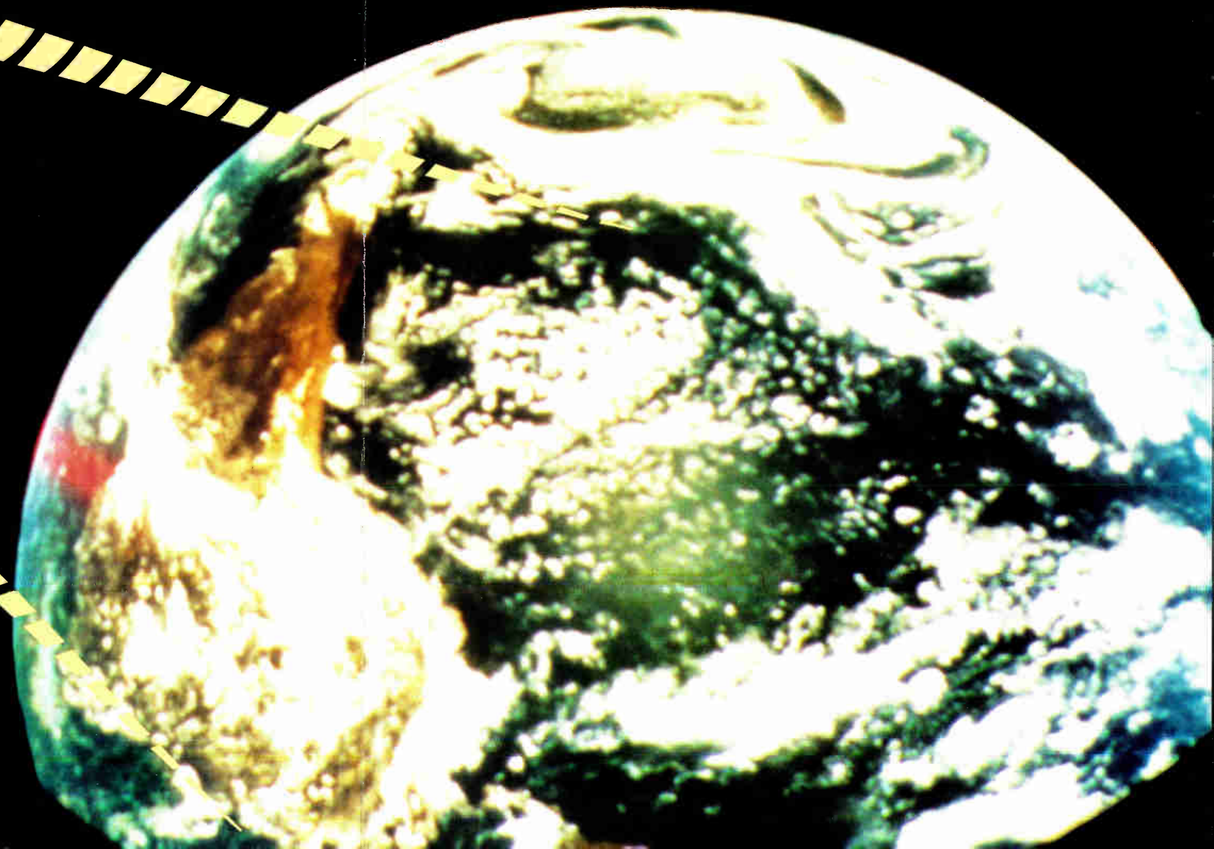

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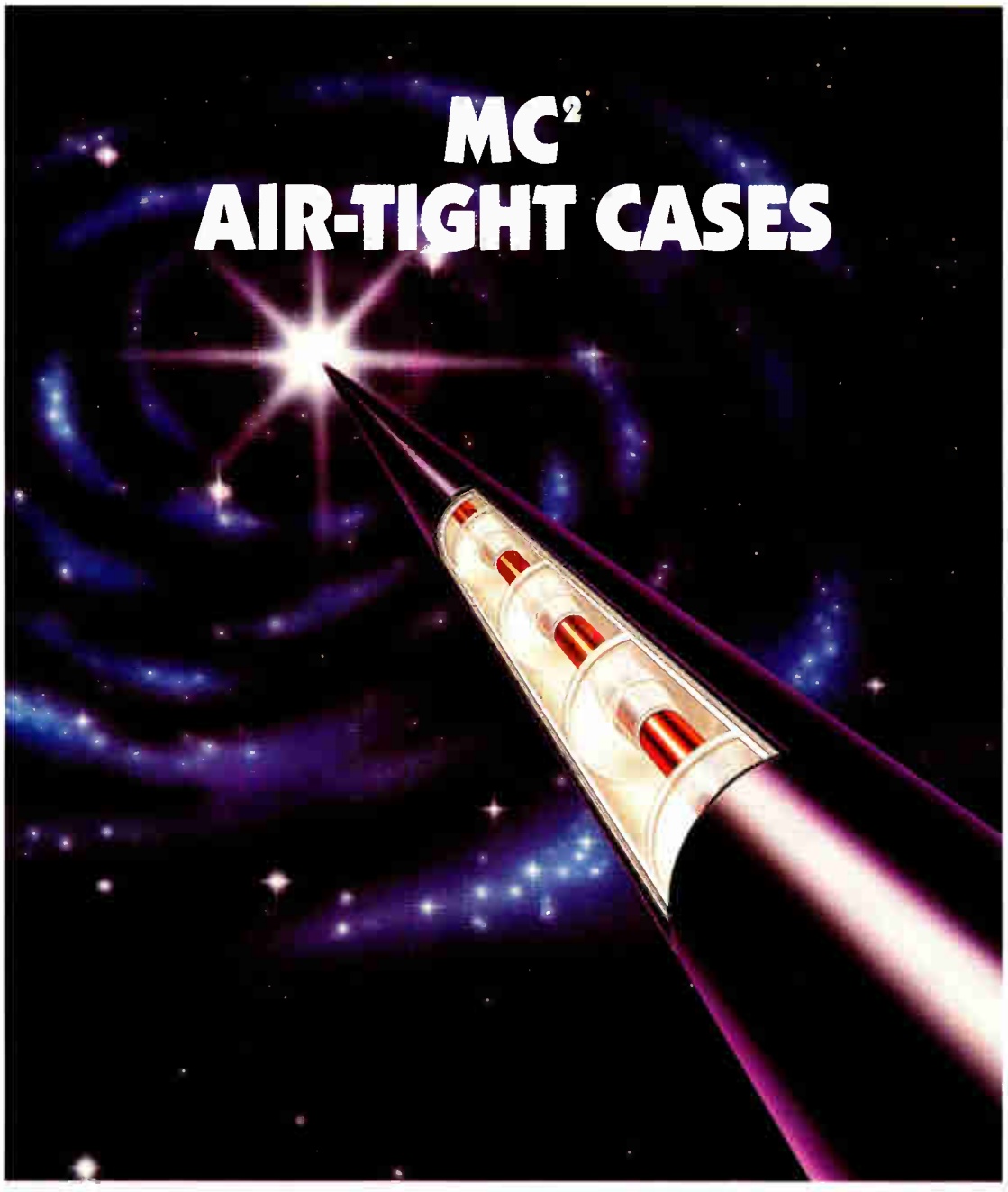

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December 1990 CED Volume 16, Number 13

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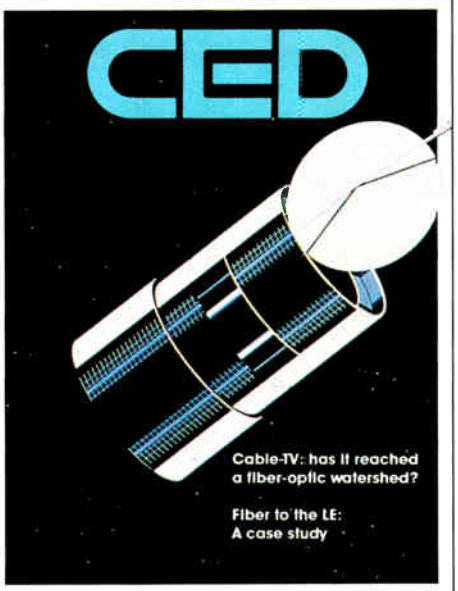

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On-board intelligence is but one of the geatures slated for future satellites. Photos from the Image Bank.

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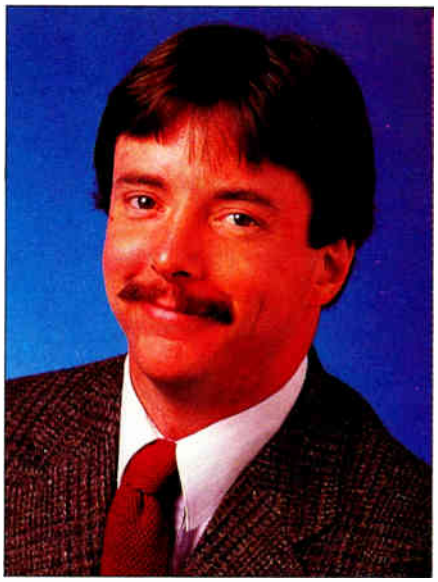
Reader Service Number 4

Taking on the telcos via PCNs

Three years ago the new industry buzzword was "fiber." Two years ago it was "HDTV." This past year it was "interdiction." What's the next one? I can't say for sure, but if I were to wager on it, I'd bet on "PCNs" (personal communications networks).

As columnist Jeffrey Krauss points out in this month's Capital Currents (page 26), the PCN is a wireless, low-power and therefore short distance voice commmunications service that has caught the attention of several cable-television MSOs. Cox Cable and Cablevision Systems have already notified the FCC they want to experiment with the technology. Others will probably follow suit after they investigate the opportunities.



The key to the future of PCNs lies with the FCC, which must decide whether the networks should be considered part of the public switched network or a competitor. Given the current Washington climate, which seems to favor a free communications market (at least most of the time), it's reasonable to assume that PCNs will be competitors to local phone companies.

You can expect heavy lobbying by the telcos to restrict access to PCNs by cable companies without quid pro quo—namely, the relaxation of regulations which prohibit entrance into cable-TV. In the meantime, cable operators should get busy and learn about PCNs. CATV networks have the perfect infrastructure for these networks.

Ultimately, PCNs will probably end up being the issue that drives the cable/telephony issue out from behind closed doors. As cable operators have adopted fiber optics as its new transmission medium, the possibility of offering local telephony services has been an unstated, yet understood, opportunity. Already, system operators are hinting of intentions to explore the new possibility.

Once again the telcos could find themselves on the outside looking in. As Krauss astutely points out, we'll probably see joint ventures between operators like Cox and cellular operators like Cellular One. The revenue possibilities of such an arrangement are as yet unknown and depends to some degree upon the technology and its cost, but the smart cable operator will begin that inquiry sooner rather than later.

All that should add fuel to Jim Chiddix's comments regarding telcos and cable (see page 28). CATV is in the catbird seat, but will it capitalize on the opportunity?

Roger J. Brown

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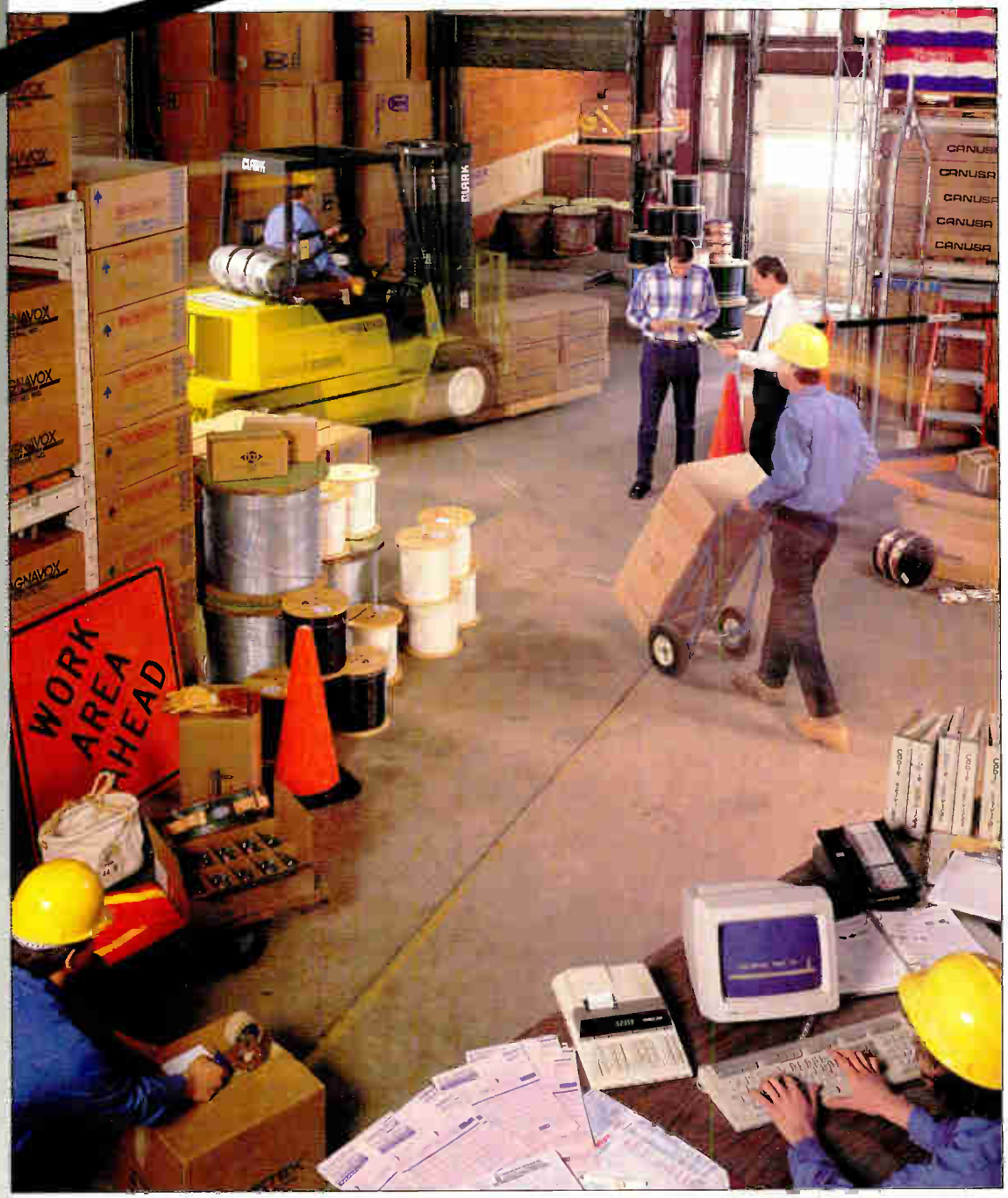

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Reader Service Number 5

Brad/PTS becomes ConTec; plans product expansion

Flush with more than $10 million in new capital and a new management team, Schenectady, N.Y.-based BradPTS has changed its name to ConTec International. According to new Chairman Danny Cachuela, ConTec plans to expand the company's existing converter and remote control product lines, perhaps add new product lines and revitalize its ailing converter repair business.

The new funding comes from Westinghouse Credit Corp., which upped its investment in the company from $10 million to more than $20 million, said Cachuela. ConTec is expected to announce key members of its new management team, including a chief financial officer and a vice president of sales and marketing at this year's Western Show in Anaheim, California.

"This company has numerous untapped resources and talents that were previously underutilized. Through. . . Westinghouse, we have received healthy refinancing that allows us to realize the full potential of our products and services," said Cachuela. A new corporate culture focusing on quality and customer service will also be created, according to Cachuela.

This will result in new OEM agreements with converter manufacturers and exclusive contracts with MSOs, some of which will be announced in the near future, he stated.

In the interim, management turnaround experts Morris Anderson and Associates as well as the CEO Group, a marketing, sales and operations company, will assist in ConTec's rebirth, under the supervision of Cachuela.

ConTec will keep its eight regional field offices, located in: Bloomington, Ind.; Fenton, Mich.; Seattle, Wash.; Longview, Texas; Tampa, Fla.; West Columbus, S.C.; Ventura, Calif.; and Schenectady. The company will be fully staffed to an excess of 300 persons who perform 14,000 converter repairs and upgrades per week and maintain an inventory of more than 200,000 converters, said Cachuela.

Although the company plans to remain focused on its present business for the next year, it desires a better mix of products and services. It will probably expand its headend and line gear business and perhaps pursue the satellite receiver repair vocation.

Western Show preview features fiber, interdiction

Early glimpses into new product introductions planned for the 1990 Western Cable Show sound some familiar themes: outdoor addressability and fiber optics.

Several companies are expected to follow Scientific-Atlanta's lead and demonstrate or introduce interdicting, "off-premise" devices which scramble video signals outside the subscriber's premises and provide a broadband feed to the home. S-A, which debuted its product last year, has experienced some success with its device.

Rival Jerrold Communications will show it's home-powered "Agile Jammer," which performs essentially the same function but is designed to be installed in existing cable systems without major re-design of powering needs or tap replacement. The system is slated for field trials early in calendar 1991.

Jerrold officials stress that the Agile Jammer is not part of a cable's system's distribution plant. The device can be mounted aerially, within pedestals or vaults or on the side of a residential dwelling. It can be used in two-, four-and eight-way tap locations, according to Jack Bryant, director of product management for Jerrold.

Because it is considered an "adjunct" to the tap, the device's cost can be accurately assessed, without consideration for system penetration or tap port utilization. Jerrold has assigned a price of about $135 per unit. "There are no overhead costs to be amortized for the non-subscribers in the (cable) system," Bryant added.

The Agile Jammer features eight oscillators covering 54 MHz to 450 MHz. With each oscillator capable of jamming up to eight channels each, a cable operator could secure any and all channels up to 450 MHz with "complete video security and audio degradation," said Bryant.

Conversely, Jerrold also plans to show off product enhancements designed to make set-top converters "welcomed members of the home entertainment system," according to Dan Moloney, director of product management in Jerrold's subscriber systems division. On hand in Anaheim will be converters with on-screen menus, new remote controls and a telephone/remote control combination.

Finally, Jerrold will once again display its Remote 'N' Phone, a product demonstration that received such interest that it's now headed for field trials. The unit allows subscribers to make and receive phone calls using the converter's remote control. "If reaction in the field is anything like what we've had when we've shown off this product, we expect it to be a booming success," said Moloney.

Here comes fiber

On the fiber front, vendors will be touting improved performance optical links, the availability of fiber-to-the-feeder architectures and equipment costs rivaling traditional coaxial-based technology.

For example, Magnavox CATV Systems will exhibit its new 550 MHz MagnaHub Optical Mainstation, which features a single mainstation design, acceptance of up to three optical receivers external ports for forward sweep and local return signal injection and a 200 MHz external return input port for upstream signaling.

Options for MagnaHub include a fiber-only design or redundancy design featuring independent A/B switching for forward and return signals with complete RF back-up.

Jerrold continues to ramp-up production of its second-generation laser, the first specifically designed for CATV use by Ortel. According to David Robinson, director of Cableoptics, Jerrold is "approaching" its goal of producing 100 lasers per month in its Tucson, Ariz. manufacturing facility. Starting October 25, devices were being shipped "in bulk" throughout North America and overseas, said Robinson.

New fiber architectures—or variations of old designs—are constantly being modeled to determine maximum reach for the least cost. "The emphasis is shifting to *how* fiber fits into CATV, not if it will work," added Robinson.

Along those lines, Optical Networks International announced the activation of the first fiber to the bridger network in a Tele-Communications Inc. cable system in Valdosta, Ga., signaling the arrival of cable systems

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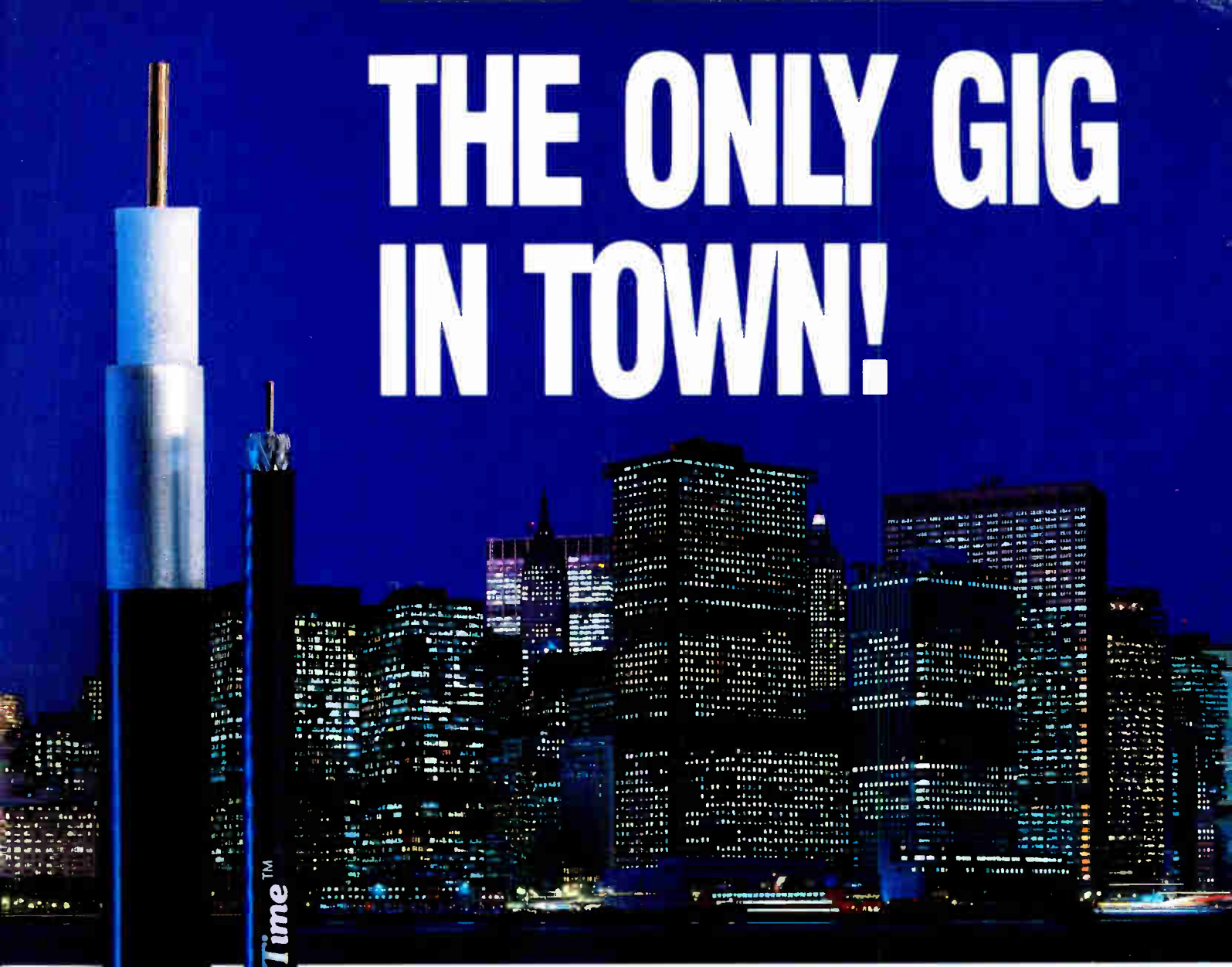

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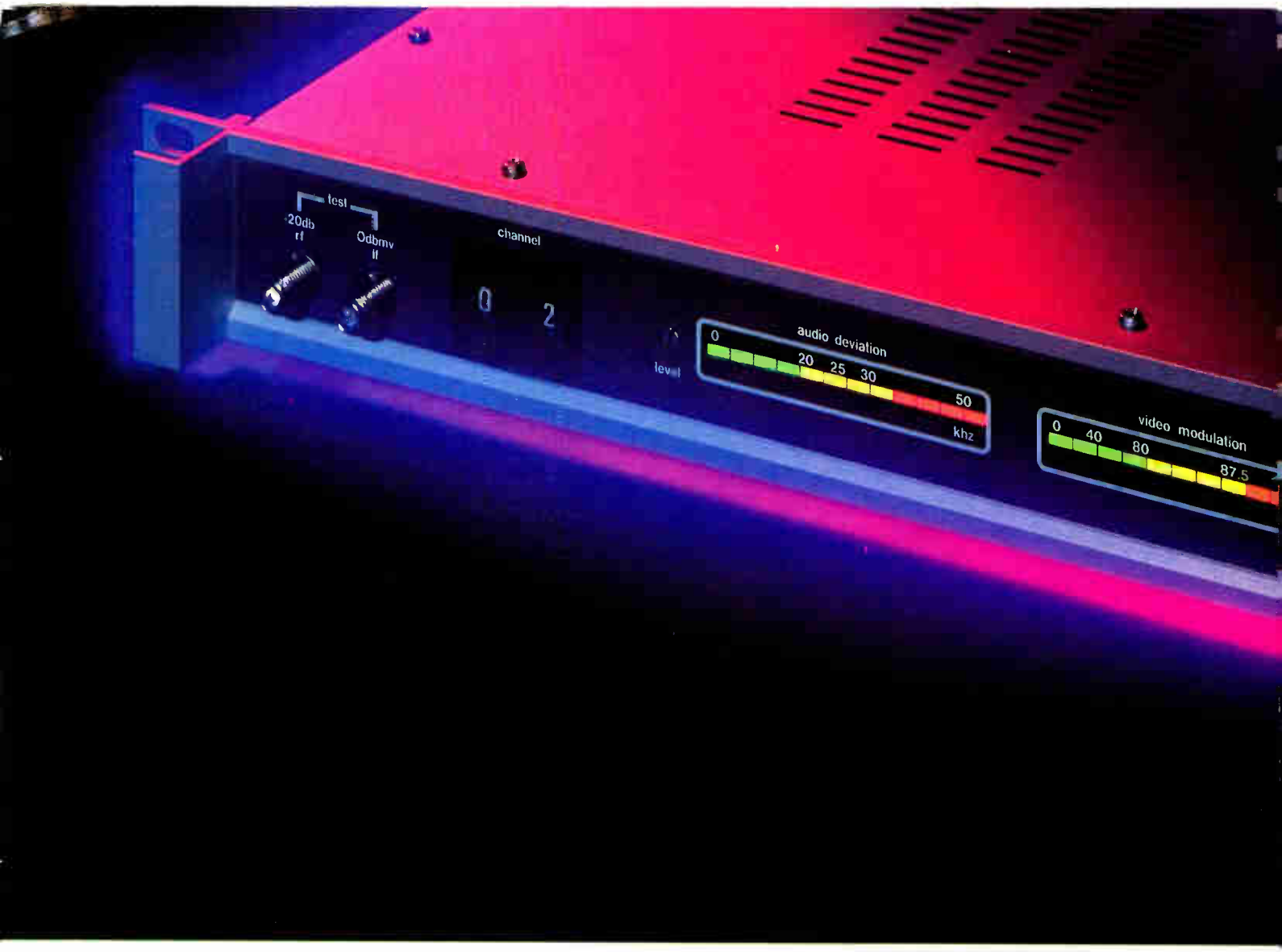

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GENERAL INSTRUMENT

Archer Taylor

A progressive conservative?

Anyone familiar with Archer Taylor's monthly column in *CED* is aware of his dueling crusade for technological innovation tempered with good, old-fashioned choosiness. "I like to be on the cutting edge of technology and its applications," says the senior vice president of engineering for Malarkey-Taylor, the prestigious Washington, D.C.-based telecommunications consulting firm. "On the other hand, I like to be careful and prepared. I don't like surprises. That's why I consider myself to be either a progressive conservative or a conservative liberal."

At 74 years of age, Taylor is decidedly well-versed in virtually all areas of cable television, having been directly involved in the vocation for the past 38 years. Additionally, Taylor is a prolific journalist, having authored a smattering of CATV-related articles over the course of his 38-year career. When not consulting or writing, Taylor spends his time afloat, having been an avid sailor since the mid-1950s.

Interestingly, Taylor has always worn a consultant's hat, from his early entrance into cable television in 1952. A degreed physicist, Taylor has spent an entire career (and then some) as a professional engineer—first with the National Bureau of Standards, then as a radio consultant.

Taylor's radio engineering interests took a natural turn to video in 1953. "In those days, everyone knew that television would simply kill radio. There wasn't going to be any more radio—who wants to listen to radio when you could be watching pictures?"

Taylor quickly recognized the power of video, and assisted in the development of Montana's first cable system—Northwest Video—in Kallispell.

Inauspicious start

"We were undercapitalized, but who wasn't in those days? In fact, we actually had to take down several miles of cable, because we couldn't get any customers. But eventually, the thing went, and by the time we sold it in 1968 we had roughly 5,000 subscribers."

By the late 1950s, Taylor had established himself as one in a handful of professional engineers involved in cable television—and as such, found himself being frequently called upon for cable lobbying and consulting in Washington, D.C.

Taylor's visits to Washington, D.C. prompted his move to the nation's capital in 1964, where he joined Martin Malarkey find opportunities for the American Broadcasting Company to enter the cable television business. "ABC established a company called 'Cablesystems,' " says Taylor. "They owned 80 percent and Martin owned 20 percent. The object of the company was to find a way for ABC to get into cable.

"First, we negotiated (the sale of) a group of systems for roughly $13 million. But, since ABC was converting to color at that time—and spending $30 million to do it—they felt that $13 million was just too much. As it turns out, the MSO we had negotiated down for $13 million was sold within three months to another well-known group for about $15 million. ABC could've turned $2 million just by doing nothing," Taylor recalls.

After a second stymied acquisition, Malarkey-Taylor launched on its own—weary of "spinning its wheels" for ABC. The company incorporated in 1966, and "has been at it ever since."

International business flourishing

These days, the overseas market is hot. Aside from Malarkey-Taylor's recent move into the cellular/personal communications network business, most of the company's engineering requests come from areas outside the U.S. "We've had clients in the United Kingdom, Hong Kong, Australia, the Philippines, Isreal—we even heard from the Ministry of Communications in Kuwait...but I haven't heard from him in a while," Taylor muses. "So, internationally, cable systems are really starting to pick up."

Not surprisingly, Taylor and his wife, LaVerne, enjoy travel, especially considering the fact that their four children are scattered across the globe—their oldest resides in Sweden. When not traveling, Taylor is an avid boat buff, frequently enjoying the waters of the nearby Chesapeake Bay.

In fact, Taylor sites the high seas as the location of the highlight of his career. "Out of college, I was hired by the National Bureau of Standards to help prepare for and participate in an Arctic expedition into the waters of west Greenland, taking scientific equipment to make soundings of the ionosphere. I was one of two scientists on the expedition. We were out for five months, and went all through Baffin Bay, on up through Greenland within about 800 miles of the North Pole. It was quite an experience."

The trip was infused with pre-WWII activities, with German submarines sighted within 10 miles of the chartered schooner Effie M. Morrissey in 1941. The group returned to U.S. soil in late 1941—just a few weeks shy of the ill-fated date of December 7, 1941. "And we all know what happened that day," Taylor remembers.

An established wordsmith

When not working on engineering projects, Taylor takes up his pen for journalistic endeavors, having published a multiplicity of articles covering subjects from fiber optics technology and high definition television to classic technological mistakes. Currently, Taylor is working to get cable television technological papers included in the Institute of Electrical and Electronic Engineer's (IEEE) publications. "The IEEE provides subscriptions to many libraries all over the world. My goal is to make archival technical papers concerning cable television available. My next move is to get some kind of agreement on copyrights."

"I think it can be done," Taylor asserts. Is this a Malarkey-Taylor project? "Oh, my, no," Taylor smiles, "This is not a paid project. It's my contribution to the industry, if you will." Count on Taylor to take this project to its fruition—with his normal infusion of progressive thinking and caution. ■

—Leslie Miller

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It seems to me highly ironic that at the same time that this industry has been fighting off a long list of naysayers, pessimists, critics and competitors, the public at large has continued to embrace our offering and to pay the very reasonable fees associated with the creative goods that they enjoy. While the credit for entertaining and informing our subscribers goes in large measure to the programming community, the engineering community can be justifiably proud of the capabilities that we have given to these creative people, as well as for the opportunities that our technology has spawned.

Foreign interest

Here at NCTA this department receives hundreds of foreign visitors each year. This year we have received visitors from most Western European countries as well as Eastern European countries. The thing they most frequently question is how we have made possible so much programming and what the relationship is between the programmers, operators and government regulators. It frequently comes as a shock to these people that the relationships between these three parties are simply based on supply and demand with the government only being involved in certain licensing matters.

In most other countries, what little cable television they have consists of very few channels. Yet without a single exception, they all tell me that they are planning for systems of 20, 30 or 40 channels for the near future. They frequently have lists of what programming they would use to fill these channels—and it is not terribly different from what we might see in any typical U.S. system.

In the U.S., we provide these programs for entertainment, education and information. We try to provide a package of programs that will appeal during all parts of the day and night, to the largest number of subscribers that we can. The cable operator in this country rarely, if ever, is interested in imposing some sort of specific message or philosophy on its subscribers. I'm not naive enough, however, to miss the point that in many foreign countries, programming goals may be far different from those which make up the American experience.

In the discussions that I have had with visitors to this office from other parts of the world, there has been a thinly veiled issue of information control and, dare I say it, propaganda. I sometimes wonder whether the provision of so many more channels of television programming will have the same effect in other parts of the world that it has had here, or if the cultural differences and governmental agendas are too different to produce the same results. The more I think about this issue, the less worried I become, for a couple of reasons.

First, we tend to forget that filling a channel with information, no matter what kind of information, is a devilishly hard thing to do. Adding channels is not just adding programming automatically. Adding channels means finding programming, writing programming, encouraging programming, creating programming—buying it, begging for it, and borrowing it.

Secondly, television is very compelling. Its ability to entertain is the one thing that attracts people to the screen. It is perfectly possible to watch television that is not entertaining—but keep in mind that the brain is a strange animal. It doesn't always have to "open." When something is on that tube that you don't wish to see, the mind tends to wander. So even in the places where television will be an information source under the control of the authorities, programming may cross the boundaries of both entertainment and information while it attempts to provide dogma that is more precisely aligned with government wishes. This type of issue doesn't apply to all the countries, however.

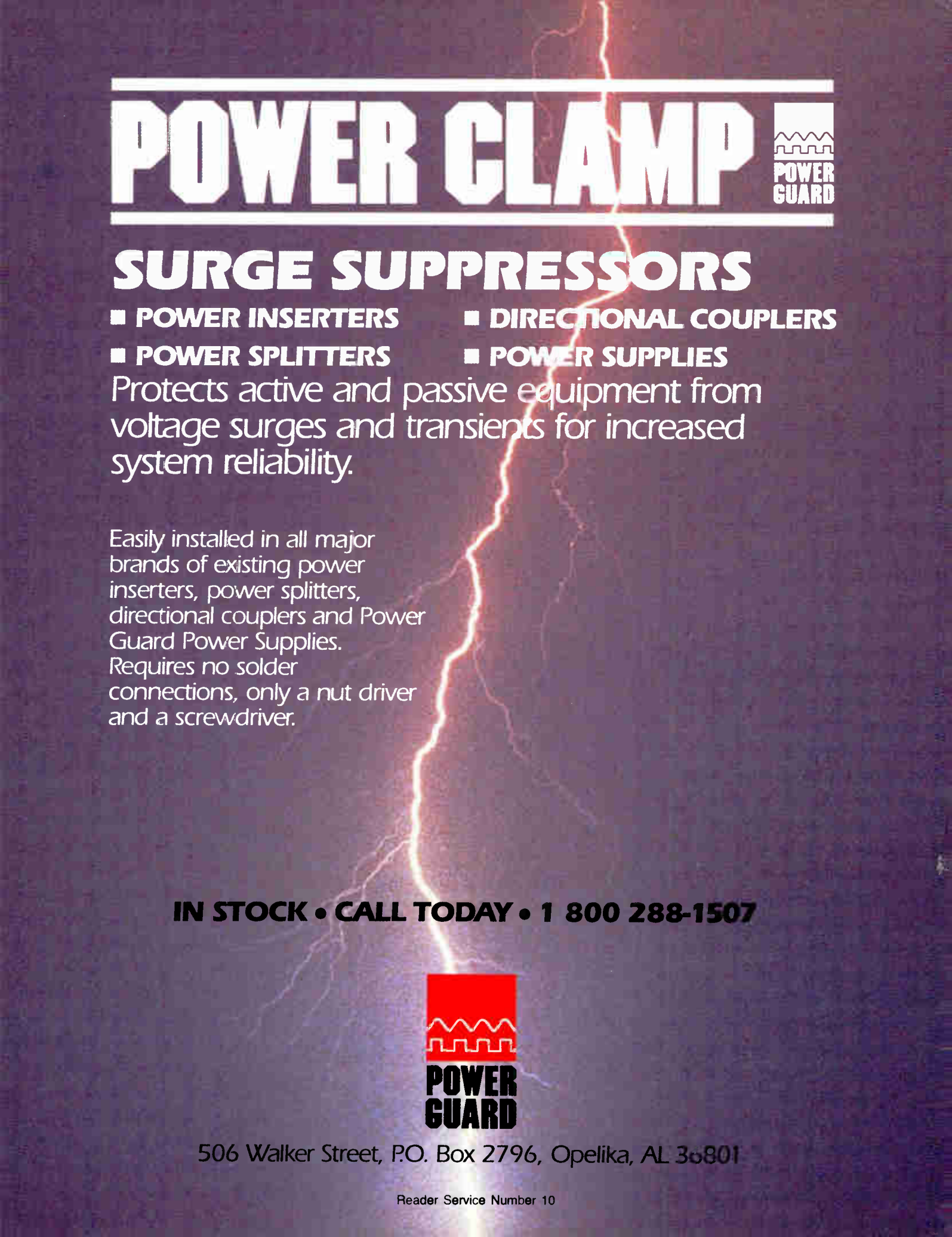
Meaty subjects abound

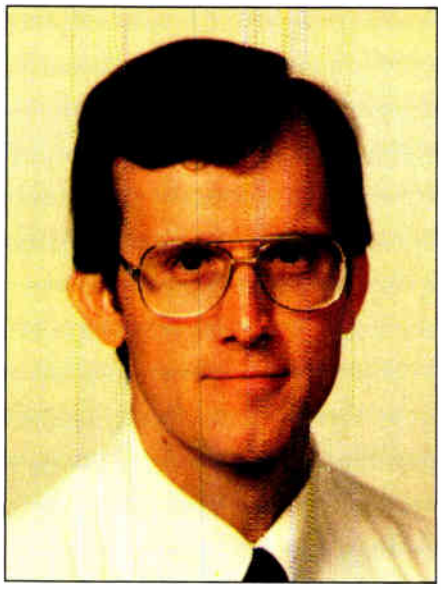
One one recent trip I visited a cable system that had eight channels. The showed me their business plan for 1991, which included an upgrade/rebuild to 30 channels. They had also planned this work so that several hears later, they could upgrade to 45 channels. When I asked what they were going to put on 30 channels, they showed me a list of programming services that sounded amazingly like one that we would find in any community in America, France or Germany—a mixture of broadcast and satellite delivered signals, as well as a larger number of locally originated channels than we are used to seeing here. When I asked about the information content of the locally originated channels, I was shown examples of programming slated for these new channels in the future.

I chose the tapes from the table myself, and when they were shown, I was pleased and surprised to see that they were mostly educational and mostly had to do with the issues of writing, language, math and science.

So perhaps my fears about what other countries will do with cable channels versus what our country has done with cable channels is misplaced. Perhaps the changes that we see in the world will have the result of television that serves the same role in the daily lives of citizens in those countries as it does in the lives of American citizens. Perhaps television and multichannel television has had some part to play in the changes that have occurred in the world. It's hard to say, it's hard to know, but certainly the fact that we have created outlets for so many diverse views is a thing that we as an industry should be proud of. ■

By Wendell Bailey, Vice President Science & Technology, NCTA





Delayed AGC in signal processors

In the headend, noise is a fact of life, and yet, it remains a relatively misunderstood topic. This month, I'll examine the output C/N performance vs. input signal level of a couple of typical headend signal processors.

The inset to Figure 1 is an extremely simplified block diagram of a generic signal processor. Here we see that a typical processor consists of a front-end, or input conversion stage, where the RF channel is first amplified, and then converted to an intermediate frequency around 45 MHz. It is here in the input converter that the noise figure of the unit, and hence its C/N performance, is determined.

The IF section of the processor provides most of the gain, adjacent channel selectivity, delay equalization, and most of the automatic gain control (AGC) capability. The output conversion stage converts the 45 MHz IF to the appropriate channel, and further amplifies the signal to provide a typical output signal level of +60 dBmV.

Many tasks

An important characteristic of a signal processor is that its output signal level remain fixed even though its input signal may be continuously varying with time. Another important characteristic is that it must be capable of handling low-level signals (-20 dBmV) while contributing little noise, and high-level signals (+30 dBmV) without overload.

What all these requirements seem to point to is a high gain, low noise figure input conversion stage when dealing with low level input signals, but a low gain, robust amplifier when dealing with higher level signals. This type of performance is typically provided through the use of a technique known as "delayed AGC."

Most of the AGC capability in most communications receivers is provided in its IF section. Typically, the AGC circuitry is a feedback loop that samples the IF's output signal level and feeds back a control voltage to the IF amplifiers to regulate their gain with varying input signal level in order to maintain a constant output level. As the input signal level increases, the IF gain is decreased to maintain a constant output signal level.

Taking out the noise

The noise figure and C/N capability is typically determined primarily by the gain and the noise figure of its input amplifier stage. Ideally, for low noise performance, you would like the gain of the first amplifier in the front-end of the processor to be high enough, and its noise figure low enough to swamp out any noise contribution from the remainder of the signal processor's circuitry—especially its AGC'ed IF section.

As AGC is applied to the input amplifier however, the noise contribution from the IF section of the processor begins to contribute significantly to the overall processor noise figure. In the extreme, at high input signal levels, the gain of the input "amplifier" may even be reduced by AGC action to unity or less, thereby becoming an attenuator and causing a degradation in the processor noise figure.

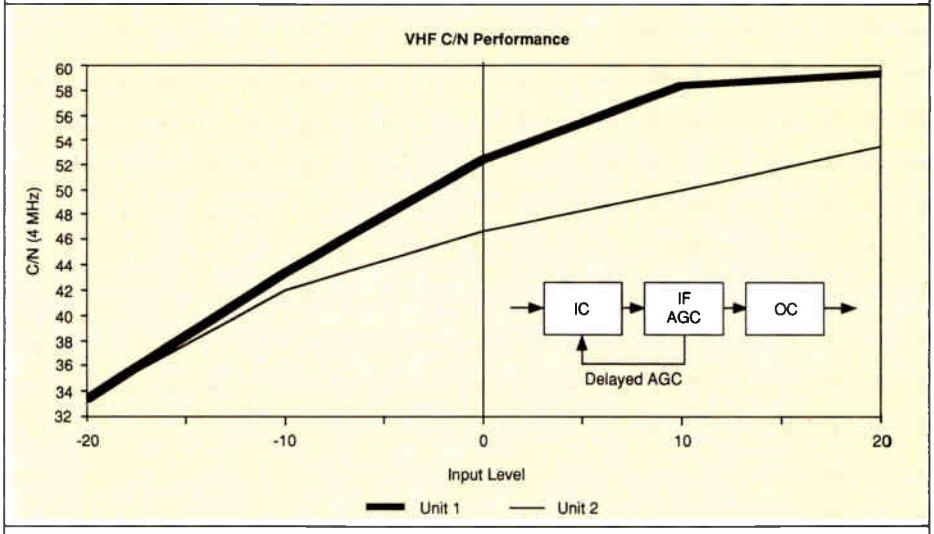
At low input signal levels, where C/N performance is critical, such noise contribution by the input amplifier and the IF section of the processor is unwanted and unnecessary. For this reason, any AGC voltage applied to the front-end of a signal processor is usually "delayed" until the input signal level is high enough (+10 dBmV) such that the negative impact to noise figure caused by the AGC doesn't severely impact the overall C/N performance.

Comparisons

The plots in Figure 1 give an indication of what can happen to the output C/N performance of a signal processor when the delayed AGC is improperly set to "kick-in" at very low signal levels. The two curves shown are plots of output C/N vs. input signal level for two off-the-shelf competing products.

In unit 1, the delayed AGC was set to kick-in at around +10 dBmV. The unit's output C/N performance at input signal levels between -20 dBmV and +10 dBmV was very good, improving somewhat linearly with input signal level, and leveling off at an output C/N of around 59 dB at input signal levels above +10 dBmV due to the effects of the delayed AGC.

Unit 2, on the other hand, which had a delayed AGC that kicked-in at an input signal level of -10 dBmV, never realized its full output C/N performance: attaining a poor 53 dB even at high input signal levels. ■



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

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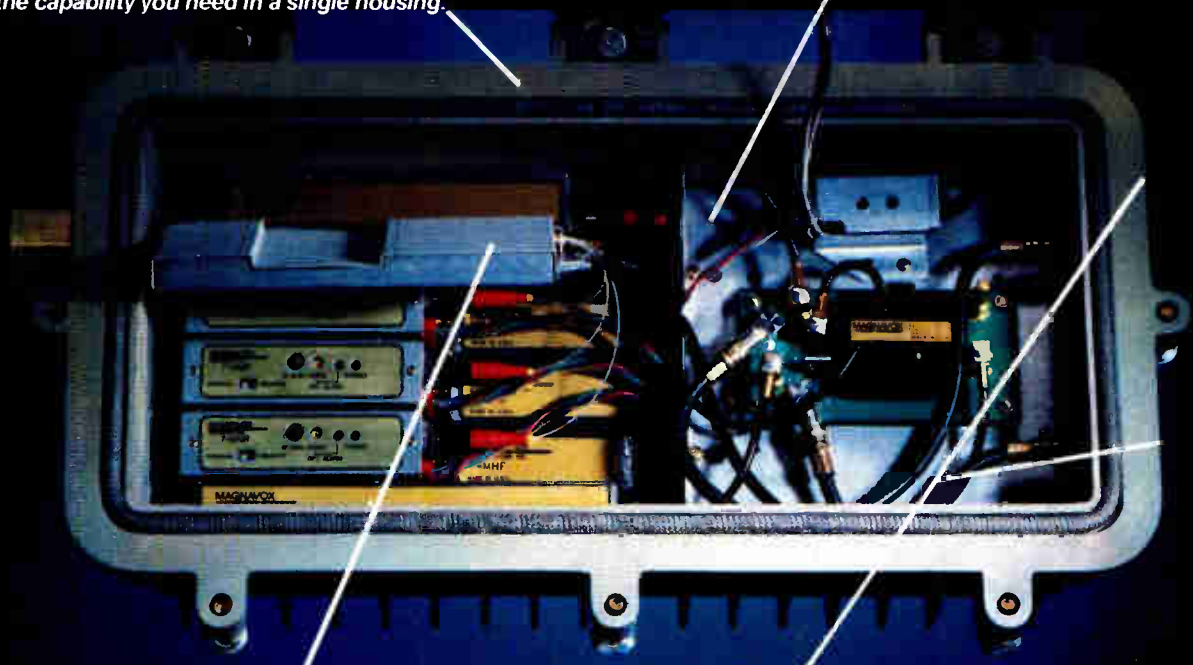

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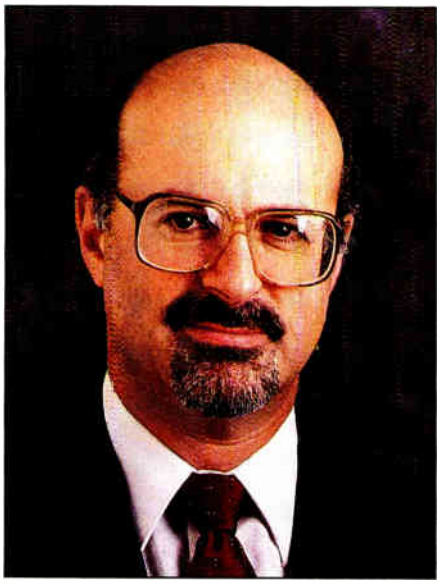

Wireless personal communications services

One of the hottest areas of telecommunications development today is "personal communications services" or PCS. In Europe it is called "personal communications networks" or PCN. The FCC has begun a broad inquiry into the technical and policy issues. Cable companies have a unique opportunity to participate in this new telecommunications service.

PCS—The markets

PCS is a short-distance, low-power wireless voice communications system. It can serve several different market sectors: vehicular, pedestrian, business and residential. The FCC is looking at whether it will be an extension of the public switched wireline telephone network, or a new competitor.

The vehicular market is served today by cellular telephone. PCS is viewed by cellular operators as an evolution of their existing service. Some cellular operators have told the FCC that there is no need to permit new vendors to offer PCS, since they or will soon provide all of the new services.

The pedestrian market for PCS is served today by pay telephones in public areas such as airline terminals, shopping malls and downtown street corners. These pay telephones would become "telepoints," or low power fixed base stations that communicate with a pocket-sized telephone transceiver. As you walk down the street, you can make a telephone call through one of these telepoints.

The business market focus is the wireless PBX. The rewiring of offices, in order to accommodate moves and rearrangements, is expensive. With a wireless PBX, there is no rewiring necessary. In addition, with a small wireless handset, you can carry your telephone with you as you visit other offices. The residential market is an evolution of the cordless telephone market. One base station might serve a cluster of 4 to 20 homes.

Each market is already served by some form of telephone technology. The key to success for PCS is to provide it with a lower-cost, smaller, lighter and more convenient system.

PCS—The technologies

Several different technologies have been proposed for PCS, and several different frequency ranges might be used. The FCC has granted several dozen experimental licenses to small start-up companies, wireline telephone companies and others to examine the feasibility of these different approaches.

There appear to be three main contenders in the technology area. One is analog FM voice modulation using frequency division multiple access to the radio spectrum. This is used in the first generation PCS systems being implemented in Great Britain under the name "CT-2," similar to the current U.S. cellular technology.

The second technology contender is compressed digital voice coding with time division multiple access to the radio spectrum. This is similar to the second generation cellular standard that will soon be implemented in the U.S.

The third contender is compressed digital voice coding with spread spectrum modulation. Supporters claim that spread spectrum modulation, which produces a noise-like signal that is spread across a wide channel, can be used to share frequencies that are already in use for point-to-point microwave systems around 2 GHz. The existing point-to-point microwave users dispute this claim.

PCS—The frequencies

The big fight in the U.S. will come over a specific allocation of frequencies for PCS. There are a few narrow slivers of spectrum around 900 MHz that are not being used, but this will not be adequate. The focus of attention now is on three bands around 1500 MHz, 1800 MHz and 2400 MHz.

The 1500 MHz band is now being used by aircraft manufacturers and the U.S. Air Force for telemetry in connection with the flight testing of new aircraft.

The 1800 MHz band is now used for point-to-point microwave by oil companies, railroads, electric utilities and local governments.

The 2400 MHz band is now used for military radars, and for consumer and industrial products such as microwave ovens and medical diathermy equipment.

The FCC has a major inquiry underway, in Docket No. 90-314, looking at possible frequency bands, regulatory structures and other issues. Some decisions are due in 1991 or 1992.

Cable TV opportunities

Two cable operators, Cablevision Systems Corp. and Cox Enterprises have told the FCC that they would like to experiment with PCS networks. They plan to operate the low power radio systems, and to interconnect them with cable, fiber and CARS microwave links.

PCS is a kind of mobile communications service, and some cable operators may be wary of entering a totally different line of business. But there is another option. Cable companies should think about entering into joint ventures with operators that already know the mobile communications marketplace. In particular, think about making a deal with your non-wireline cellular operator.

In every city, there are two cellular operators. One of them is the local wireline telephone company. The other operator, known as the non-wireline cellular system, competes with the local telco. The non-wireline operator knows the mobile radio marketplace, but unlike the wireline telco, does not have an existing citywide wired network in place. The cable operator has that network. A joint venture between a the non-wireline cellular operator and the cable company would bring together the strengths of both, and provide cable systems with an important early-entry opportunity into PCS. ■

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

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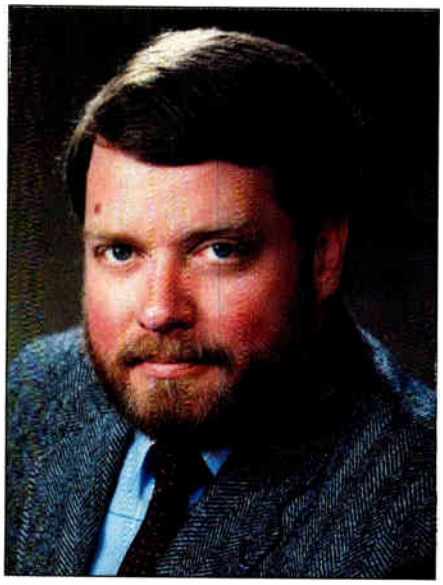

Telco cable

There continues to be widespread talk about telco entry into the cable business. Indeed, the telephone companies and their research organizations are devoting a level of resources to this issue which is almost unimaginable in our industry. There are literally thousands of people, many of them research engineers and strategic planners, who are focused on ways in which this may be accomplished.

This is a battle being fought at many levels. In Washington, telco and cable lobbyists clash over cross-subsidies and the public policy implications of letting telephone companies into the cable business—in particular, into the business of "controlling content."

Depreciation

At the state level, the cable and telephone industries are battling over accelerated depreciation schedules. If telephone companies can accelerate the rate at which they depreciate their existing assets, they essentially get reimbursed more quickly for those assets by telephone rate payers. This provides funds which are earmarked for use in replacing of the assets; in this case, replacing them with fiber plant capable of providing video capabilities in addition to the voice capabilities of the original plant.

The fear of the cable industry is that we will see overbuilds of our systems financed by an increase in the rates that *everyone* pays for Plain Old Telephone Service (POTS). That is a serious prospect indeed—competition is a fact of life in any successful business, but no incumbent wants to see a competitor enter the field with an unfair advantage, particularly when that advantage amounts to public spending.

While most people are fundamentally satisfied with the cable service they get, they have observed that their rates have climbed over the last few years. We have not been successful in making them sufficiently aware of all the new services and plant improvements which have come along with those rate increases. In addition, too many people have experienced some form of poor service from their local cable operator.

Making headway with service

Some of the criticism which we receive is justified. We need to, and *are*, making progress in our front office customer service and the training level of our field personnel.

But we are in a fundamentally intrusive business. People want to watch television, not deal with our customer service reps on the telephone or our installers at the doorstep. Our real goal may be to merely lessen the irritation which having cable installs entails. Interdiction technology and a more coherent inside wiring strategy may go a long way toward helping this, but they cannot omit it entirely. The only good news is that any competitor providing video services into the home will run afoul of the same problems, and we will be further along the learning curve toward solving them.

Telcos face eroding market

There has been much talk about new information services which telco fiber-to-the-home market could provide. While there have not been *any* successful demonstrations of these services, most information services could be provided on twisted pair. Unless new services emerge for which there is a mass market, that rationale for replacing the residential telecommunications network may have a hollow ring, if it is to be paid for by the average consumer, which, of course, it must be.

That leaves the revenues to be generated by the video business as the only likely engine behind the construction of a replacement telco plant. But there, too, changes underway are likely to be discouraging. The cable industry is entering a mature phase, and efforts are already underway to improve service and to make our product more usable by the customer. In addition, the industry is in a gradual process of upgrading its plant. Through the use of fiber, these upgrades will be highly cost-effective and will lead to economical, high performance 80-channel systems in the near term, and 100-plus channel systems before long. This trend alone will be discouraging to overbuilders, but the picture will be complicated significantly by the entrance of a variety of DBS video delivery systems as the decade progresses.

Telephone *companies* will thus face the prospect of making an enormous investment as they replace their plant on a house-by-house basis only to find that the only incremental revenue available to pay for that investment will have to be extracted from a fiercely competitive video delivery marketplace. At the same time, they will see their voice revenues threatened, particularly at the high-revenue end of the market. Hand-in-hand with that goes a threat to their lucrative long-distance access fees.

The years ahead will be tough ones for the telephone industry. We should not underestimate them as potential competitors because they are large, wealthy and adept at manipulating the regulatory and legislative processes. Nevertheless, we may find that time is on our side, and that overbuilding cable systems will prove to be economically uninteresting to telephone companies in the long run.

We should not rejoice prematurely at this, however, for we will have competition of our own. It will take the form of DBS and MMDS video delivery, along with the proliferation of inexpensive laser disc media and the continued refinement of videotape delivery. We are, however, well positioned to capitalize on the broadband plant which we have spent the last four decades building. As we add fiber trunking, and refine the remaining coaxial "last mile," we will find that we have a highly efficient, and competitively formidable, delivery system for video and virtually any other imaginable service.

The ultimate winner will, of course, be the consumer, but there is no reason to believe the cable industry will not be a pivotal player in providing the cost-effective services which make the consumer happy. ■

By Jim Chiddix, Sr. Vice President, Technology and Engineering, ATC

Network architecture

Cable TV network architecture has come a long way in 40 years: from single channel strip amplifiers carrying up to three non-adjacent, low-band VHF TV stations to modern broadband designs carrying 80 adjacent TV signals; from braided shield coaxial cable to solid sheath aluminum; from coaxial cable to optical fiber hybrids; from tapped trunks to multi-hub distribution; from traps to scrambling and addressability; from vacuum tubes in sheet metal pole cabinets to solid state hybrids in die-cast, weatherproof housings; from the 704-B FSM to sophisticated, automated sweep testing and signal analyzers.

Where do we go next? Some handwriting is already on the wall, but there is also a glow in the sky foretelling even greater transformations still to come.

Fiber optics

The fiber backbone architecture appears to have become an acceptable option for rebuilding and upgrading, using either the ATC architecture developed by Jim Chiddix, or the CAN (cable area network) architecture developed by Bob Luff. The concept of extending fiber to the bridger, or feeder, is quickly overtaking the fiber backbone. Not far behind is an architecture based on optical fiber to the tap, or as the telephone industry puts it, to the curb. Photonic amplification seems destined to play a significant part in optical fiber network architecture.

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

Deflecting VSB/AMs progress

The related, but somewhat peripheral developments in HDTV and digital transmission may well deflect the apparent forward progress of VSB/AM optical fiber architecture as we presently understand it.

The remarkable progress of the Digicipher HDTV proposal, and a host of aggressive digital compression schemes could have significant impact on cable TV network architecture. The advantages of digital over analog transmission have long been recognized and widely appreciated. Digital signals can be transmitted over almost unlimited distances without significant degradation. Digital transmission avoids the severe analog linearity requirement needed to prevent intermodulation. Output level control, peak-to-valley response, and signal-to-noise ratios are less critical for digital than for analog systems. Security for conditional access can be greatly enhanced with digital encryption.

Compression

Without aggressive bandwidth compression ratios, however, digital transmission must be paid for with intolerably large blocks of spectrum. It is the practicability of compressing 100 to 150 megabits per second of video, audio and control information into 6 MHz of spectral bandwidth that has raised engineering eyebrows.

Actually, the Digicipher system achieves about half of its compression by means of 16-QAM (16 level quadrature amplitude modulation). Therefore, it cannot be as free from the effects of amplitude errors in transmission as FSK, PSK or QPSK. The QAM signal cannot, for example, be hard limited, or clipped. Moreover, the bits at lower absolute amplitude levels must be more sensitive to noise. Success in the laboratory must be followed by successful experience in the real but imperfect world before we can join Archimedes in the bathtub, crying: "Eureka! I have found it!"

Nevertheless, while proof of performance still lies ahead, there is scant reason to doubt that Digicipher or some similar digital compression system will become an important part of the television landscape before the end of this decade. Conventional wisdom, buttressed by market surveys, indicates that HDTV has little to offer the public unless displayed on screens large enough for the eye to see the fine detail.

New TV receivers required

Some believe rear-screen projection will do the job; others insist flat panel displays will be required. In either case, FCC has decided that a wholly new generation of TV receivers will be required, probably at significantly higher price, to display television pictures with the quality defined by HDTV. There now seems a strong likelihood that the new HDTV sets will be totally digital. Even videocassette players will either become digital, or give way to some form of digital laser disc or video CD.

However, even while accommodating digital transmission, cable TV networks will probably be expected to continue distribution of analog NTSC television for several more decades. What network architecture can be devised effectively and economically to distribute both analog and digital transmissions? That is our homework assignment for the next few years.

Once we are in the digital business, switching is a natural corollary. Video on demand, or demand access video in telephone lingo, is probably the most viable video switching application. Video on demand means that any subscriber literally could specify the time and date for viewing any program title in the catalog.

For such a service, a separate channel would have to be dedicated, from the program switch to each and every subscriber. Near video on demand might more realistically restrict the freedom of choice to a limited number of titles, available only at pre-designated times, with a cap on the number of concurrent users that could be accommodated.

To switch or not to switch?

Another plan, described in the Malarkey-Taylor report to the White House Office of Telecommunications Policy in 1971, would not require switching. Each title would be repeated continuously on separate channels, at staggered starting times. It is too early to

Continued on page 150

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Reader Service Number 15

The fiber optic watershed

Fiber optic technology has proven its worth for cable television. Lasers deployed in volume during 1990 are 600 percent better on a price/performance basis than those available in early 1989. And the proof has come where it counts most, in the field.

As a result, large purchase orders were placed for amplitude modulated (AM) fiber optic systems in 1990. Virtually every operator budgeting new, rebuild or upgrade construction for the early 1990s now incorporates fiber optics.

Work on AM systems, begun in 1988 and carried through 1990, initially was dominated by field trials, microwave link replacements and limited amplifier cascade-reduction links.

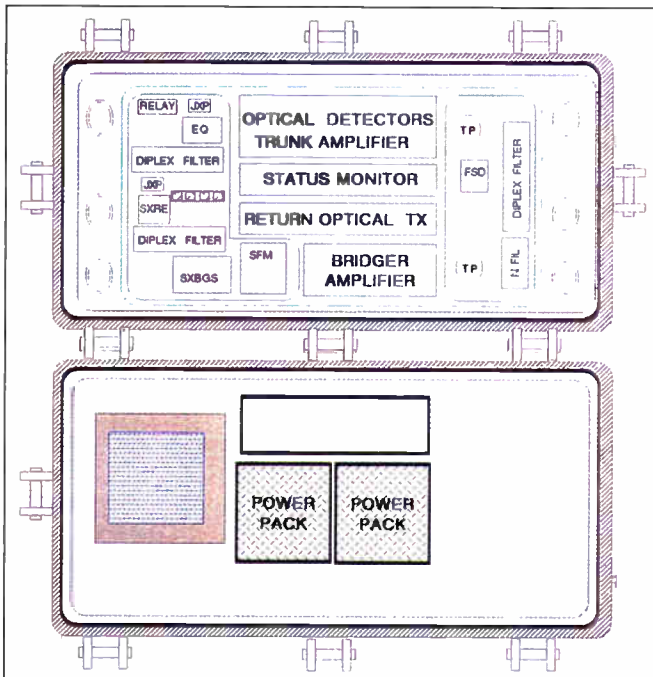


Figure 1

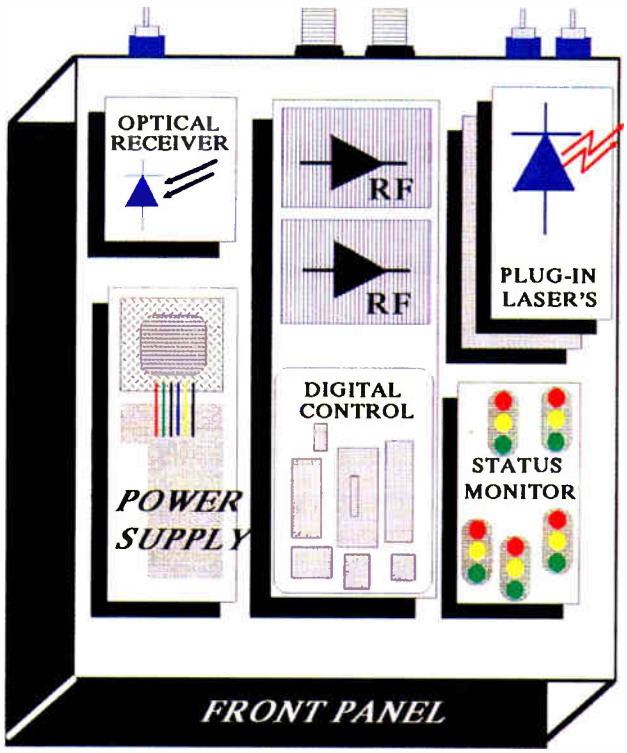


Figure 2

Trunking options abound

This pioneering work led to the fiber optic watershed that we are now enjoying; AM fiber optic trunking options abound. A laser's performance provides one input to each system solution, yet there are many other factors to consider. Meanwhile, science continues. Fiber optic technology will provide more system improvement options as the years progress.

This article will highlight the status of fiber optics in cable TV and offer a glimpse of what may be possible with the technology as the 1990s unfold.

Just a few years ago, many "experts" said it could "not be done." Scientists were among those who doubted whether highly linear lasers could be manufactured in volume with sufficiently high output power and low noise. Prudent business managers were among those with doubts about costs, reliability and maintenance.

Many of the doubts were erased when our industry was able to use lasers truly designed for multichannel AM video trunking systems. No longer forced to "cherry-pick" from lasers originally designed for digital telephony applications, volume use began. For example, today's best standard AM fiber optic transmitters generate signals that can be optically split four ways and still provide the same system loss budget and carrier-to-noise (C/N) performance as the best product available in early 1989. Intermodulation distortion performance also is better. Pricing for today's higher performing systems is about $20,000 per 40-channel/fiber transmitter-receiver pair. In early 1989, the equivalent price for the lower performing systems then available was approximately $30,000.

Reliability experience also has been encouraging. In fact, the mean-time-before-failure projections for the distributed feedback (DFB) laser modules used in the best AM systems exceed 25 years.

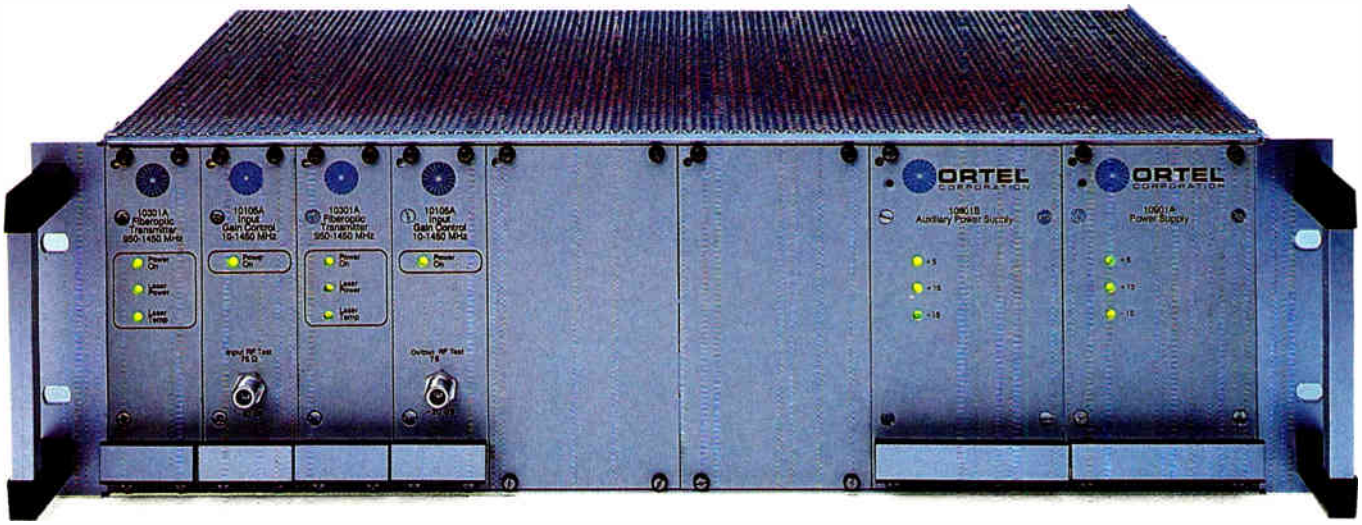
Generally favorable field reliability results for the best systems and continually encouraging laboratory accelerated-lifetime testing of key components have contributed to the broadening selection of AM fiber optics for cable TV trunking.

Improved product features for installation and maintenance of AM fiber optics also contribute to the technology's acceptance.

For example, systems now often feature modular designs. Laser and/or receiver modules plug into headend and strand-mount optoelectronic housings. Field-proven trunk-and-distribution stations now can incorporate the optoelectronic receivers, return-path lasers, status-monitoring modules, redundant power supplies and high output-power electronic bridging amplifiers (see Figure 1). The best headend transmitters may now include linear pre-amplifier laser drive

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

Freedom package.



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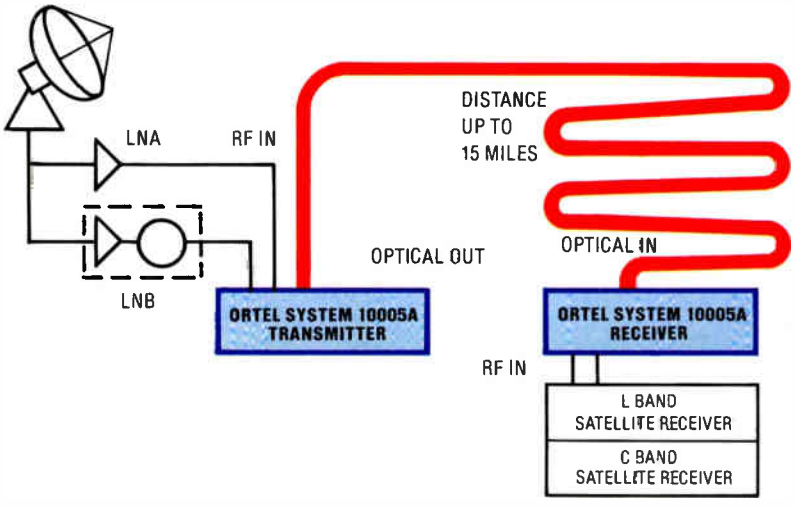
Ortel's new 10005A TVRO Fiberoptic Transmitter and Receiver give you the freedom to locate your satellite antenna where you want it without regard to the headend location... **anywhere up to 15 miles away!** The 10005A frees you from problems like terrestrial interference, line-of-sight obstructions and legal restrictions.

Installation is easy. The LNA or LNB output feeds directly into the transmitter, which delivers either one **or both** over a single optical fiber cable to the receiver, wherever you want it.

The modular design 10005A system uses a standard 19-inch rack mount incorporating dual, redundant power supplies for added reliability.

Modular design means you can expand the system to handle multiple polarizations. It also minimizes the cost of spares.



- *Passband: 950 — 1450 MHz*
  3.7 — 4.2 GHz
- *I/O gain adjustment range: 20dB*
- *Typical demodulated signal-to-noise ratio at 15 miles: 60dB*
- *Standard 19" rack mount x 5.25" high x 11.8" deep, houses four polarizations.*

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circuitry, automatic microprocessor controls and return-path receiver and status monitoring options (see Figure 2). Easy access test points and status displays further ease installation and maintenance.

Enabling the full benefits of modularity, optical connectors suitable for AM terminal equipment use became available in volume during 1990. These connectors typically feature an angle-polished fiber design to ensure that reflections are minimized. Index-matching gels and matched-pair mating no longer are required to assure low insertion loss. Models qualified for outdoor use also are available.

In most of the optical fiber plant, where quick-connects and disconnects are seldom required, fusion splicing continues to perform the best for AM cable TV. Today's more advanced splicing machines, featuring an array of automated functions, make it difficult to perform bad splices. Reflections are negligible. Insertion loss almost always is below 0.10 dB and typically is below 0.05 dB.

Some manufacturers also have begun offering lower priced splicing machines and others that perform multiple splices simultaneously.

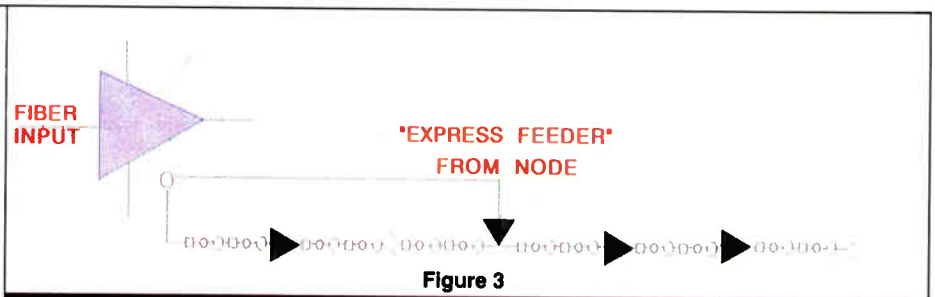

Figure 3

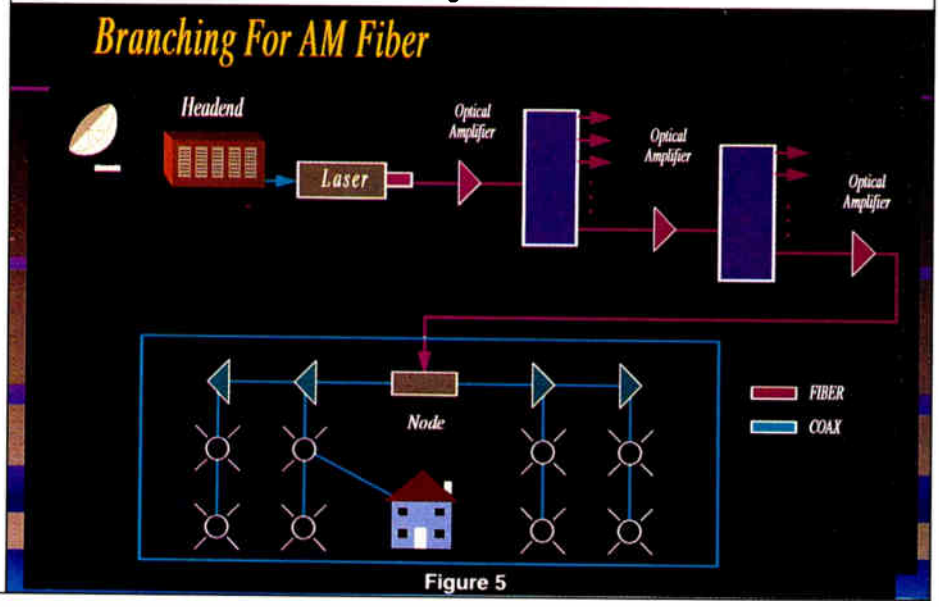

Figure 5

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Sigma's control system features open-ended architecture so powerful that it can deliver service to 600,000+ subscribers, control 56 PPV channels simultaneously and hold an active inventory of 3,000 PPV events vs. the current 102 of other technology. These benefits translate to increased revenues plus the potential of changing Americans' viewing habits with an expanded menu of pay programming choices. The enhanced security of audio and video encryption eliminates piracy, thus increasing the number of revenue producing subscribers. With Sigma 2000, everyone playing is paying.

The combination of its powerful control system and the proven dependability of its hardware makes Sigma 2000 the most completely advanced, addressable system available anywhere.

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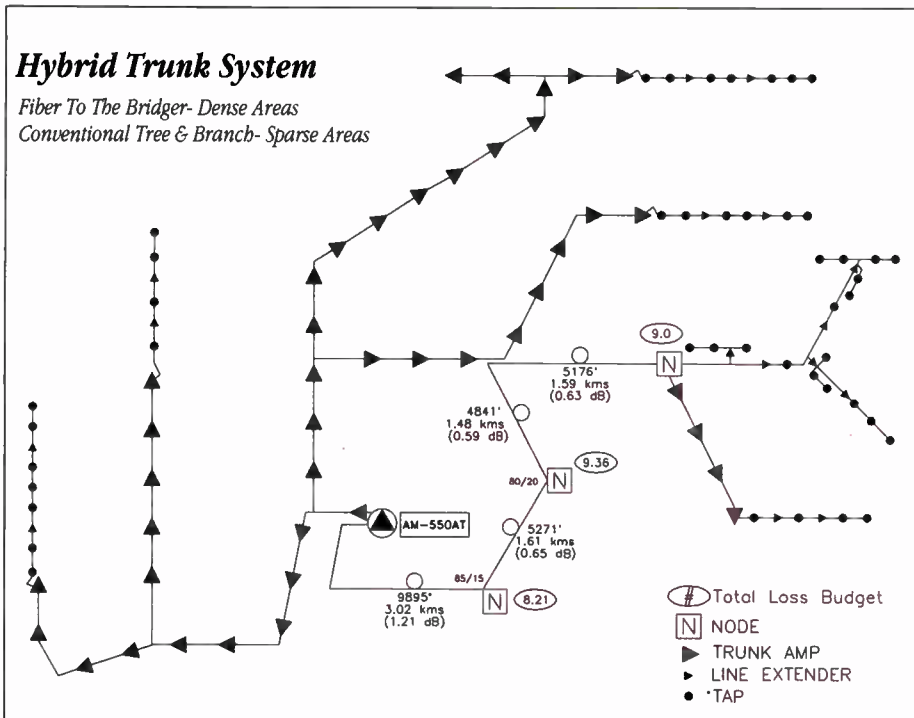

Figure 4

Fiber optic trunking options

AM fiber optic systems facilitate improved picture quality, expanded channel capacity, improved service reliability, reduced operating costs and potential new communications services. Yet none of this is cost-effectively possible today without complementary use of the better radio frequency (RF) electronics.

"Fiber Trunk and Feeder" (FTF), "All Fiber Trunk" (AFT) and "Fiber to the Bridger" (FTTB) are some of the names given to the more aggressive use of optical fiber plant. Generally, these architectures take fiber directly to an optoelectronic bridging node. But do not let the names fool you: the bridger is seldom located where it used to be, and the definition of the feeder plant can change. And if there is no pure definition of the architectures, then there is no one "right" solution that fits all system construction cases.

For example, a traditional coaxial cable tree-and-branch system uses two or three line extender amplifiers in its feeder cascade. The more aggressive fiber trunking architectures usually use three or more line extenders in their feeder cascades. Automatic gain control (AGC) sometimes shows up as a beneficial feature in conjunction with aggressive fiber trunking architectures. Because of higher costs, AGC rarely is considered for traditional feeder plant.

A cross between trunk plant and feeder plant, termed "express feeder," has emerged (see Figure 3). Express

24 Channels, 1 Fiber, 1 Wavelength. And No Compression.

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SUMINET 5700

Specifications for 2.4Gbps PCM video transmission equipment

Specifications		NTSC 24 Channel	NTSC BTSC-Composite 20 Channel
Bit rate		2488. 32Mbps	2488. 32Mbps
Loss Budget		20dB	20dB
Max. transmission distance		50km (on 0.4dB/km loss SMF)	50km (on 0.4dB/km loss SMF)
Optical device		1310nm LD/1550nm LD InGaAs PIN PD	1310nm LD/1550nm LD InGaAS PIN PD
Video signal	Number of channels	24 ch / 48 using WDM	20 ch / 40 using WDM
	Coding	10.368MHz 8 bits	12.4416MHz 8 bits
	Amp. freq. response	20Hz-4.2MHz±0.5dB	20Hz-4.2MHz±0.5dB 4.2MHz-4.8MHz +0.5/−1.0dB
	DG/DP	< 3% / 1.3°	< 3% / 1.3°
	S/N (unweighted)		
	(weighted)	> 60dB (*1)	> 60dB (*1)
	Chrome/Lume Delay	< 33ns (3.58MHz)	< 33ns (3.58MHz)
	Line/Field tilt	< 1%	< 1%
	Luminance Non-Linearity	< 4%	< 4%
Audio signal	Number of channels	48ch / 96 using WDM	20ch (4.5MHz subcarrier BTSC) / 40 using WDM
	Coding	16 bits linear	
	Amp. Freq. response	20Hz-18kMz±0.5dB 18kHz-20kHz±1.0dB	
	S/N (unweighted)	> 60dB	
	Distortion	< 0.1% (1.04kHz, 0dBm)	
Size (inches)	Video	19×14×13⅜ (W×H×D)	19×14×13⅜ (W×H×D)
	Audio	19×7×13⅜ (W×H×D) × 2	
Power supply		90-130VAC or 180-260VAC	90-130VAC or 180-260VAC
Power consumption		to be estimated	to be estimated
Temperature range		0 to 40 degree Celsius	0 to 40 degree Celsius
Humidity		< 85%RH	< 85%RH

*1 target value (not yet evaluated experimentally)

Connectors:

Optical connectors	FC/PC type
Video connectors	1Vpp (Max. 1.2V) 75 ohms unbalanced BNC connectors
Audio connectors	+10 dBm Max. 600 ohms unbalanced (Option) Cannon connector ref: HA16PA-35 (TX) ref: HA16JA-3P (RX)

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AT LAST, DIGITAL VIDEO ADDS UP.

feeder lines do not directly serve RF taps or homes, but instead run from the optoelectronic bridger node and parallel to tap-feeder lines before recombining with those tap-feeder lines near the end of distribution. With this configuration, up to eight "line extenders" might be run in cascade.

The "best" architecture depends on a particular cable TV operation's existing plant, geography, subscriber density, marketing strategy, future expansion philosophy and budget. From a global perspective, each country's communications regulatory policies, programming availability and local construction costs may lead to somewhat different architectures, even though the "parts" costs are roughly the same.

Jerrold has designed aggressive fiber trunking systems with costs in the same ballpark as traditional coax architectures in certain cases for home density ranging from 18 per mile to over 200 per mile. Some other construction cases have yet to appear as attractive. A "hybrid trunk" system such as the sample illustrated in Figure 4 has offered another useful option in at least one case so far. Many fiber optic trunking options now can be considered, along with the different RF amplifier technologies, in choosing the best solution for each construction situation.

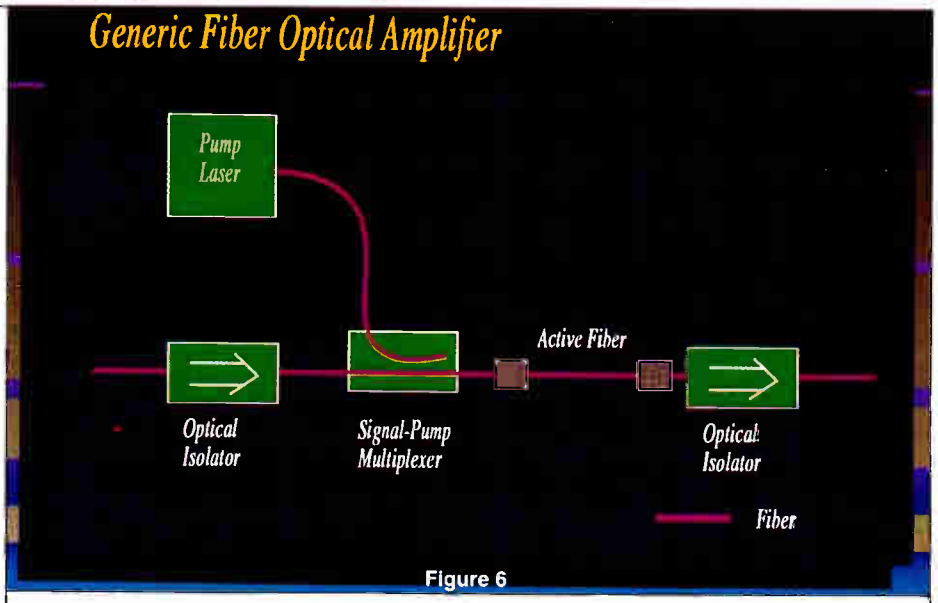

Figure 6

Future technologies

Optical amplifiers, coherent systems, compressed digital video and the longer 1550 nm wavelengths are among the technologies with promising futures. Some of these technologies may be experimented with first for headend-to-headend supertrunk links.

The real benefits will multiply when some or a combination of such technologies are proven for large volume distribution and/or advanced trunking applications. For example, an ideal application of optical amplifiers is illustrated in Figure 5. Optical amplifiers generate more photons than input without

an inefficient interim conversion to electrons. The illustrated system uses optical amplifiers to cost-effectively extend fiber to an optoelectronic bridger station by allowing conservation of headend laser transmitters and optical transmission fibers.

Perhaps the most promising amplifier for AM cable TV is the rare-earthed doped fiber. Figure 6 shows a co-propogating pump laser at 810 nm exciting a fiber dopant's (erbium) ions to a higher energy state. Through the natural relaxation process, photons are generated (at 1540 nm in this case). These photons combine with incoming photons from the system's source laser, resulting in optical gain.

Neodymium is the rare earth dopant that appears to work best in the 1310 nm transmission window. Erbium in the dopant that appears to work best at the 1550 nm window.

Counter to the case with today's linear lasers, 1550 nm wavelength optical amplifiers are ahead of their 1310 nm counterparts. Many design and reliability issues must be resolved to satisfy the stringent requirements of AM cable TV distribution. Speedy resolution over the next few years could provide even more advantages if the 1550 nm wavelength proves best. It would be a bonus to take advantage of optical transmission fiber's approximately 0.2 dB/kilometer lower loss at the longer wavelength.

Of course, linear light sources would have to be commercialized at 1550 nm, too, for this to work. So far the challenge has been far from trivial. Despite the inherently lower electron-photon conversion efficiency at 1550 nm (theory says it is approximately 70 percent that of 1310 nm), laboratory progress suggests larger volume commercialization is possible. And the now-familiar direct-modulation light sources might be but one option. External modulation might prove practical over time.

Fiber extending all the way to the home is unlikely to occur in volume during this decade. Even BellCore now is allowing for AM video and "fiber-to-the-curb." We call it "fiber-to-the-tap," and also do not rule out digital modulation of video.

Consider that digital video may be much more highly compressed than the 45 megabits per second (MBs) proposed as a telephone industry standard. Ten-to-one ratios sound more economically attractive than 2:1 or 3:1. Further consider that it does not have to be "all or none." With about 200 million TV sets requiring AM video inputs, that is good news. Hybrid AM/digital systems may evolve. Further good news is that if the distribution plant is built to handle multichannel AM video, then digital video transmission is easy. Note that the reverse usually is not true, even with all fiber optics.

Further out in time, the optical heterodyne tuning aspects of coherent systems technology may allow virtually unlimited channel capacity. Today we often force 40 to 60 frequency-division-multiplexed RF channels down a transmission fiber on a single optical wavelength. If we could precisely control the optical signal transmission and reception wavelengths, we might also, in time, transmit perhaps 60 or more optical carriers. Multiplying the number of RF carriers by the number of optical carriers, we wind up with capacity for thousands of channels over a single fiber. ■

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Case study: Fiber to the line extender

Hillsborough, North Carolina, is a town of 5,060 people located in a semi-rural area of approximately four square miles. Alert Cable, a system of approximately 1,300 subscribers acquired by Cablevision Industries, experienced a level of picture quality and reliability which failed to meet the MSO's standards. The problems resulted from long cascades of active devices.

The search for an optimum solution motivated Cablevision Industries to deploy an innovative and cost-effective fiber optic network architecture for this project. The new "'fiber to the line extender" (FTLE) architecture, or variations of it, may prove beneficial to a broad range of cable systems.

At Hillsborough, the FTLE design cost less to implement than a conventional coax or "fiber trunk and node" backbone system. The new design has reduced the number of active devices between the origination point and subscribers from as many as 50-plus to a maximum of six.

Fiber to the line extender was made commercially viable for Hillsborough by the availability of a strand-mount optical repeater and the recent introduction of a relatively low cost, high-output optical receiver. This case study examines conditions that led to development of the new architecture, events which made the development possible, challenges encountered, solutions devised, and preliminary results stemming from the project.

Situation

Cascades. The Hillsborough system was, and still is, fed from a headend in neighboring Carrboro, 12 miles away. The original coax supertrunk to Hillsborough contained 32 amplifiers. From there, the longest cascade to reach the beginning of a feeder line contained 18 additional amplifiers. Between the headend and subscriber, then, the signal was cumulatively distorted by as many as 50 trunk amplifiers, plus one bridger and two line extenders (see Figure 1).

By Carl Newberry, Regional Engineer, Cablevision Industries Inc.

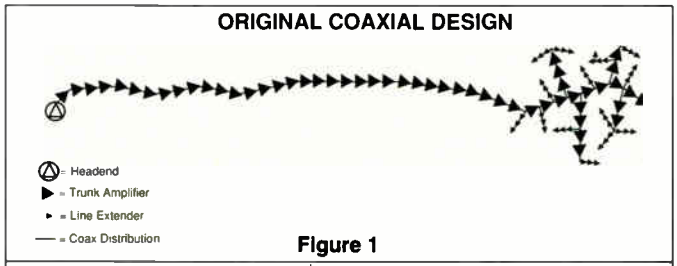

Figure 1

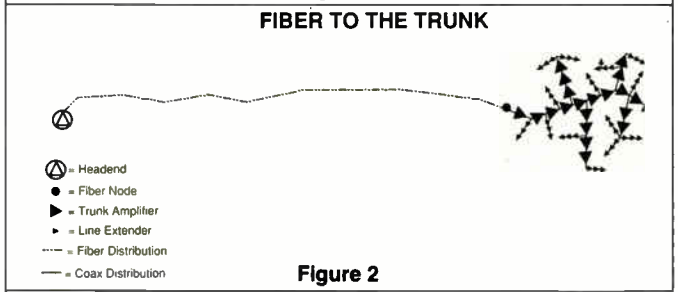

Figure 2

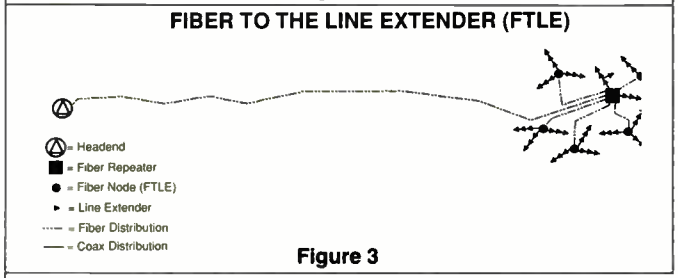

Figure 3

As may be imagined, outages often occurred and picture quality at the system's extremities was marginal. Such substandard performance was unacceptable to Cablevision Industries, the affected subscribers and the town of Hillsborough, which granted the cable system franchise.

Cablevision Industries' standards call for a minimum end-of-line carrier-to-noise ratio of 46 dB; and -53 dB each for composite triple beat, composite second order and cross modulation.

Marketing. The performance problems hampered Alert Cable's ability to maintain and expand its subscriber base within neighborhoods served by the existing network. In several cases, extending the plant into new neighborhoods would have required the use of even longer cascades, and was therefore unacceptable.

In effect, then, long cascades of active devices were costing Cablevision Industries a significant amount of potential sales and revenues within both its existing and prospective service areas.

Bandwidth. The existing coaxial plant in Hillsborough ranged in age from one to 15 years. The oldest portion, within the Hillsborough town borders, had a bandwidth capacity of only 300 MHz. A major extension north of town, built the previous year, could carry 450 MHz. The extension ran 12 amps deep, with a maximum of 44 active devices between the headend and customers. The rebuild design would seek to preserve the operator's investment in this section of the plant while reducing the number of active devices.

Cablevision Industries saw the future need for channel expansion brought on by the addition of new services and service enhancements such as high definition television. The MSO thus sought to upgrade the entire network's bandwidth capacity to 450 MHz, and have the ability to upgrade further at minimum cost.

Alternatives

The least-cost alternative, dropping an electronics upgrade into the existing plant, failed to meet the two main requirements: reducing the number of active devices and meeting Cablevision Industries' carrier-to-noise and distortion specifications. These factors dictated virtually a complete rebuild of the Hillsborough plant except for the recently completed extension.

For the transportation run from Carrboro, upgrading the coaxial cable was eliminated as an option because it would not reduce the long cascade. Microwave was technically feasible but not commercially viable due to the high capital cost of constructing line-of-

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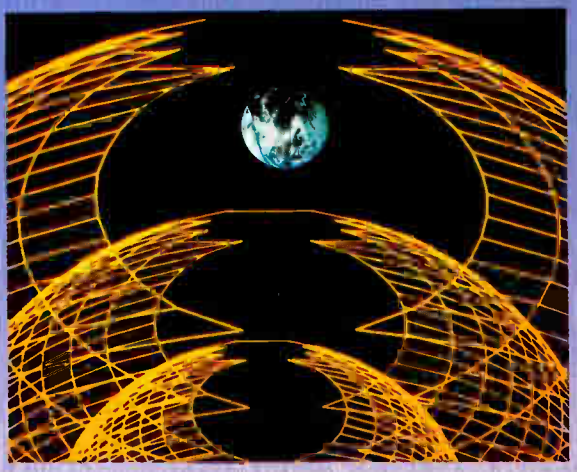

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sight towers. Optical fiber became the logical alternative.

At the project's outset, Cablevision Industries' local and regional engineering personnel responsible for Hillsborough had no experience working with optical fiber. They climbed the learning curve by studying literature, attending seminars, meeting with sales engineers from various vendors, and visiting cable systems where fiber was used.

Their initial design for Hillsborough followed the conventional "fiber to the trunk node" architecture (Figure 2). A fiber backbone was to be run 12 miles from the Carrboro headend. Upgraded coaxial trunk lines and feeders would then distribute the signal. This design placed a maximum of 23 active devices between the headend and subscribers.

Design philosophy

During this process the design team also sought ways to maximize the useful life of the rebuilt plant and thus obtain the greatest return on the capital that would be invested. This meant studying (a) performance and service demands which might be placed on the system within 5 to 15 years, and (b) the inherent capabilities of fiber and optoelectronics.

The team concluded that (a) advances such as digital television receivers and fiber-to-the-home represent the future of cable television, (b) these advances may obsolete current technologies within 15 years, and (c) technologies in general are advancing so rapidly, it is nearly impossible to predict what cable television systems may truly be like at the turn of the century.

As a design philosophy, then, the team viewed every new section of coax, with the possible exception of feeders, as a liability in terms of maximizing the plant's adaptability and useful life.

A 550 MHz optical receiver/VSB/AM optical repeater combination suggested a third design alternative for Hillsborough: running fiber all the way to the first line extender in each feeder line. To the Hillsborough team this represented a logical intermediate evolutionary step in the use of fiber for cable networking (Figure 3).

Fiber to the Line Extender (FTLE)

Potentially, fiber to the line extender would further reduce the number of active devices, which in turn would further improve picture quality and reliability. It would reduce plant obsolescence by making it easier to adapt the network to future technologies and service demands. And as it turned out, the installed cost would actually be lower than for coaxial trunking.

The Cablevision Industries team began discussions with Sumitomo Electric that addressed carrier-to-noise ratio, cost of the optoelectronics, verification of the published specifications, and the optical receiver's RF output level.

The receiver, employed in the new design as an "optical line extender," initially had an output of 30 dBmV. However, the Cablevision Industries team sought an output of 48 dBmV to match that of existing RF bridger units. This would avoid the necessity of placing an RF amplifier immediately behind the optical receiver to boost its signal to feeder-distribution levels.

As various questions were resolved, it became apparent that using fiber in place of coax bridger lines would not

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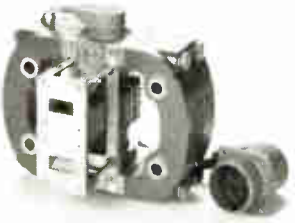

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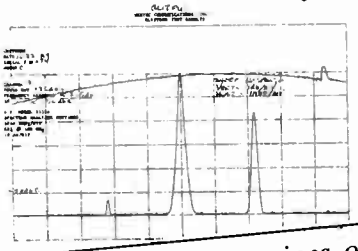

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be a simple one-for-one replacement of the existing lines. To optimize cost, a new architecture would be needed.

Optimizing cost

The operator set an overall design goal of cost-effectively distributing the signal via fiber from the Carrboro headend to the nearest line extender in each of several coaxial feeder lines.

The first option was a one-for-one replacement of coax trunk lines with fiber. This was technically feasible but would have required a VSB/AM optical receiver at each of 41 bridger locations, a very costly strategy.

Nearly all Hillsborough subscribers were located within a roughly circular area whose radius was less than a mile. This fact, plus the goal of minimizing the number of optical receivers, led to the design that was finally employed. The team determined that all feeders could be served from a single optical repeater plus six secondary optical receiver nodes, i.e., the optical line extenders.

Mini-headend

In effect, the repeater would serve as a "mini-headend." The signal would pass through optical splitters—passive devices—and then be distributed via secondary fiber lines to the optical receivers (Figure 3). These nodes would be positioned at the head of the feeder lines. Each optical receiver would output RF 48 dBmV.

As a design goal for Hillsborough, no more than three line extenders would be cascaded. This would effectively limit feeders to a maximum length of approximately 5,000 feet to 5,500 feet, assuming a relatively low flat loss produced by the RF couplers. A 5,000- to 5,500-foot limit would not pose a significant design constraint, given the relatively compact distribution of Hillsborough subscribers, i.e., within a radius of approximately one mile. (In other applications, it is envisioned that up to five RF line extenders would be cascaded.)

Optimizing the design

Optical repeater. At this point it should be noted that cable systems are conventionally designed outward from a fixed headend to trunk and feeder lines whose location and configuration are optimized by the network's designers. At Hillsborough the challenge was considerably different: the feeder de-

sign could be refined by optimizing (a) the location of the strand-mounted "mini-headend" optical repeater relative to its accompanying optical receiver nodes, and (b) the locations of the nodes themselves, relative to the configuration of feeder routes.

The Cablevision Industries team quickly learned to work with these two challenges interactively. The team began by arbitrarily selecting a generally central repeater node location in Hillsborough. However, calculations soon revealed that there would not be sufficient signal strength to provide high quality service to subscribers 5,000 feet down a feeder line, given the use of only three line extenders.

Design issues. Several design attempts were made by trial and error to reposition the repeater node. This did not produce the desired minimum carrier-to-noise ratio at the 5,000-foot distance. The team found that it had significantly underestimated the amount of flat loss produced by the RF couplers.

Normally, this would not be a major design concern. A trunk station would simply be added in order to position a bridger closer to the required feeder section. However, in a fiber to the line extender design there are no trunk stations, so this solution isn't possible.

Thus, Cablevision Industries discovered the necessity of more precise and comprehensive network planning. This applies to all variables including the strand map accuracy—footages, drop lengths, tap levels, etc.—as well as flat loss and other transmission variables.

At Hillsborough, after all assumptions were rechecked, the team found that flat loss would effectively limit the length of feeders to approximately 4,500 feet. Once this issue was resolved, more careful positioning of the repeater node quickly produced an optimum solution. It was confirmed that the repeater could feed the six secondary optical receiver nodes and meet all other design requirements, permitting a cost-effective solution.

Backfeeding. There are differences of opinion within the industry as to the desirability of backfeeding as a cable network design solution. The Hillsborough rebuild suggests that in the case of FTLE architectures, backfeeding can play a valuable role.

Backfeeding between the optical repeater and receiver nodes in Hillsborough eliminated the need for a second optical repeater. The cost of an additional 550-MHz strand-mount optical repeater was higher than that of purchasing and installing backfed coaxial cable.

Remarkably, the purchase and installation cost of the fiber to the line extender design employed in Hillsborough was less than the corresponding cost for conventional coaxial trunking (Table 1).

TABLE 1

THREE DESIGN ALTERNATIVES

For all three alternatives, the following items were found to be essentially cost-equivalent:

Make Ready
Map & Design
Strand & Hardware
Feeder Cable
Distribution Devices (Active & Passive)
Cable Installation (Labor)

ITEM	DESIGN ALTERNATIVE		
	Coaxial	Fiber Node	FTLE*
Relative Cost	100	100	80
Backbone Cable (mi.)	11.4	11.4	11.4
Sub Trunk Cable (mi.)	10.6	10.6	10.6
Trunk Amplifiers (qty.)	77	45	-0-
Optical Transmitters (qty.)	-0-	1	1
Optical Repeaters (qty.)	-0-	-0-	1
Optical Nodes (qty.)	-0-	1	6

Fiber to the Line Extender

Conclusion

The Hillsborough rebuild commenced in October 1990. It is expected that the project will be on-line before the end of December, completing the first application of an advanced fiber to the line extender architecture.

Employing FTLE architecture has entirely eliminated the use of trunk amplifiers and bridgers in Hillsborough. It has reduced the maximum number of cascaded active devices from 23 to six, compared with conventional fiber backbone (fiber to the trunk node) architecture, and by 50 to six as compared with the original all-coaxial system.

Cablevision Industries subscribes to the view that (a) fiber cable and optical transmission equipment will largely replace coaxial cable and RF transmission equipment within the next 10 to 15 years, and (b) within five years, all trunk line construction will be fiber optic.

The first stage of this overall process was the replacement of supertrunk and some trunk coax with fiber. Now, as the next evolutionary step, FTLE architecture supplants conventional fiber backbone designs, eliminating entirely the need for trunk RF amplifiers. A third evolutionary stage, fiber to the tap, may eventually emerge.

Given this context, it is believed that employing fiber optics in general—and today, fiber to the line extender architecture in particular—will help protect an operator's capital investment by extending the life of the system. Optical fiber's extremely low signal loss and tremendous information-carrying capacity provides a significant reduction in the maximum number of cascaded active devices. Inevitably, this means higher picture quality and reduced costs over the long term.

It is highly possible that later in this decade, a competitive market for high-quality home services may emerge. Therefore Cablevision Industries seeks every viable opportunity to install fiber closer to the home. ■

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- Parental control of premium channels or all service

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Field experience with outdoor addressability

Operational benefits significant, operators discover

Editor's Note: *As the interest in off-premise or outdoor addressability has gained renewed vigor recently, it has become time to review the benefits associated with such technology. However, because the installed base of devices is quite low, it's often difficult to get first-hand information from cable system operators. Electroline Equipment, however, has hundreds of thousands of units working in the field. It is for this reason this article highlights only Electroline equipment.* CED *by no means specifically endorses Electroline's product over any other.*

If one were to believe the hype surrounding the so-called off-premises addressable conversion systems (actually a misnomer since they are not "conversion" systems per se) being touted recently, you would think that off-premises addressability was the latest technology to come along. The fact is it has been around, in pretty much the same form, since the early 1980s.

Perhaps addressability's ancestor was a system developed by the British Redifussion Company which offered its "Dial-A-Program" system in the earliest days of television. Early off-premises addressable systems for cable television included Ameco's Discade system, the Mini-Hub system marketed and then discontinued by Times Wire & Cable, C-Cor's SCAT Series, the OTAS from Pico Products, E-Com's Tier Guard, the TRACS system by Texscan, the AuTap from Augat and one from Delta Benco Cascade which was eventually bought out by Triple Crown.

By George Sell, Contributing Editor

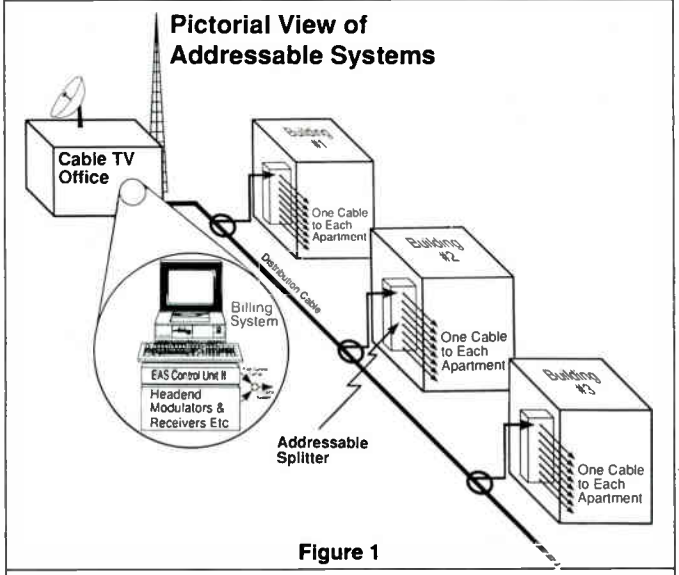
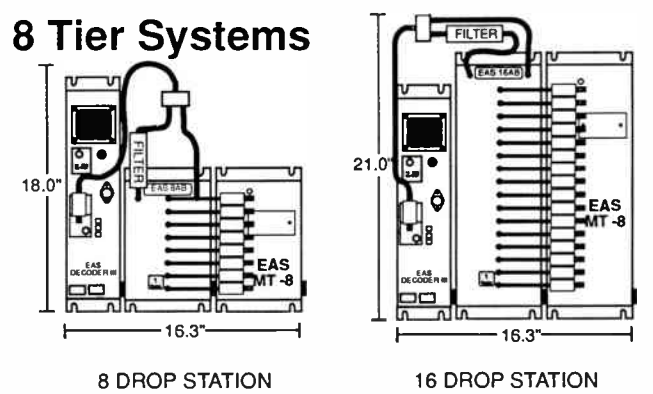


Figure 1



Tiering Description

1) Complete Service Disconnect (5-862 MHz)	5) Premium Channel #2
2) Basic Service	6) Premium Channel #3
3) Extended Basic Service	7) Premium Channel #4
4) Premium Channel #1	8) Premium Channel #5
	9) Premium Channel #6

Figure 2

Others came and went but Electroline Equipment has supplied North American cable systems since 1982 with a broadband off-premises addressable system of its own. However, for years the product remained a hard sell. Today, the Electroline off-premises addressable system is being used in about 80 percent of cable systems throughout Canada. And there is a growing number of American cable systems using the device.

With this success, Electroline has the most extensive off-premises addressable field experience in the industry. Cable operators seeking hard information about the operational benefits of off-premises addressable technology can draw upon this experience.

The technology

Electroline's current product is a fourth generation off-premises addressable system. It could be likened to an addressable multi-tap. Housed in an enclosure outside the home or in a central location in an apartment building, the taps are controlled from the cable company office. The EAS Control Unit at the cable office is a microcomputer which controls and records the status of each subscriber and can be interfaced with the cable system's billing computer. The Control Unit can address more than a million subscribers.

Subscriber information is entered on the keyboard of the computer which communicates with the Control Unit. Various firmware packages for the Control Unit have been developed for specific requirements including pay-per-view, hotel movies, hospital services, correctional institution services and churn control in apartments.

Multi-tiering is achieved by using a tier expanding device and/or by combining addressable multi-taps where each multi-tap assembly controls one tier of service. A tier can consist of one channel or several channels.

Depending on the modular configuration selected, the drop stations can remotely connect or disconnect service,

or control anywhere from two tiers (total service or basic and/or extended basic) up to eight tiers (total service, basic, extended basic and six premium channels).

The number of drops per station range from four to 64 for either the single tier or the two tier units, and from four to 16 drops for the eight tier units. The most popular drop stations are the single tier and two tier units.

Operational benefits

There are some obvious and not so obvious operational benefits of such a system. Perhaps the most obvious is that it provides remote automated connect/disconnect and authorization. This often radically reduces the number of truck rolls and technician service calls. Automating the connect/disconnect process means skilled technical staff can concentrate on other pressing tasks.

This gives the operator the capability of conducting an exact audit from the office using the control computer.

An off-premises addressable system increases drop cable and connector reliability (an important consideration to operators concerned about signal leakage) because drops are handled less frequently. With automated connection and disconnection, installers and technicians can usually install the drop once and may never touch it again.

An off-premises addressable system increases drop cable and connector reliability.

When cable-ready consumer electronics are in the home, broadband off-premises technology permits such equipment to work to their best advantage.

Of course, because the customer receives the signals without a set-top addressable converter, the temptation to steal the signal by tampering with an expensive in-home addressable converter is removed. Also, the widespread subscriber dissatisfaction with set-top addressability can be eliminated if the configuration installed allows for the removal of the set-top addressable converter. Off-premises technology, when used to its fullest potential, can eliminate all use of headend scrambling of services. The signal degradation caused by scrambling and the equipment costs associated with it, including both the electronics at the headend and the expensive set-top converter/descrambler, could be a thing of the past.

The remote multi-tiering capability gives the cable operator enhanced flexibility for marketing of services targeting subscribers that are signed up only for basic service. The potential subscriber can sample the service during a marketing trial offer.

The cable operator has the same automated flexibility in controlling pay-per-view. This can give the cable industry a long-term advantage in addressable pay-per-view relative to competition from Direct Broadcast Satellite and the telephone industry.

Field applications

While it's easy to list the theoretical advantages of off-premises addressabil-

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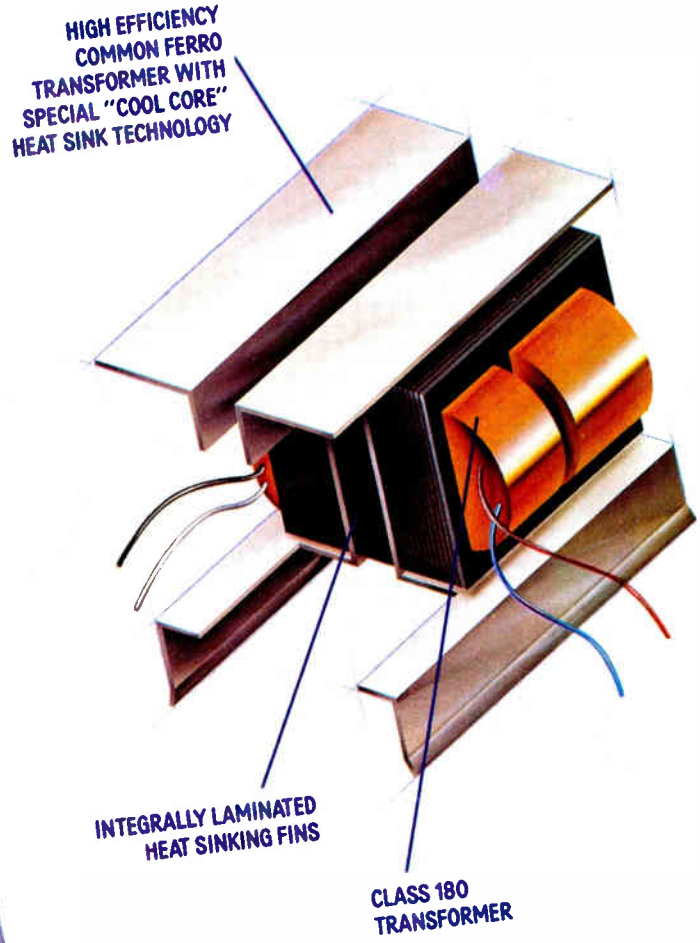

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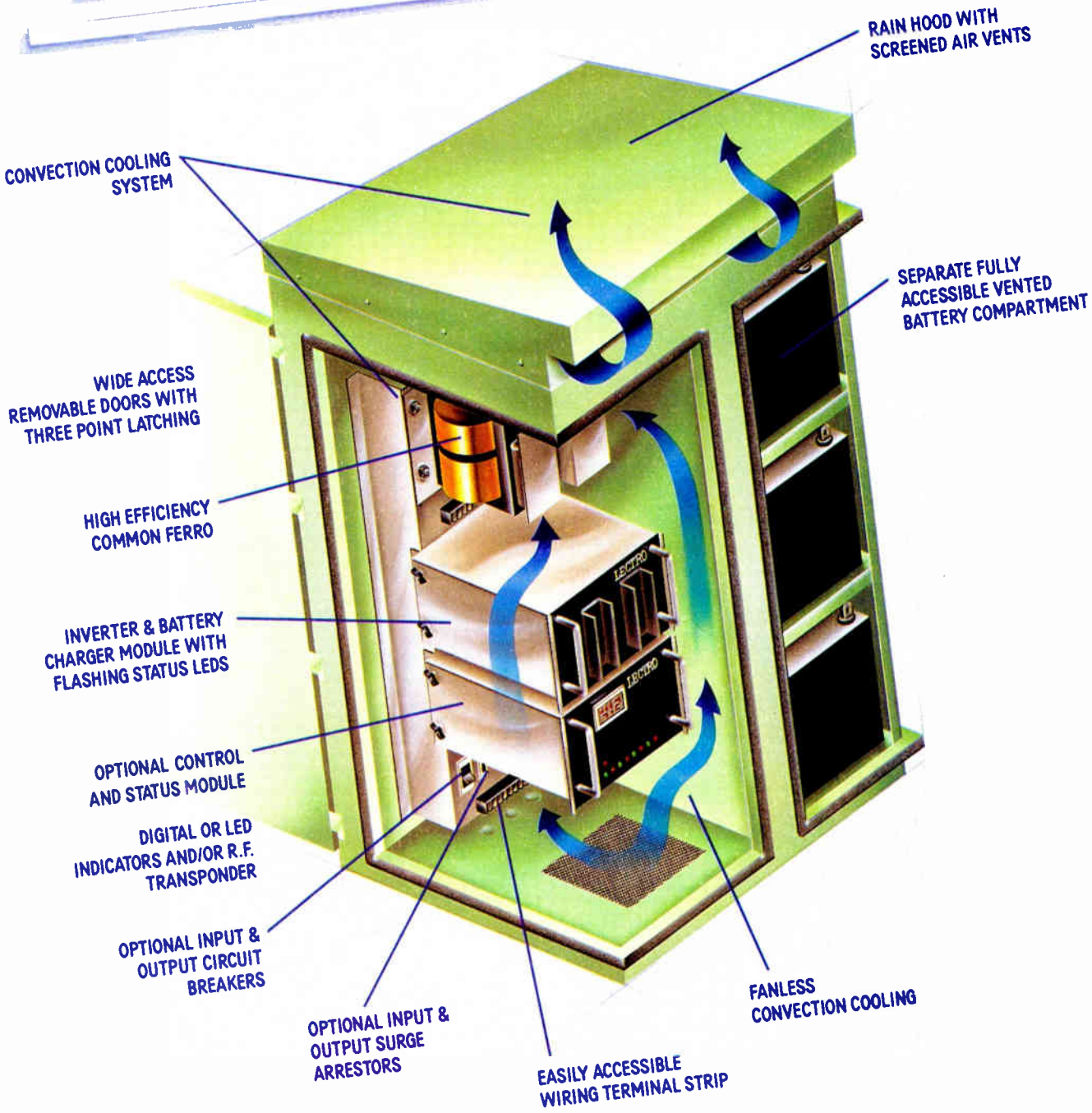

ity, the proof is in the pudding. The Halifax, Nova Scotia cable system was one of the earliest systems to install off-premises addressability in 1982. The system serves over 42,000 subscribers, which represents an 82 percent penetration rate. Halifax Cable is also the MSO for about 72 percent of the Province of Nova Scotia through common ownership with a consortium of shareholders. Currently, Halifax Cable has about 5,000 outlets that use the Electroline off-premises addressable system.

Bill Sayers, GM of Halifax Cable, reports that the technology has been upgraded in terms of capability in the last 12 months. "We upgraded from a basic service on-off to include basic service on-off plus on-off for the second tier which we call our Value Pack tier."

This upgrade has meant that they can now offer TSN Sports Network, Much Music (a music video channel), Arts & Entertainment, Nashville Network and CNN, and an additional PBS station from Detroit. Those six services tiered together are available for $3.25.

More revenue, less cost

While increased revenue is always a desirable outcome to have from a technology upgrade, the reduction of operational costs has also pleased Sayers. Halifax, which has four major universities and a large military presence, is considered highly transient. So the system has plenty of churn, especially within apartment buildings.

"Costs really hit you where you have a lot of connect/disconnects," says Sayers. "(But with off-premises addressability,) you don't roll a truck anymore. We estimate that truck rolls for connection or disconnection costs us approximately $28.75 (Canadian). We don't have to spend that money," Sayers cheerfully reports. "We've recovered our costs fairly rapidly."

Sayers is also impressed with the equipment's reliability. "I'm aware of only two instances when we lost service in a building. Sixteen (apartment) units failed (when) one strip went out. And one time a water pipe broke that was directly above this equipment. We had to replace the decoding unit to get the service back on immediately. But after we dried out the one that had been drenched, we checked it over and put it back into service."

Rogers Cable, the largest MSO in Canada, is another major purchaser of off-premise addressable equipment. Nick Hamilton-Piercy, Roger's vice president of engineering and technical services, says, "We've probably got several hundred thousand units in multi-unit apartment houses." Rogers has been using the equipment for the past five years.

"The unit we are using is the basic unit, just the on-off switch. We are not using the tiering at this point." Hamilton-Piercy believes that the tiering capability will become more attractive in the Canadian environment after the CRTC's cable regulator (Canada's FCC) allows operators to offer pay-per-view.

In terms of the device's reliability, Hamilton-Piercy is impressed. "They certainly have given us next to zero service problems in a technical sense. They've made the high churn environment of apartment buildings a lot more manageable from an operating sense and allowed us to have much better administrative control of who should be connected and who should not."

How reliable is it?

Equipment reliability is consistently reported by operators. American Tele-

Continued on page 101

1988-1990

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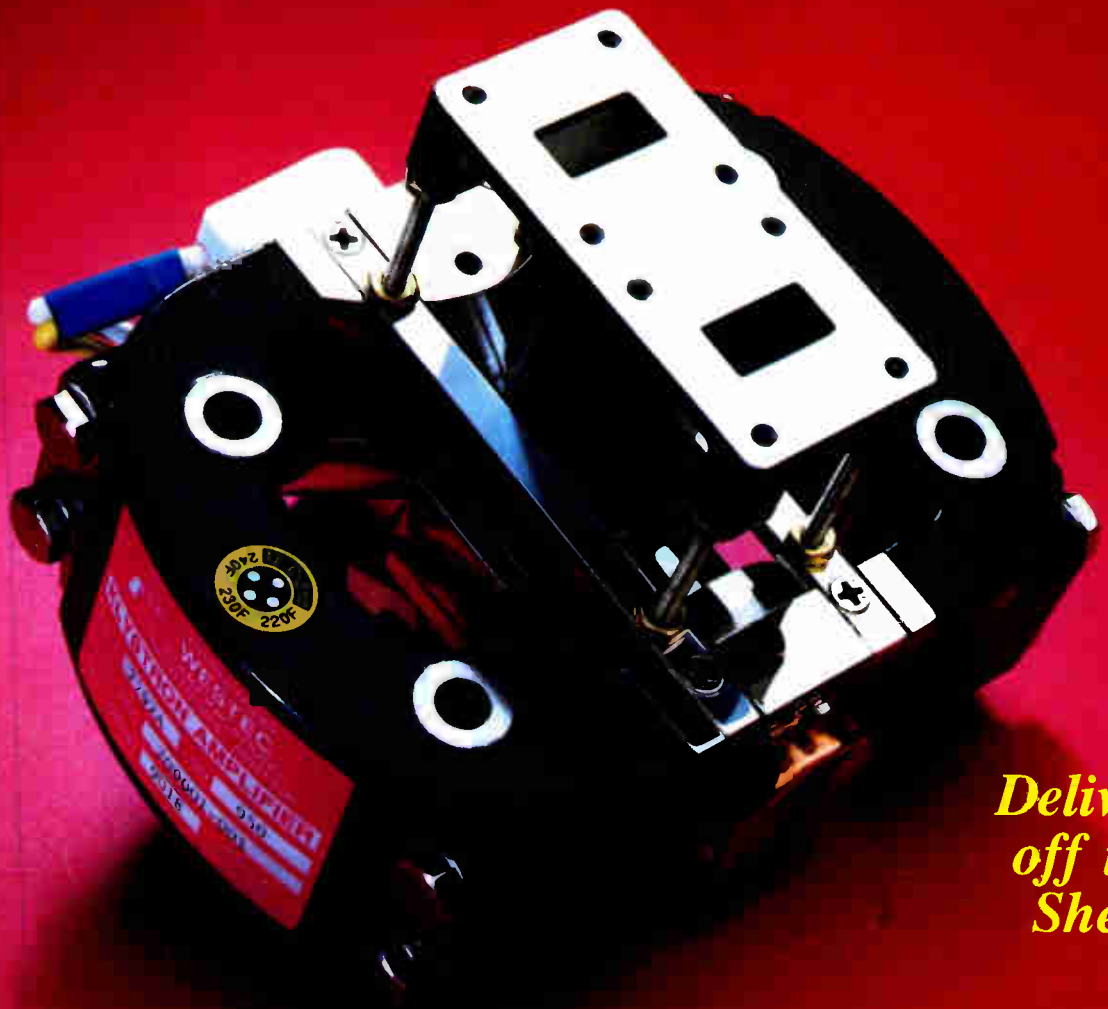

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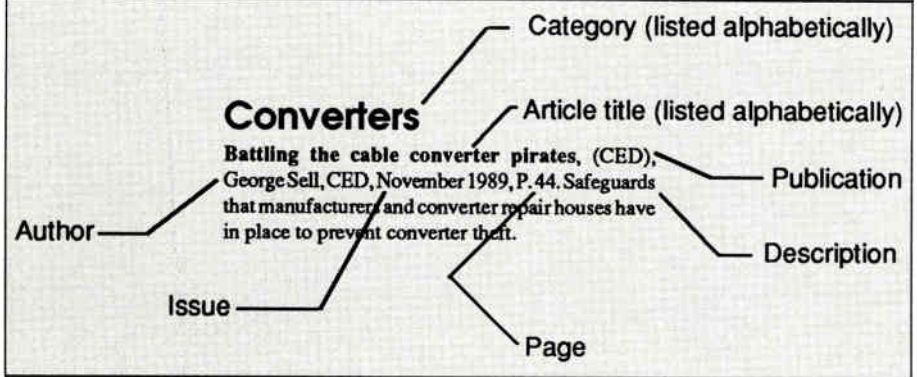
Welcome to the industry's first all-inclusive index to technical articles. Over the years, we've had repeated demands by our readers for an editorial index to *CED* magazine. But we decided to take it one step further and the result is a more useful product for you, the reader—this all-inclusive roster of technical articles that have appeared over the past three years in *CED, CableVision, Communications Technology* and *Cable Television Business* magazines.

The index is divided into broad topics of interest, with articles that pertain to that subject listed alphabetically underneath. As shown below, the article title is shown in bold type, followed by the publication in which it appeared, the author and page number. In many cases, a short description of the article is also included.



Articles that encompass multiple subjects are often listed under more than one subject area. However, space limitations prohibited this practice in all cases. Therefore, stories are listed in the category which dominates the story's theme. For example, a story about using filters in the headend to reduce distortions could be listed under "Distortions" and "Headends." However, it may only appear under "Distortions" because that is the primary theme of the article.

This index covers articles that were published between January 1988 and October 1990. For information about any of the articles listed, please call or write the editor of the publication in which the story was published:

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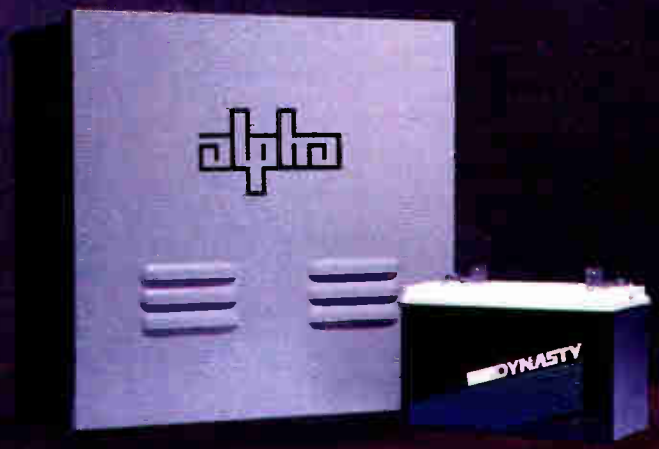

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Improved NTSC won't be easy (CED), Archer Taylor, Malarkey-Taylor Associates Inc., May 1988, p.10. History of NTSC standards and suggestions for improved performance.

Issues for HDTV, cable (CT), Walter Ciciora, ATC, February 1988, p.86

The issues of HDTV (CED), George Sell, CED, January 1989, p.21. Review of the HDTV technical session held at the 1988 Western Show.

Ku-band consortium eyes HDTV delivery via DBS signal (CV), Fred Dawson, January 1, 1990, p.8. A review of Scientific-Atlanta's HBD-MAC system.

Large video display screens (CED), Archer S. Taylor, Malarkey Taylor Associates Inc., May 1990, p.96. A review of the principal large screen display technologies currently under consideration.

A non-NTSC-based HDTV system (CT), Pieter Fockens, Zenith Electronics, October 1989, p.72

Not if, but when (CTB), September 1, 1990, p.29

An objective review of the HDTV proposals (CED), Birney Dayton, Grass Valley Group, June 1989, p.78. The HDTV System Subcommittee/Working Party 1 Interim Progress Report to the Advisory Committee on Advanced Television Service.

Observations on a couple of HDTV receiver schemes (CT), Lawrence Lockwood, TeleResources, January 1989, p.105

Oscillator phase noise and its effects in a CATV system (CT), Rezin Pidgeon, Scientific-Atlanta, and Dan Pike, Prime Cable, October 1988, p.78

Oscillator phase noise: A follow-up (CT), Dan Pike, Prime Cable, and Rezin Pidgeon, Scientific-Atlanta, November 1988, p.80

Putting HDTV to the test (CT), Willem Mostert, Magnavox CATV Systems, October 1988, p.72

Rational expectations for ATV (CT), Walter Ciciora, ATC, May 1989, p.126

The road ahead (CV), Chuck Moozakis, July 16, 1990, p.56. Bridging the technical gap between technological application and field usage.

Ruminations on HDTV transmission (CT), Lawrence Lockwood, TeleResources, May 1988, p.96

Satellites ready and waiting for HDTV (CED), George Sell, CED, March 1989, p.50. Effect HDTV will have on satellites.

Selected topics on HDTV: A tutorial on the basics (CT), Gerald Robinson, Scientific-Atlanta, October 1989, p.32

Shattering an HDTV myth (CT), Walter Ciciora, ATC, December 1988, p.146

Some working assumptions in the economics of CATV HDTV, (CED) George Sell, CED, March 1989, p.56. A brief discussion of the economic impact HDTV will have on U.S. industries.

Strategies for a de facto cable/HDTV standard (CED), George Sell, CED, August 1989, p.44. Explores the possibility of cable setting its own HDTV standard without waiting for an FCC decision.

Subscriber value in ATV (CT), Walter Ciciora, ATC, August 1989, p.140

TCI at odds with other MSOs on best approach to HDTV (CV), Steve Tuttle, May 22, 1989, p.44. Operators dispute over whether to pursue advanced television technology offered by Faroudja Labs and NBC/Sarnoff, or to wait for the emergence of true HDTV.

TCI offers HDTV plan (CV), Simon Applebaum, April 10, 1989, p.12. TCI's John Sie tells Congress that the U.S. should adopt a 10-year plan that protects broadcasters and cable television in the move toward HDTV.

A testing program in preparation for advanced television systems (CT), Nick Hamilton-Piercy, Rogers Cablesystems, October 1989, p.42

A trail guide to the FCC HDTV committees (CT), Walter Ciciora, ATC, May 1988, p.120

TVRO requirements for ATV signal reception, part I (CT), Marvin Freeling, GE American Communications, and Krish Jonnalagadda, David Sarnoff Research Center, August 1990, p.26

TVRO requirements for ATV signal reception, part II (CT), Marvin Freeling, GE American Communications, and Krish Jonnalagadda, David Sarnoff Research Center, September 1990, p.42

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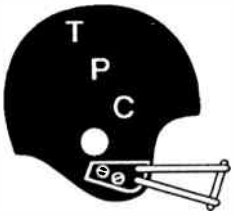

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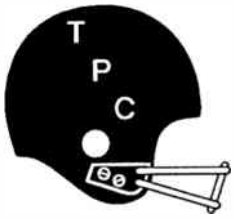

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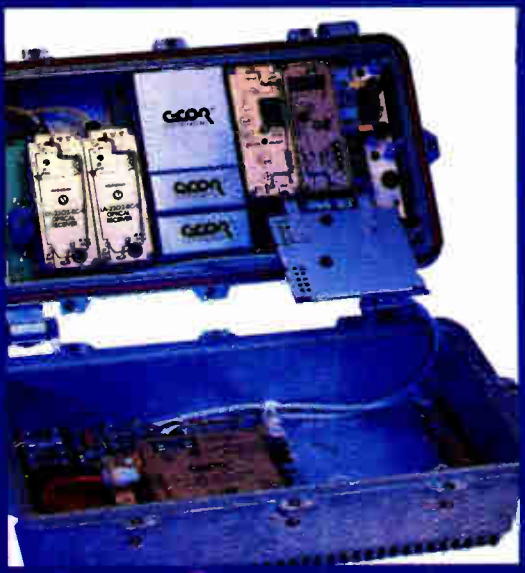

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Today's complex systems contain many long amplifier cascades which can create signature build-up that distorts reception. In the eyes of your subscribers, that's not what they're paying for.

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You could also test parameters most affected by laser nonlinearity — cross-mod, and second and third order distortion.

Elegant but easy.

The Wavetek 1882A does so much, but so easily. Most modes of operation are entered by pressing one, two or three keys. If you make a mistake, it lets you back up, asks you a question, or lists your options.

It takes only a few minutes to store your HEADEND,

to the future. Without interference.

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Then simply connect to your test point, press "3", "1", FUNCTION, and you are sweeping.

Because the 1882A is so easy to learn and use, your sweep techs will be more efficient and effective.

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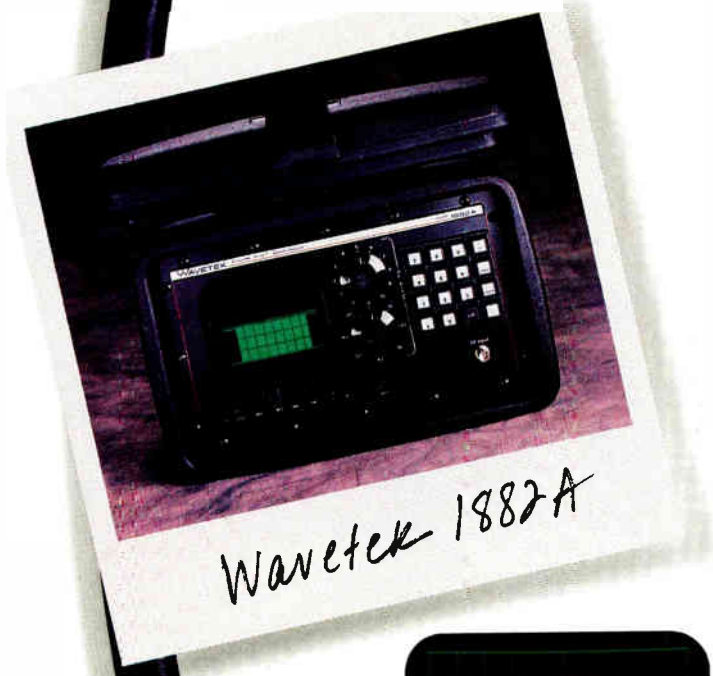

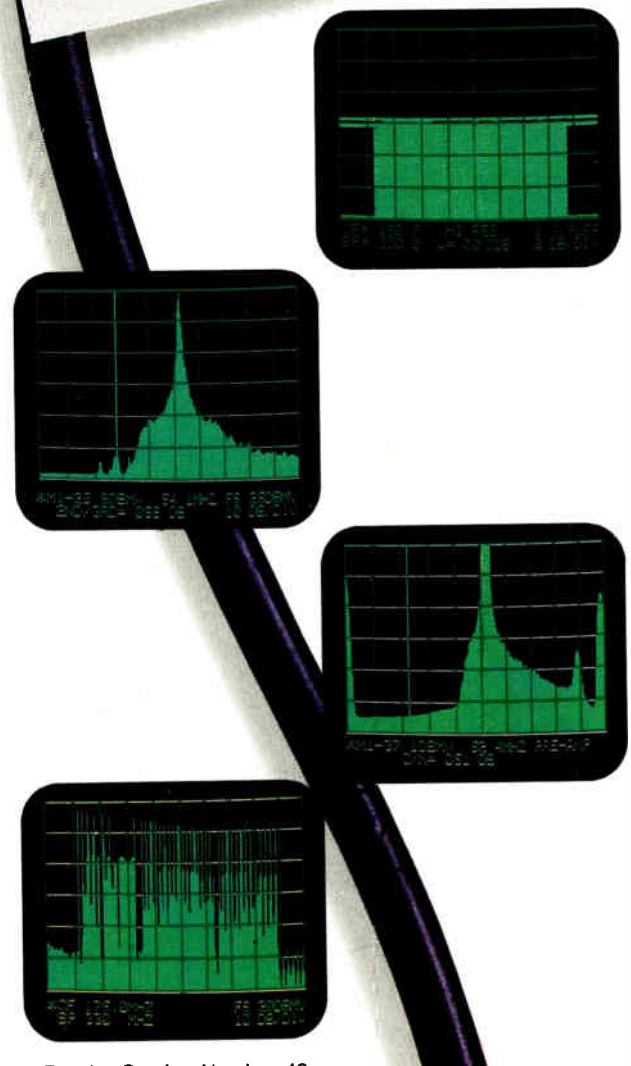

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From the Headend

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Frontline

(All CED columns written by Wendell Bailey, NCTA)

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The art of reducing grounding resistance (CT), Roy Carpenter Jr., Lightning Eliminators, August 1988, p.16

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Spotlight

(A CED department)

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Cable's strength lies in its people, Kathy Berlin, CED, June 1989, p.14. Bill Kohrt, Kohrt Communications Inc.

Callahan charts cable's future, Kathy Berlin, CED, April 1989, p.10. Ed Callahan, Vice President of research and development for United Cable Television Corp.

CATV must now shun complacency, Roger Brown, CED, November 1988, p.12. Dan Pike, Vice President of Engineering for Prime Cable.

Jim Chiddix: Forging new CATV technologies (Man of the Year), Roger Brown, CED, January 1989, p. 53. Jim Chiddix, Senior Vice President of engineering at ATC.

A decade for reality, Kathy Berlin, CED, December 1989, p.24. Andy Paff, VP of National Accounts, Anixter Cable TV.

Early days gave Perez experience he needs today, Roger Brown, CED, April 1988 CED, p.6. Paul Perez of Recoton.

An eye for technology (CED), Leslie Miller, CED, October 1990, p.16. Dom Stasi, president, Flight Trac Inc.

Facing up to the challenges (CED), Kathy Berlin, CED, April 1990, p.14. James W. Stilwell, Retired Corporate Vice President for Engineering Research and Development, TeleSystems Corp.

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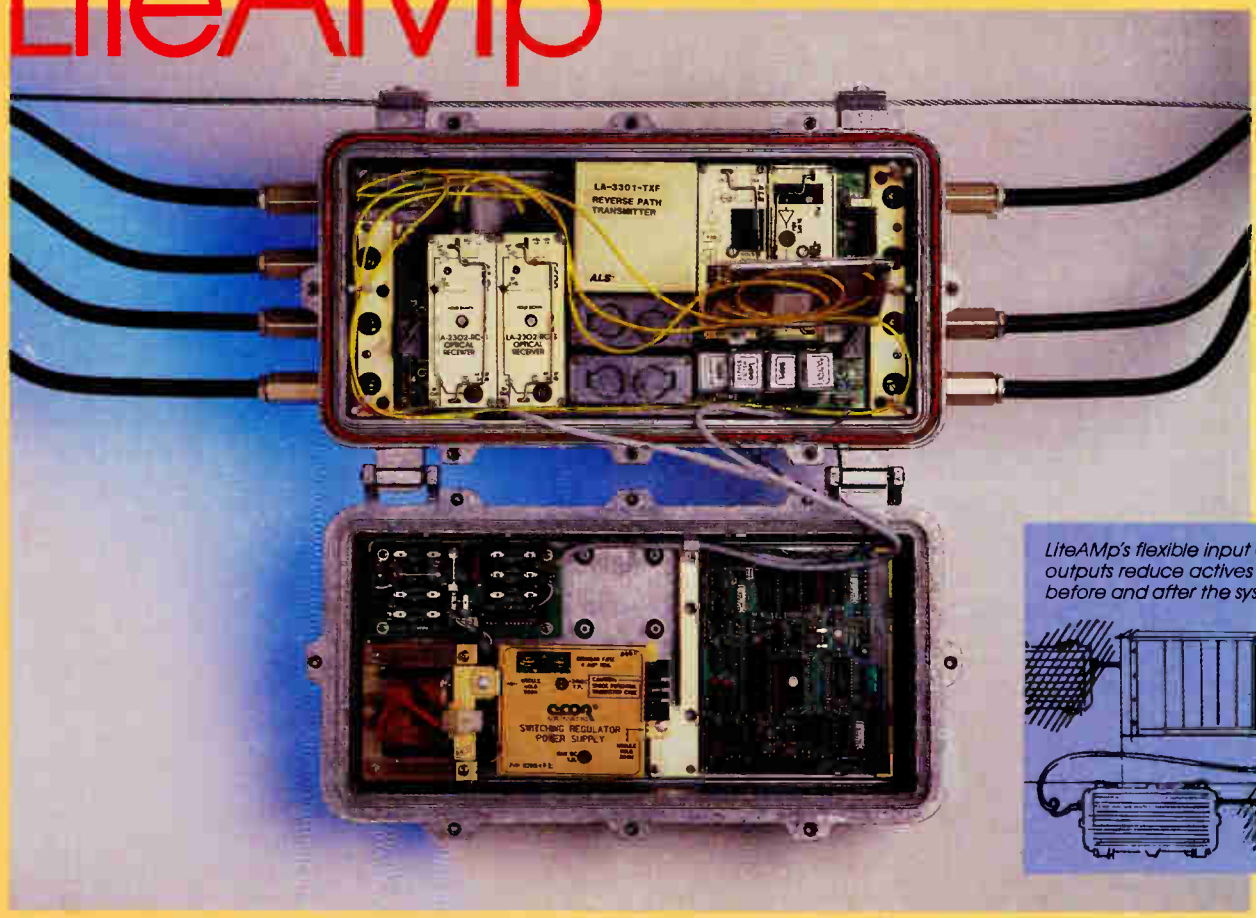

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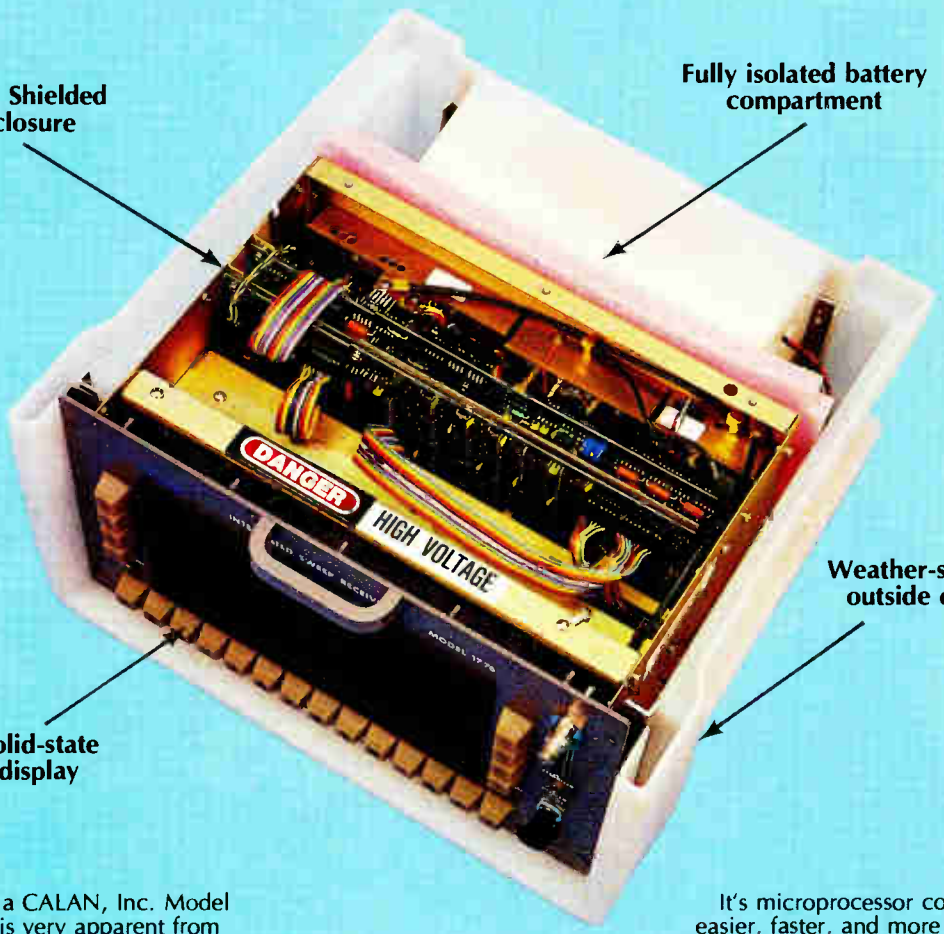

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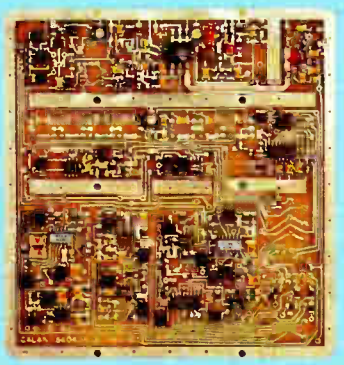

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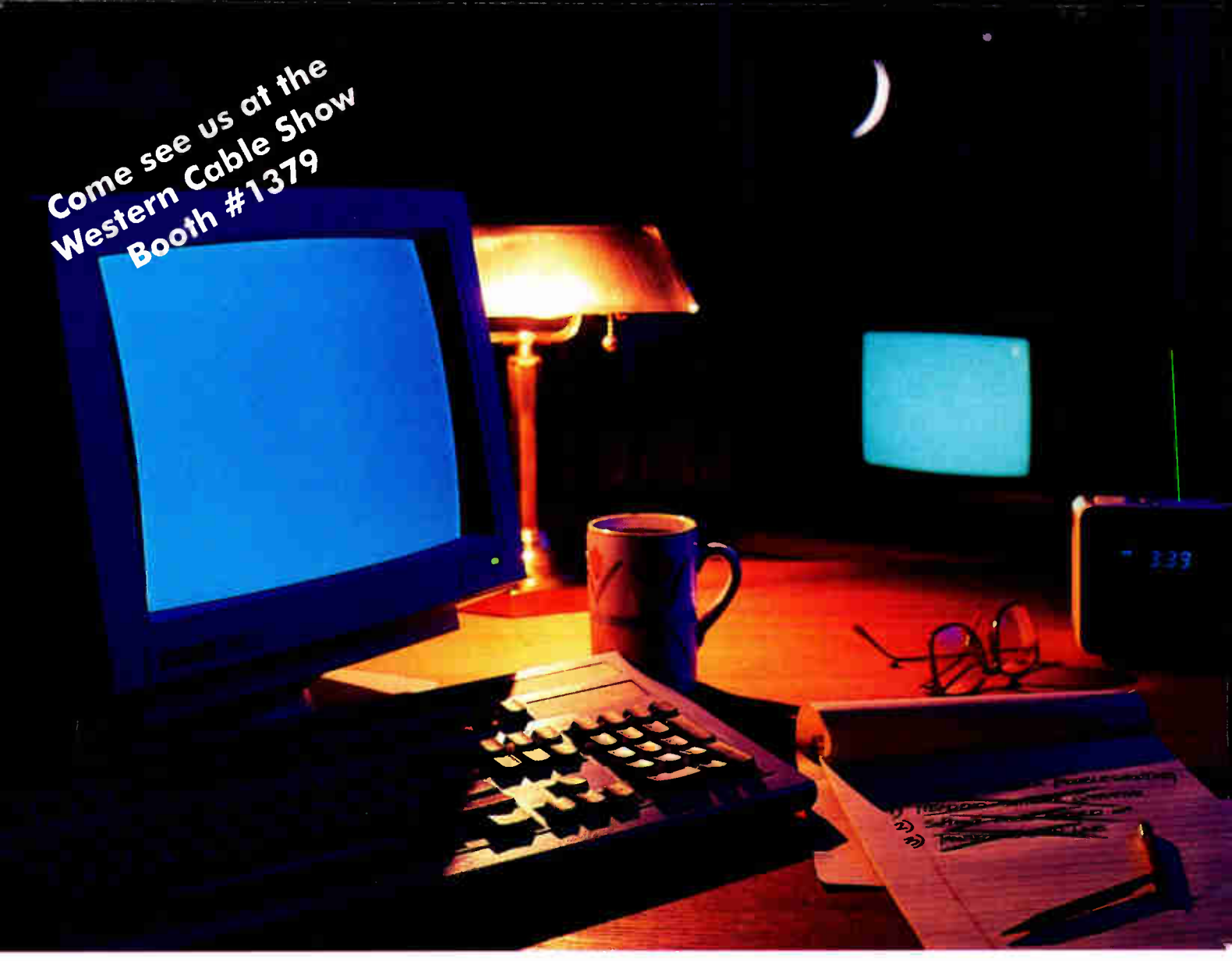

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Reader Service Number 49

vision and Communication's Oceanic Cablevision system on the island of Hawaii, where environmental conditions can be hostile, is one. But Oceanic Cablevision sees the major benefit of off-premise as security for addressable hardware and for remote connects/disconnects.

According to Norman Santos, VP of technical operations, "We are using the tap in its simplest form. We are just using it for on-off or connect and disconnect. We still have addressable converters in the homes that take movie channels."

"We use about 300 units in one lower income area (Mayor Wright House) where we didn't expect the installers would want to do disconnects and we expected some theft. So we took some measures to wire the building with cable encased in pipes and the taps mounted 18 feet high on the building on a shear concrete face to make sure no theft occurred," Santos explains.

"When we get a disconnect for non-payment, we shut the tap off on the outside," says Santos.

Oceanic has had Electroline units operating for two and a half years and can compare penetration rates based on similar types of living areas. "We consider Mayor Wright to be comparable to another place called Camp Four Housing and about the same size," Santos reports. "Our penetration in Mayor Wright seems to be about 20 percent higher than Camp Four. With the ability to control service (remotely), our bad debt is much lower there and our disconnect rate, of course, we do 100 percent on time."

Field testing commences

One cable operator field testing Electroline's off-premises addressable system is Cox Cable's New Orleans system. Installed in a complex with 150 apartments, it has been operating for a few months. John Babich, the technical manager there, is evaluating the cost-benefits of the remote connect/disconnect capability. Is the investment worth it just for that application? "Oh, you know it!" says Babich.

Babich was looking to reduce the number of truck rolls typical with standard drop situations. "You go out there and do a soft disconnect," Babich relates, "and they bypass the converter and still watch everything else you've got on the cable until you go out and do a hard disconnect. That's one roll. And then they come in and pay the bill. You've got to go connect it up again. That's two rolls. Sometimes we repeat that quite often."

And, as in many apartment complexes where entry into the subscriber's dwelling can be difficult, you may have to make return calls if you weren't able to get in the first time. "I have a place down in the French Quarter where it's real hard to get in and do connects because people won't let you in. I'm evaluating this unit to perhaps put in there."

Presently, Babich is considering implementing this technology in other apartment complexes because he also sees an application for the two-tier configuration. "Depending on how big a complex it is and what we sell out there, we might want to use it where we could do a tier and a converter encompassing both. If we have an MDU situation or a bulk complex, we would be able to say, 'Okay, this is your bulk signal,' reconfigure out there and sell them other services. We can always just shut it off and that way they would lose their premiums."

Bottom line

Rogers' Hamilton-Piercy has developed some hard numbers by studying the Electroline system. He looked at churn in residential situations where the occupants were not particularly unusual, demographically.

"When you have 48 apartments, it then becomes cost-effective to put in a completely automated system," Hamilton-Piercy observes, "and anything above that becomes obviously profitable. But in a high churn apartment, such as a student's residence where it is rather vigorous churn, then that 48 number goes down to 16. There are some unique situations in seasonal places where eight may make sense but it's more the exception than the rule," Hamilton-Piercy concludes.

Santos in Hawaii has not conducted a cost-benefit analysis comparing operating with standard drop and set-top converters vs. off-premise addressability. But where he has the off-premises addressable equipment, "I know our trouble call rate still runs lower than the rest of the system. It has been a very reliable system to date and, because people know they can't get their hands on the tap, the tampering aspect is gone."

According to Mitchell Olfman, president of Electroline, the cost of signal on-off control capability gives the operator the most immediate payback.

"To put a (non-addressable) multi-tap on a line, (an operator) is probably paying about $3 a subscriber. To put our unit on the line, it would cost about $15 per subscriber.

"He might pay $12 more per subscriber but on the other hand you have no truck rolls and no servicing of a connect or disconnect."

Often the additional cost is recovered with the first connection or disconnection because it might require several truck rolls before the installer can make entry to the home.

Olfman points out, "When you think that a truck roll costs as much as $30, (a single disconnect) can end up costing $60 or $90. Or the same thing can be said if a new customer is coming on. Rather than him waiting for two to three weeks for an install, the cable company can connect him instantaneously and start collecting revenue instantaneously."

The amount of labor cost savings depends on the wage rate paid. In Hawaii the cost of living has always been high. But Oceanic Cablevision also trains its journeyman installers and service technicians for up to four years after they hire them out of electronics schools.

For Series or Loop Wired Buildings, Addressable Loop-Taps

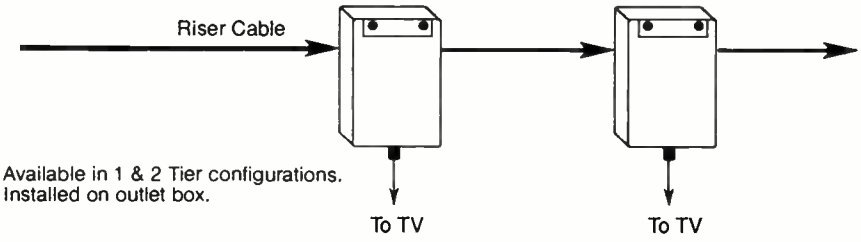

Figure 3

"We have seen," says Santos, "a great deal of time savings. Because we have these people and train them, we pay them rather well. So anytime we don't have to roll a truck we save probably $65 to $70. We think the system has some very desirable qualities in that sense."

A technical challenge for off-premises technology is to keep power consumption to a minimum—particularly for the active devices used. According to Olfman, new models will require less than a watt and a half per subscriber. Conversely, today's typical set-top addressable device requires 10 watts.

Future applications

With the Electroline interdiction system that will be introduced next year, a cable system will have the opportunity to eliminate headend scrambling and all the attendant costs, related equipment and customer dissatisfaction. Electroline will have a pole-mount or strand-mount version of its current product in a cast aluminum housing in the first quarter of next year.

And it's ready for 1 GHz, an important consideration for high definition television (HDTV). Already, prototypes have been developed that accommodate

up to 862 MHz for European applications.

While the HDTV standard is yet to be decided, it is clear it will require increased bandwidth and signal control systems that do not degrade the signal. Wide bandwidth off-premises addressable systems will allow for control of multi-channel and non-standard HDTV signals.

High definition services will need to be offered only to those subscribers who have HDTV sets. Because cable systems experience the greatest squeeze in the drop cable in terms of limited bandwidth, off-premises addressable systems may be useful in overcoming this problem.

Most channels will continue to be NTSC without a HDTV counterpart. By placing the few simulcast HDTV channels in a tier configuration and just their NTSC counterparts on another tier, the homes with HDTV sets could be "authorized" for the HDTV signals without their corresponding NTSC signal. For homes without HDTV-compatible sets, "the NTSC tier" would automatically be authorized.

Therefore, bandwidth could be conserved in the drop since either an NTSC signal or its HDTV equivalent would be passed to the home, not both. And as HDTV households increase incrementally they could be instantly served with the appropriate signal by the pressing of a button from the central office.

In any case, if the CATV industry opts for off-premises technology it will have increased its competitive edge in addressability relative to other competing technologies and future applications. ■

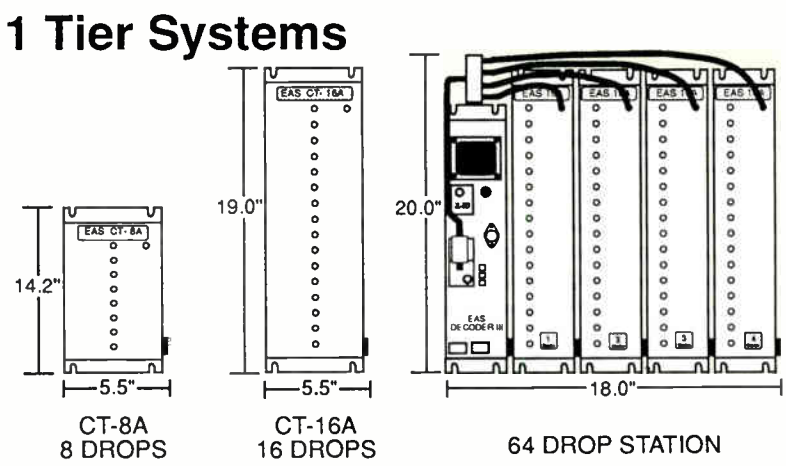

Figure 4

Novel low cost relay programmable attenuators

The familiar TO-5 relay based programmable attenuator just turned 21. Mr. Manfred Franke invented it in 1969 in Indianapolis, Ind. Extensions and improvements on the Franke design followed with a frequency/temperature compensating design in the 1970s and a miniature model in the 1980s. Relay programmable, often called "electromechanical," attenuators are manufactured by at least six companies.

Many designs exceed 1 GHz and at least one company produces a model covering DC to 3 GHz using an improved version of the relay. All designs have at least one thing in common: They are costly to manufacture. TO-5 relays cost $12 to $14 for failsafe, (non-latching), and roughly twice as much for latching models. This is a great leveler for all manufacturers and creates a price plateau to the users. Many 1 GHz and below applications are in the more price sensitive commercial markets such as CATV instrumentation. Therefore, the revenues and profits of some programmable attenuator users are lower than they should be.

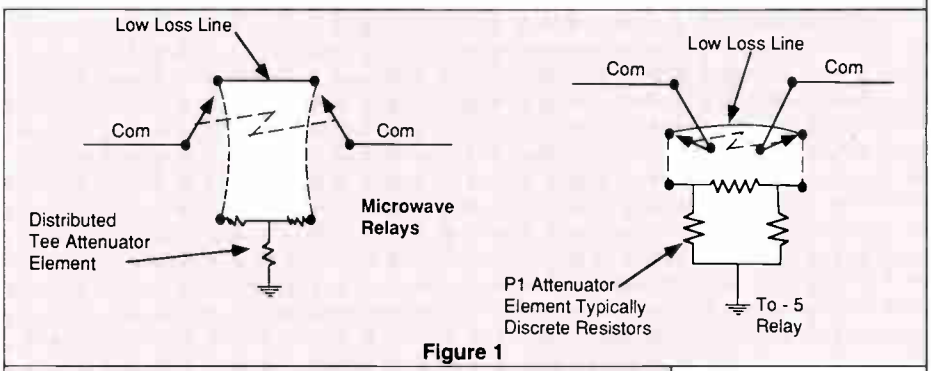

Figure 1

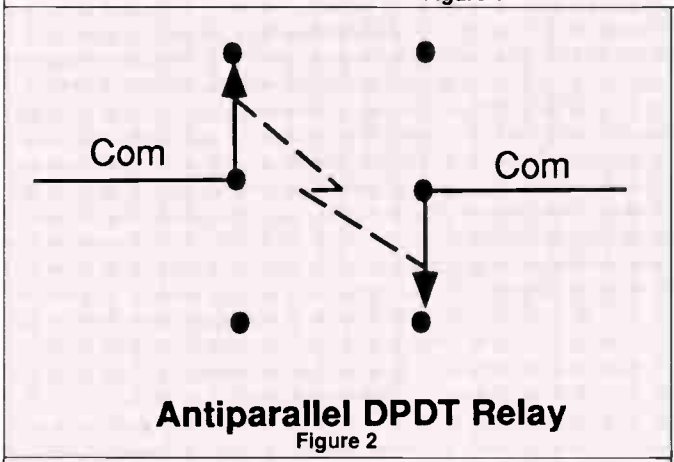

Figure 2

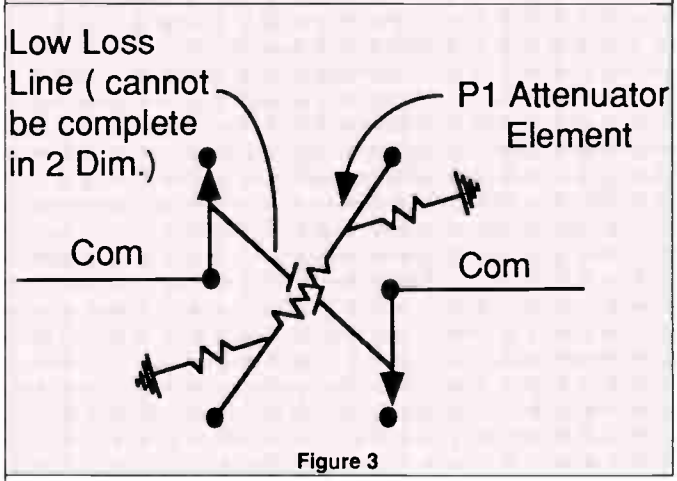

Figure 3

How programmable attenuators work

A DPDT relay that will pass the desired frequency range with low loss, freedom from resonances, and with a good match is used in the configurations shown in Figure 1. The ganged moving contacts switch the common lines between the low loss transmission line and the attenuator element. A 63 dB attenuator with a 1 dB step size has six cells with values of 1-, 2-, 4-, 8-, 16-and 32-dB. A 70-dB attenuator with 10 dB steps has three cells with values of 10-, 20- and 40-dB.

Sometimes, more than one cell per bit is used to achieve attenuation steps larger than the relay isolation will support. A TO-5 relay has enough isolation to support attenuation of 32 dB or 35 dB. A 64 dB bit consists of two 32-dB cells.

The relays mount on the ground plane side of a microstrip line and the attenuator element is soldered to the microstrip and adjacent ground. One manufacturer uses an alumina, instead of plastic, substrate and screens the attenuator element onto the substrate. The substrate attaches mechanically or by soldering to ground inside the case. The case shields the attenuation cells and provides means to mount the connectors. Combinations of RF chokes, capacitors and feedthroughs isolate the attenuator from the relay driver circuitry.

Both failsafe and latching programmable attenuators can be internally wired for both sourcing and sinking drivers. A sinking drive, while more natural to the circuit designer, is less friendly to the attenuator designer because a common high rail provides an internal alternate RF path. An external rail requires twice as many feedthrough terminals. An alternate RF path is devastating to accuracy at high attenuation levels.

But, attenuator designers are accustomed to solving problems like that with internal filtering in the alternative path.

All TO-5 relay programmable attenuators, (also all solenoid actuated microwave attenuators that cover up to DC to 40 GHz), use a relay or switch topology that causes ganged movable contacts to move together in the same direction. So the actual physical topol-

By Bruce Malcolm, President and CEO, Trilithic Inc.

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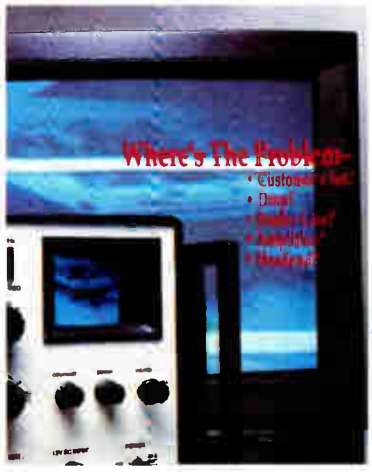

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ogy matches the circuit of Figure 1.

A new design

The obvious way to make a cost breakthrough is to find lower cost parts. Inexpensive RF relays for cable ready TV sets had been available for some time, but the switching topology was antiparallel, as shown in Figure 2. An attenuator cell cannot be constructed in a two dimensional plane because the low loss RF line would run into the line containing the attenuation element, as can be seen by examining Figure 3. However, if an inexpensive way to route the RF signal in three dimensions could be constructed, a low cost programmable attenuator would be possible.

The answer was to use a combination of stripline and microstrip lines. Stripline is a TEM line between ground planes and microstrip is a quasi-TEM line above a ground plane[1,2]. Both types of transmission line are easily constructed using plastic substrate materials.

The heart of the design is a three-layer stack of substrates with crossing and fully isolated lines. Ground planes and plated-through holes help maintain the impedance as the signal moves up and down the stack. There are also guard grounds beside the transmission lines, plated through holes to "carry" the RF ground everywhere in the multilayer stack it needs to be, and a place on the exposed microstrip level for the attenuation elements.

Slashing the costs

With the initial tests of the prototype models showing potential DC to 1 GHz performance, it was appropriate to look at each functional part and decide how the cost might be reduced and whether the part was really necessary.

If an inexpensive way to route the RF signal in three dimensions could be constructed, a low cost programmable attenuator would be possible.

Enclosure. An enclosure was necessary for many applications and it was likely that the user's mechanical mounting requirements would vary greatly. That suggested sheet metal because it is flexible and less costly than milling. Castings and extrusions require costly tooling and tend to freeze the mechanical design. Over a period of months, an extremely simple mechanical package evolved with the help of local machine shop operators. These practical sheet metal experts managed to eliminate a lot more cost. Finally, when the improvements stopped, new fabrication bids indicated that the plating cost was now 30 percent of the cost of the enclosure.

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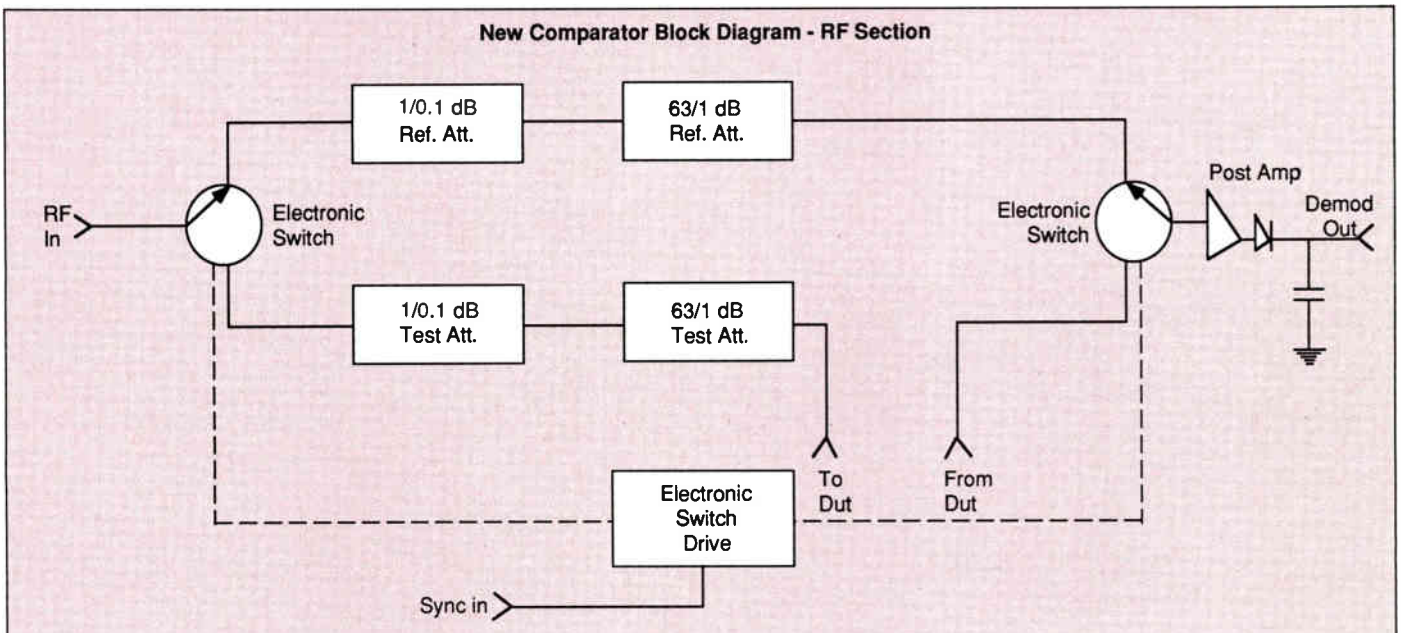


Figure 4

was needed to eliminate the requirement for plating. Considerable time and effort were spent to find and qualify a material for the new attenuator enclosures. While the material is not particularly inexpensive, it meets the other criteria. The result is a net savings compared to plated brass, as well as the improved delivery time resulting from one-step fabrication. A related saving came about through elimination of tapped holes. Sheet metal screws can be used without the risk of corrosion that results from damaged plating on non-stainless material.

RF shielding. The design never needed internal shields, (at least for source driven models), because the stack of substrates provides natural shielding and the relays are well sealed

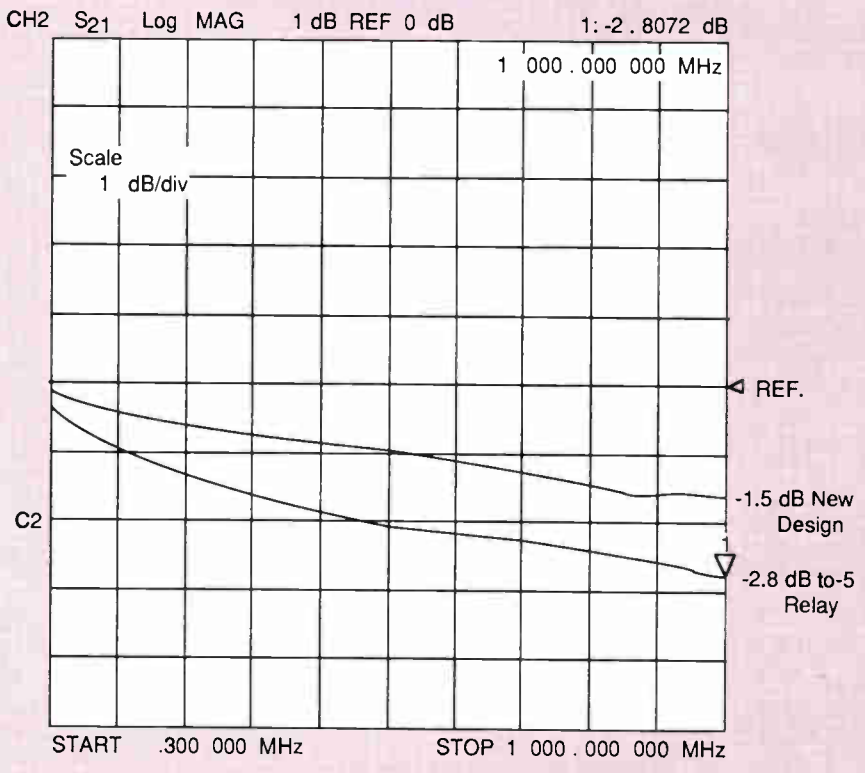
against RF egress/ingress. In addition, while the initial design called for solder-in feedthrough filters, much less costly capacitors later proved adequate.

Attenuator elements. Along with the case material, the design approach for the attenuator elements is also proprietary to Trilithic. It achieves the design goal of better than 0.02 percent, (in dB), accuracy at a cost not exceeding 12 cents per cell and averaging closer to 10 cents.

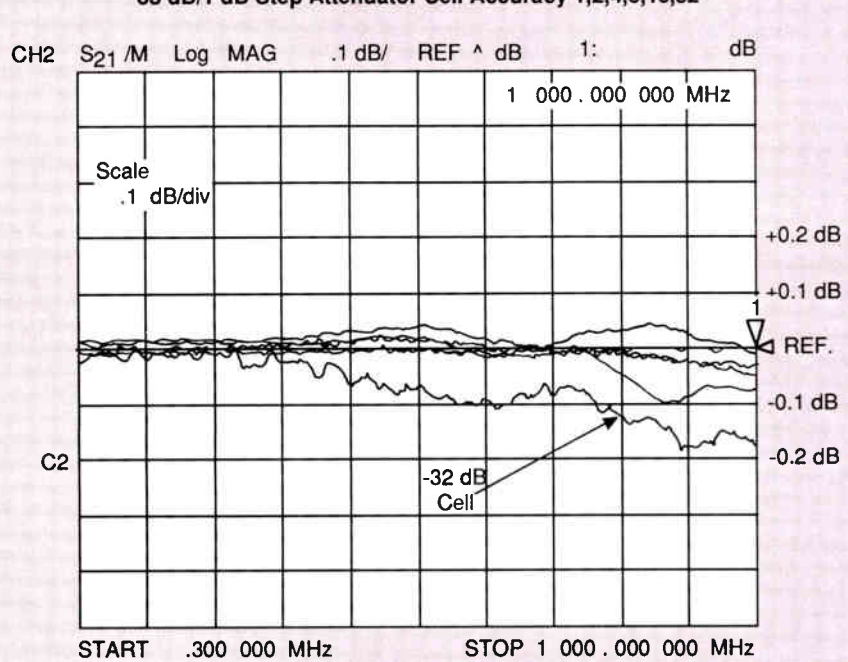
Other parts. No cost saving. The connector cost is equivalent to that of any other RF relay programmable attenuator. Only the printed circuit boards are more expensive as there are two per cell plus one. This is modest price to pay as seen in the material cost comparison (Table 1).

Lower cost attenuators

It appeared that many users might not need or want connectors. Lack of connectors on the attenuator eliminates cost and potential cable problems. And, if connectors aren't needed, why have an enclosure? Well, RFI of course. But many applications don't need 150 dB shielding.



Graph 1



Graph 2

Attenuators, like those described above with no enclosure or connectors, were developed. They were designed by making the board wider and mounting it above the user's board on standard .025 square pins. Switching current comes in on the mounting pins as does RF. The package looks much like a larger version of a DIP IC with the RF I/O pins centered between the dual in-line pins at either end of the package. While they have less performance at higher frequencies than enclosed models, they are adequate for many applications and are indistinguishable in performance below a few hundred MHz. Table 1 also includes the material cost of this line for comparison.

Performance

The performance strengths and weaknesses compared to TO-5 relay based attenuators are the following:

Strengths include lower insertion loss, generally better attenuation accuracy, higher relay isolation that allows 40 dB single cells and, if it can be considered a performance criterion, drive flexibility that isn't otherwise available. This is especially true of the latching relay units that use dual coil relays.

Weaknesses are a practical frequency limitation of 1 GHz, less smooth, (not to be confused with accurate), frequency response due to the greater transmission line length per cell, and return loss of 17 dB to 20 dB because of imperfect internal match of the

Vocabulary based automation

So you've thrown around the idea of of automating your cable system, but you hesitate in taking the plunge, because 1) the chances of finding a system that would be compatible to your current equipment are slim to none and 2) the thought of shelling out the megabucks to a project like this would surely be less than enjoyable.

The good news is headend automation doesn't necessarily have to be a head-scratcher, nor a major expedition into the wallet. Several systems are available on the market today that automate a variety of daily tasks, including routing switch control, local origination playback, commercial insertion, automatic dubbing and compiling and router trunking. And generally speaking (system prices vary), automation systems are cost effective in that the time saved equates to money in the pocket.

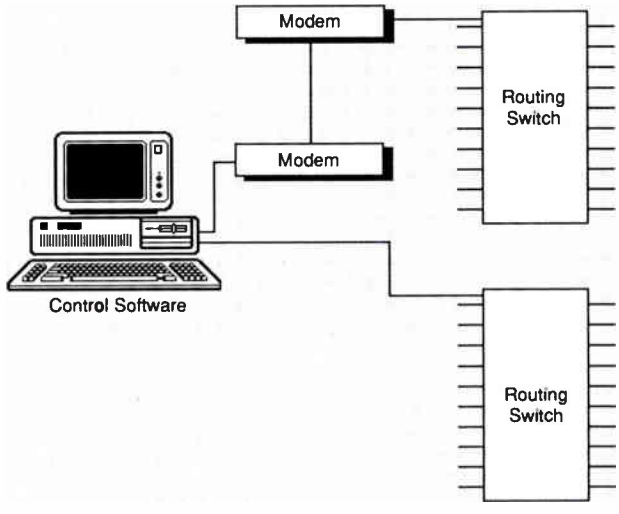


Figure 1

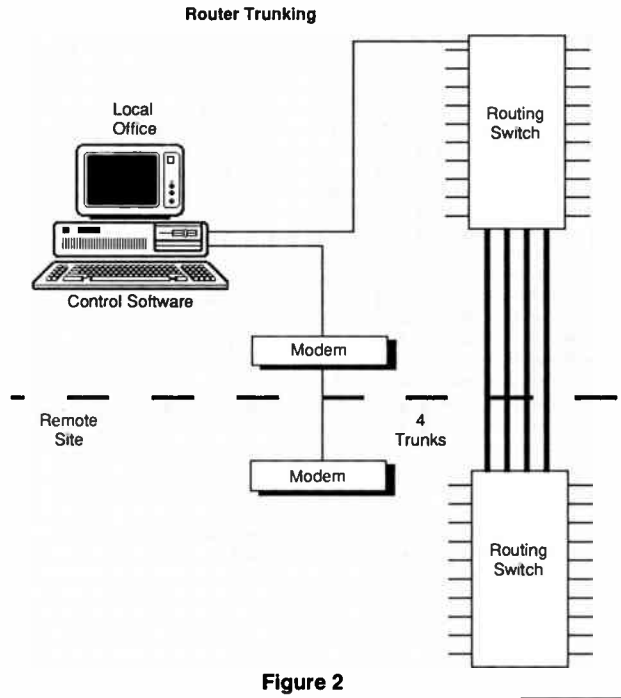


Figure 2

The problem

Michelangelo (the artist, not the turtle) once said that a statue was inside a block of marble before he began carving. His job was to remove all the rock that was not part of the statue.

Similarly, a software programmer's task is to reduce the number of things that the computer can do, until all that is left is the user's wish list.

The great trade-off in any computer-based program is to remove enough options so that the program becomes easy to use, but keep enough to do everything needed.

Computers are programmed by the use of special purpose languages. Computer languages differ from human languages in that computers require a precise syntax and exact structure. When writing in a high level computer language, the entire capability of the computer is in the hands of the programmer. To express a set of requirements in a computer language requires precision and endless detail. Computer programs are written by professionals to present the user with a set of structures appropriate to the task at hand.

By Julie Peterson, Senior Technical Writer, Telecommunication Products Corp. (TPC) and Tim Black, President, Tim Black Engineering

The early years

Broadcast and cable automation systems have been around for many years. Early systems were built with computers that, in this day and age, could be outperformed by a common home video game. Early systems used a fixed format with predefined fields—the user could only fill in the fields with limited choices.

A form-based structure is similar to what is used in electronic spreadsheet programs. Many types of calculations can be entered and understood. Similarly, many automation systems are like spreadsheets, with "rows" of events and "columns" of devices which are filled in by the operator. Even though much more powerful computers are now available, there has been little improvement in the user-interface of automation systems. The form-based approach, although well-suited for a single channel broadcast environment, has a very narrow application in the cable television environment.

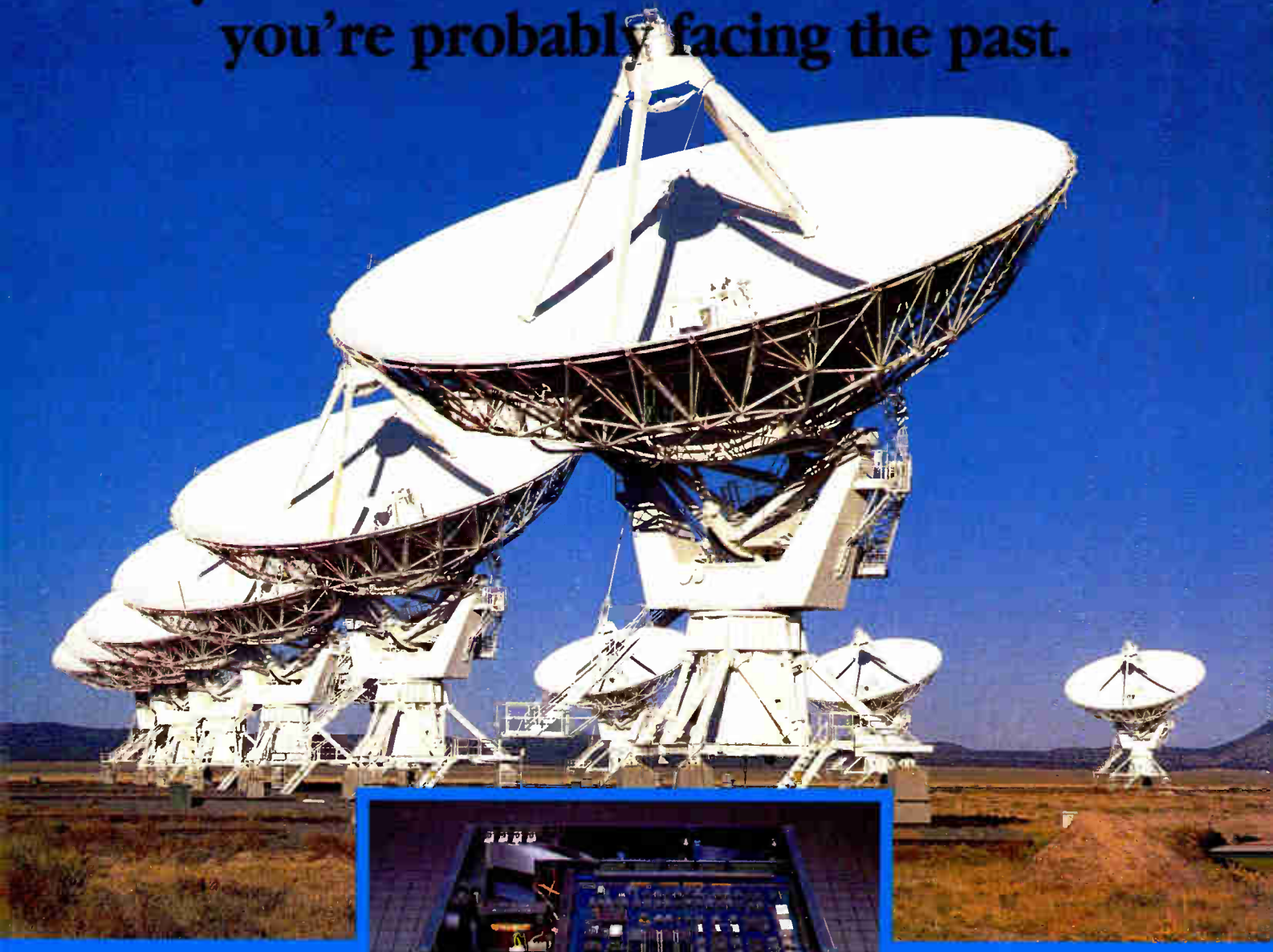
On the other hand, if you are trying to control a system with multiple origination points and multiple channels, the form-based approach rapidly becomes cumbersome enough to be rendered useless.

The real world of systems automation is not as neatly ordered as a spreadsheet. Events are related to other events. Last-minute changes occur. And systems are largely reconfigured for special events. In this environment, a form-based system removes too many options from the user. The best type of automation system should be as easy to use as a spreadsheet but have the power of a programming language.

Vocabulary based automation

An alternative means of controlling

If your head is not tuned to the future, you're probably facing the past.



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television systems is a relatively new technology referred to here as a Vocabulary Based System (VBS), available from several industry suppliers. A vocabulary based system is extremely flexible, in that the technology resembles its name—it is completely vocabulary based. New commands can be added to the system by adding new words to the overall vocabulary. This expands the capability of the system without losing compatibility with existing commands. There are no predetermined limits of channels, tape decks, the size of routing switchers, the number of routing switchers or even the type of commands to be performed.

In a VBS, the event list does not have any predetermined structure. The automation system recognizes certain words such as "switch," "play," "do," "to," "thru," "rewind" and "select." These words form the basis of a command structure. In addition, a section of memory is set aside to allow user-defined words. These user-defined words or labels allow the details of a system (such as router input and output and control addresses) to be hidden from the casual operator. The labels may also be used to group commonly performed blocks of events into a single command.

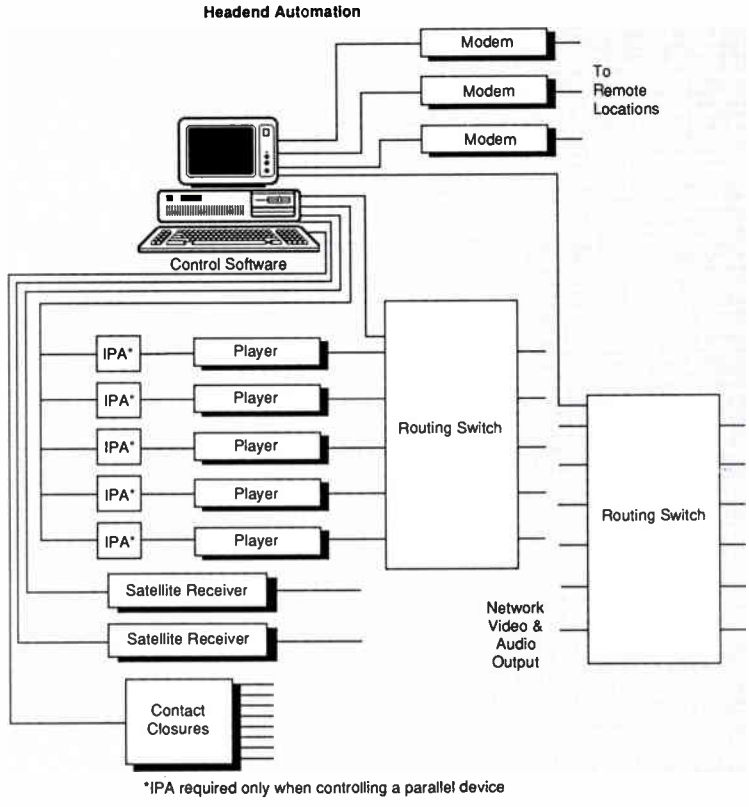

Figure 3

For example, all of the switch commands required to reset a routing switcher to its normal input and output structures could be grouped together under the label "reset router."

An automation system must be designed to be "customizable." The great variety of devices and protocols that now exist cannot be addressed through a fixed form. Automation systems must support many different ways of controlling different devices. The range of schemes that need to be accommodated is very wide and includes individual contact closures, BCD or binary parallel addressing, keypad emulation, serial communication in binary or ASCII form (RS-232 or RS-422) and networking through ethernet or token-ring architectures.

Many automation systems today fail to take advantage of current trends in user interface design. Features such as help screens, self-explanatory menus, resizeable windows and mouse support should be expected in any current software.

An important aspect of any automation package is cost-effectiveness. Many automation systems are supplied as package deals, necessitating the purchase of a new routing switcher or other equipment.

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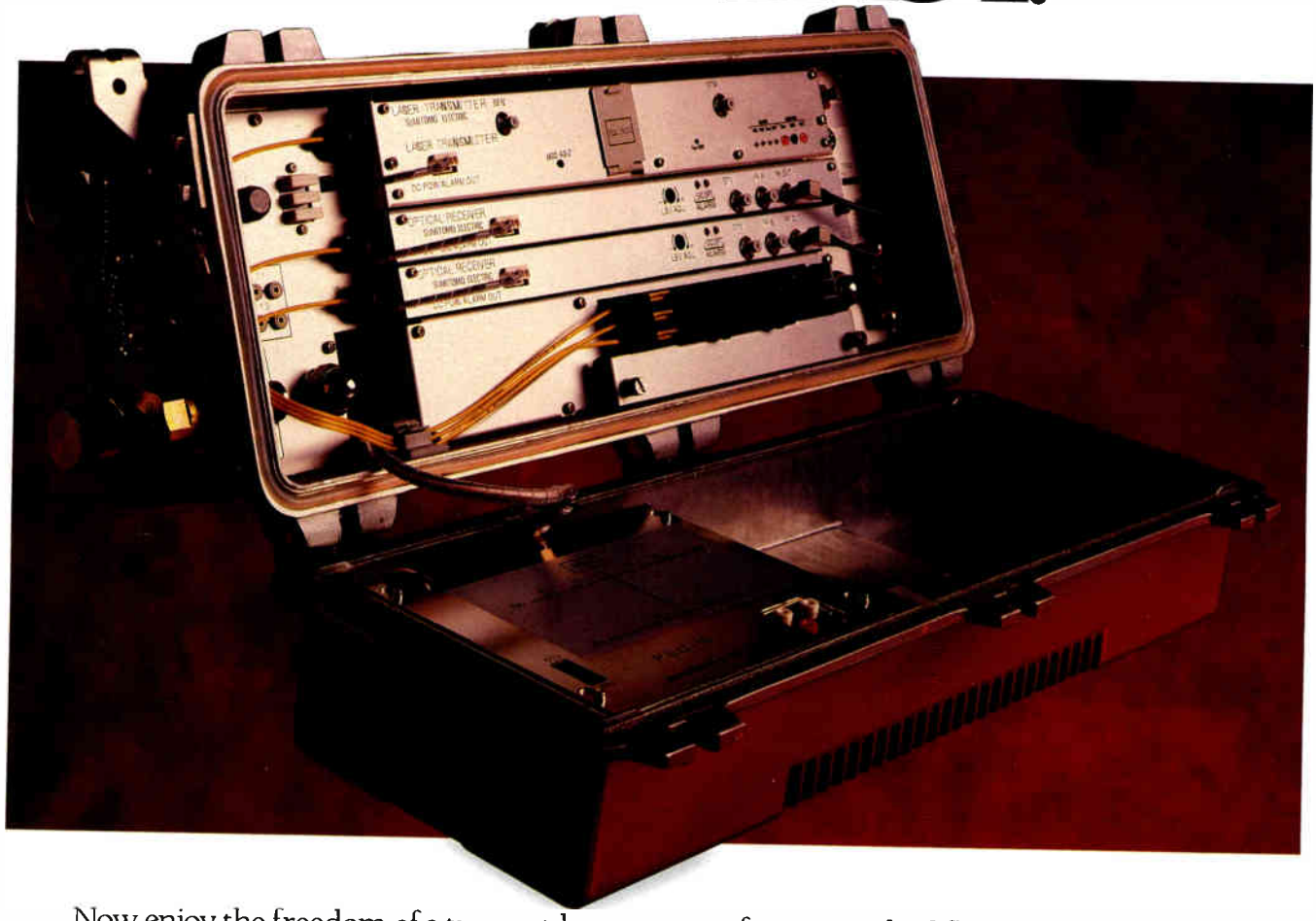

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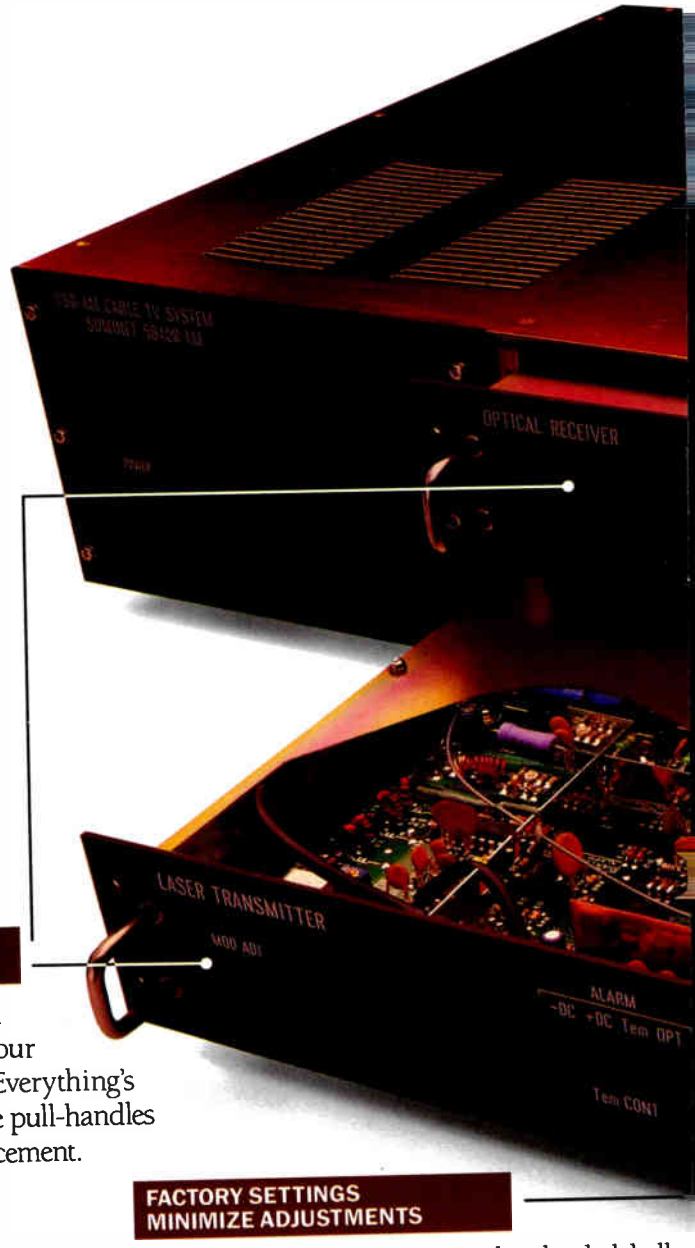
Optical transmitters and receivers are not created equal. Sumitomo Electric has long been a leading designer and manufacturer of VSB-AM optical transmission equipment. One result is our new-generation Series II. It's transparently compatible with coax cable TV systems of up to 550 MHz, with built-in advantages like those shown here.

Uniform Specs Save Management Headaches

Anyone can give you best-of-the-bunch "hero" lasers that squeeze out an extra dB or so. But what happens when you face real-world maintenance, repair and replacement needs? Sumitomo Electric offers a saner approach: *lasers that meet uniformly high performance specifications in every unit we make.* Result: you get consistent high performance, plus components that are interchangeable throughout the network. Which makes for low-cost spare stocking — and makes managing the entire system a lot easier.



QUICK-CHANGE MODULES CUT DOWNTIME

If the need ever arises, you can swap out a subsystem to put your unit back on line in seconds. Everything's plugged or connectorized. The pull-handles help speed removal and replacement.

FACTORY SETTINGS MINIMIZE ADJUSTMENTS

All test points are accessed on the clearly labelled front panel. Inside, you set only the transmitter's depth of modulation and the receiver's RF level. Everything else is factory-set for optimum performance.

TOUGH STEEL COVERS PROTECT EVEN THE SUBSYSTEMS

Our philosophy: everything matters. Such as steel housings for added rack-unit durability. The assemblies have a carefully finished look about them, inside and out. It reflects good workmanship: the care and thought we put into every detail.

LASER ISOLATOR BOOSTS PERFORMANCE, STABILITY

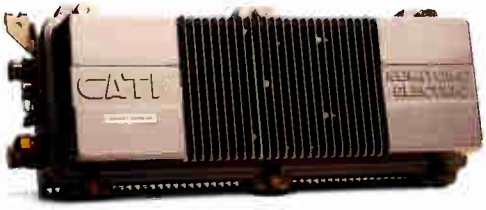
Not everyone's optical transmitter has an isolator, a reflection-cancelling device which helps optimize laser performance. Ours does.

SURFACE-MOUNT ELECTRONICS ADD NETWORK RELIABILITY

Look for neat, orderly packaging: no jumpers, no jerry-rigs, no confusion. Our advanced surface-mount electronics, all on one board, are measurably more reliable than conventional wiring and mounting. All of which minimizes downtime, simplifies network management.

VSB-AM Optical Transmitters And Receivers

More Packages, More Options Permit More Flexible Network Engineering

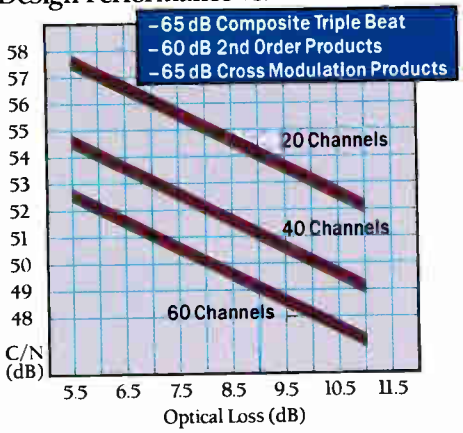


STRAND MOUNT. Install any combination of transmitters and/or receivers. Local alarms help quickly pinpoint system status.

RACK MOUNT. Two half-height transmitter and/or receiver units are supported by a single 2RU chassis/power supply.

POLE MOUNT. Rugged pole mount for optical transmitters and receivers.

Design Performance vs. Attenuation



SPECIFICATIONS — SUMINET 5840 SERIES II

RACK UNIT

	COAX RF		OPTICAL	
	IN		OUT	
Transmitter	Bandwidth	50-550 MHz	Source	DFB-LD
	Level	25±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Isolator	Yes
	Return Loss	14 dB Min	Avg Power	4 mW (set)
	Connector	F-Female	Output	Pigtail (5 m)
	OUT		IN	
Receiver	Bandwidth	50-550 MHz	Detector	PIN-PD
	Level	25±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Performance	SEE GRAPH
	Return Loss	14 dB Min	Input	Pigtail (5m)
	Connector	F-Female		

NOTE: Rack Mount Chassis Accommodates Two Units — Either Transmitters or Receivers or one of each.

STRAND UNIT

	COAX RF		OPTICAL	
	IN		OUT	
Transmitter Forward	Bandwidth	50-550 MHz	Source	DFB-LD
	Level	30±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Isolator	Yes
	Return Loss	14 dB Min	Avg Power	4 mW (set)
	Connector	Standard 5/8 x 24	Output	Pigtail (2 m)
	OUT		IN	
Receiver Forward	Bandwidth	50-550 MHz	Detector	PIN-PD
	Level	25±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Performance	SEE GRAPH
	Return Loss	14 dB Min	Input	Pigtail (2 m)
	Connector	Standard 5/8 x 24		
	IN		OUT	
Transmitter Return	Bandwidth	5-30 MHz	Source	DFB-LD or FP
	Level	30±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Isolator	Yes
	Return Loss	14 dB Min	Avg Power	4 mW (set)
	Connector	Standard 5/8 x 24	Output	Pigtail (2 m)
	OUT		IN	
Receiver Return	Bandwidth	5-30 MHz	Detector	PIN-PD
	Level	25±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Performance	SEE GRAPH
	Return Loss	14 dB Min	Input	Pigtail (2 m)
	Connector	Standard 5/8 x 24		

NOTE: Strand Housing accommodations: Up to 4 receivers or one transmitter (Forward or Return) and two receivers or two transmitters. Also, it can be configured as a repeater with one receiver and transmitter.

GENERAL	RACK UNIT	STRAND UNIT
Power	110/220 VAC 50/60 Hz 30 W/unit	30/60 VAC 50/60 Hz 30 W/unit
Operating Temperature	0° C to 40° C	–20° C to 50° C
Operating Humidity	Max 85% RH	Max 100% RH
Dimensions	EIA 19" Rack Mount 3 9/10" High (2 RU)	18¾" L x 8" H x 7" D
Weight	25 lbs Max	25 lbs Max
Splice Ctr	—	3 Tray (12 Fibers)

Specifications are subject to change without notice.

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Obviously, there is little incentive to install an automation system if it forces you to replace other expensive equipment. A system should be compatible with any equipment that can be remotely controlled.

Automation applications

What exactly does a VBS system do? In cable television, there exists a variety of applications. Figure 1 depicts one such application, where two 10x10 video/audio switching matrices are controlled. One switching matrix is in the same location as the VBS computer, while the other is controlled remotely via telephone modem on a dedicated line.

This scenario shows the flexibility of a vocabulary based system in that the user is not locked into one layout, but can incorporate both local and remote sites alike. The two switching matrices shown can operate independently based on an event list generated in the VBS software. If the routing switch matrix selected provides audio break-way, then video and audio switches can be scheduled separately. A log is maintained within the computer that records all switching activity for each matrix and any errors that occur. An audible alarm is sounded if a scheduled switch does not occur.

One of the most challenging applications for any automation system is network trunk management. Automation support of trunk lines allows the expansion of an existing router by adding a smaller secondary router and using the logic of the automation system to make the two routers appear to be one. This allows a system to grow in reasonable increments (see Figure 2).

Trunk management also involves coordination of video routing across multiple switching hubs. These hubs may be spread around a building, a state or a planet. Many schemes exist for the management of complex wide area networks.

A vocabulary based automation system will use a self-adaptive route selection algorithm. This algorithm provides least-cost routing through a complex network of intermediate points. It does this in a self-adapting manner, which means that busy circuits, faults and routing failures are automatically managed without the need for network maps.

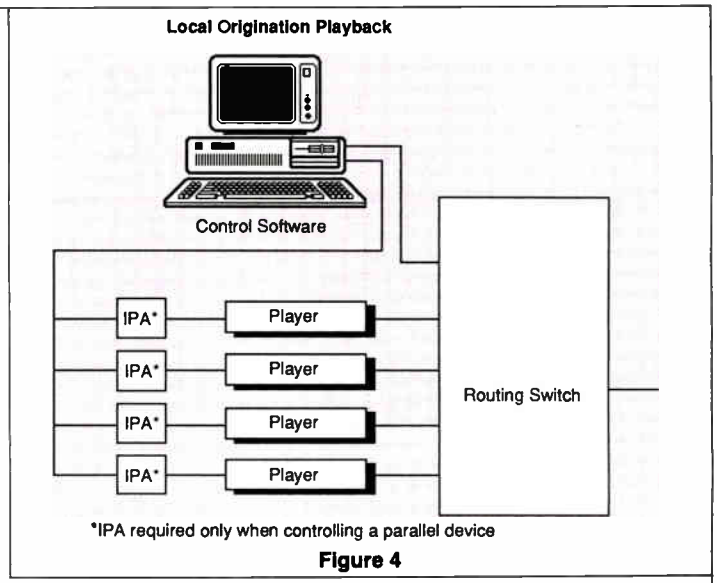


Figure 4

Commercial insertion

Many types of commercial insertion can be managed by a vocabulary based system. One of the simplest means of inserting commercials is to control the playback of pods (groups of commercial spots) from a single tape deck onto a single channel. This is easily accomplished by creating a definition file to cue and roll a tape deck. Conditional macros (special command words) allow playback functions to be synchronized with external events.

Conditional macros are special words which relate a group of functions to a specific synchronizing event. For instance, if you wanted a group of seven router switch outputs to be changed with the press of a single key, you could feasibly group the seven switch commands under the conditional macro ALT-F1. Then, by pressing ALT-F1 on the computer keyboard, the seven switches would simultaneously occur.

In the same way, a conditional macro can monitor the status of a contact from a satellite receiver. This contact closure can cause an entire sequence of events—such as pre-rolling a tape, switching it on air, waiting for the commercial to run and switching back to the network. Note that there is nothing specific in the automation system to support a particular type or brand of commercial playback. All of the specifics of the system operation are user defined. It is possible, in fact, to create many variations on the simple commercial insertion scheme. Multiple tape decks may be cued and pre-rolled in sequence to insert spots from multiple tapes into a single commercial pod or a single tape may be inserted onto multiple channels on an as-needed basis. A VBS has even been used to control distributed commercial insertion across multiple hubs.

A vocabulary based system will also have the ability to provide automated control of an assortment of headend operations. Figure 3 depicts a typical example where three ports are connected to remote locations via telephone modem. Two ports are used to control routing switch matrices for local origination and channel reconfiguration. One port is designated as a tape machine interface loop (referred to in Figures 3, 4 and 5 for tape deck control. Two ports provide control of satellite receivers. Additionally, eight contact closures are provided to control IF switching or other closure initiated devices. For additional functionality, a feedback path could be incorporated for monitoring test equipment.

Figure 4 illustrates how a VBS can be used for local origination playback. Here, the controlling software operates a playback center consisting of four videotape players and a routing switch matrix. This configuration is also typically used for pay-per-view playback. One port controls the switch matrix, while the second port controls four tape machines via a tape machine interface loop. A tape machine interface is, as it sounds, an addressable tape machine controller. In some controllers, up to 100 tape machines can be controlled in one tape machine interface loop.

Cueing and playback of the tape machines and routing of the appropriate switch matrix inputs is executed according to an event list generated in the software. A log maintained by the software records all tape machine and switch matrix activity, as well as any errors that occur. Tape machines can be cued by control track or by FSK toning. Verification of playback can also be generated by means of FSK toning. In any application shown, VTRs can be replaced with laser disks.

Many possibilities exist in using laser disk video playback of commercials. The VBS approach to automation will allow mixing laser disk and video tape devices on the same system.

Time-shifting

A bothersome task at many sites is time-shifting of network and satellite programs. Often this will require full time attention of an operator to put a tape deck into the record mode once or twice an hour. It is easy to put extra record and playback commands into a log. Simple record and playback commands are adequate for shifting whole programs to another playback time.

However, suppose you want to take a live show and shift it just five minutes later than it would normally air, a phenomenon which is done at many broadcast stations to provide an extra commercial break in the evening news. This is a complicated task, as it requires recording the show in segments of a few minutes each and then splicing them back together. This can be accomplished on a general purpose automation system by use of a schedule compiler. A schedule compiler is a small computer program that accepts three parameters: The time the show starts, the time the show ends and how long to delay the show.

From these three parameters, the schedule compiler will create a complete list of events to cut the live show into pieces and edit it back together after the appropriate time delay. With three tape decks dedicated to this net delay function, time shifts of three to 90 minutes can be achieved. The delayed show can be many hours long because tapes are continuously reused.

Yet another application for headend automation is that of automatic dubbing and compiling. With a vocabulary based system, a switch matrix and six tape machines can be controlled. Four videotape players used as library sources are routed through the switch matrix to the record decks. Two record decks are used to simultaneously produce two dubs of the final tape. There is practically no limit to the number of library source decks and record decks that may be utilized in one operation.

Note that all of the functions described—router management, trunk management, headend automation, commercial insertion, local origination, net delays, automatic dubbing and compiling and event logging—can feasibly be achieved by the same vocabulary based automation program. The details of one individual system are defined by the user creating his own system vocabulary, which can be changed or edited at any time.

Tom Sheridan, chief engineer at ATC's American Cablevision, has utilized a vocabulary based system in the company's Indianapolis, Indiana facility with notable results. In the configuration, the VBS system controls VCR playback, satellite downlink recording, stereo encoder switching, scrambling units, switching of character generators and management of alternate feeds. "When our original automation system failed us, we switched to a vocabulary based approach," Sheridan comments. "Not having budgeted for a new automation system, the VBS method proved to be the most cost-effective, in that it used an IBM compatible computer and a specifal interface that allowed us to use our older tape machine interface (IPA) cards."

Cost effectivness is certainly good news in light of current CATV market conditions—obviously, to be profitable, more money needs to come in than goes out. When selecting an automation system, keep an eye out for equipment that offers "budget friendliness", compatibility with existing technology and design specifications that provide for future growth—as offered in a vocabulary based approach. The result will be an automation expedition that is

Complete automation equals profit

"When you've sold out all your avails, there's no room for error, and no room for make-goods," says Norm Scott, video engineering supervisor for Cox Cable, San Diego. Scott faced that kind of situation last December, when the aggressive efforts of Cox's local sales staff resulted in the scheduling of 24,950 paid commercial spots to be inserted into 10 separate cable channels.

That kind of spot load would have many engineering managers shaking their heads. But for Scott, armed with his commercial insertion "money machine," it was business as usual. And with 99.8 percent of the scheduled spots "run as ordered," for Cox Cable, it was money in the bank.

What works

The key to a successful local advertising operation is the ability to insert local commercials into the satellite network feeds with a high degree of accuracy and reliability, while utilizing a minimum amount of manpower. System operators have—and continue to—look to modern technology for the means to maximize productivity and profits. While there are many possible approaches to commercial insertion, system operators are beginning to recognize that the total integration of all control functions and tape playback operations represents the best possible application of technology.

"Our policy is to take every avail and fill it," says Clint Rathmell, director of developmental engineering for Paragon Cable. "If it's not a paid spot, we fill with cross channel promotions or corporate image advertising," he adds.

Both Paragon and Cox Cable have selected a total automation package for commercial insertion. A total automation system approach allows the operator to select only those functions which meet current, specific requirements, while providing for future expansion. As the cable industry grows and matures, this capability is essential, as it permits operators to respond to changes in the marketplace.

For example, the Paragon systems handle commercial insertion on 16 cable channels by building channel-specific spot reels. According to Clint Rathmell this approach provides the "capability to support the projected level of business, while falling within the capital amount we had to spend." Down the road, Rathmell is looking to add the capability to control almost all of his technical operations through a complete headend automation system.

Meanwhile, at Cox Cable's San Diego facility, commercial insertion, public access, local origination and pay-per-view playback are all under automated control. Using a bank of Super VHS players, all machines operate in a random access mode, with any player able to feed any channel through the computer controlled routing switcher. In addition, syndication blackouts are handled automatically, with "informercial" programming rolling from several 3/4-inch players used to fill in as required. Even the pay-per-view barker channel is under computer control. Additionally, Cox Cable's Eureka, California cable origination station (dubbed "KCBL-TV") has started 18-hour per day operation using a similar automation system.

As the number of viewing options increases, advertisers will require cable operators to deliver even more specific audiences. By using fiber optic distribution, combined with the capabilities of a random access playback system, operators will be able to zone thier spot announcements, just as a newspaper produces zoned editions with specific ads for specific geographic areas. While this type of zoned delivery is impossible for "over the air" broadcasters, it will provide considerable revenue opportunities for cable operators, who deliver via hardwire—allowing the sale of the same commercial "spot" to different advertisers.

While this approach may sound like something out of "Star Wars," the groundwork is already underway, with New York City's Manhattan Cable Television feeding zoned commercials to its different franchise areas from a central automation system. This allows advertisers to cablecast their messages only in those areas where their potential customers live.

The future will present both challenges and opportunities for cable system operators. Technology will provide the capability to meet these challenges. To best take advantage of the opportunities, cable operators must build a platform today—to reap the profits of tommorrow. ■

By Jeff O'Brian, Vice President, Basys LaKart Inc.

Orbital satellite spacing—getting the third degree?

Just when you thought you knew the rules, somebody wants to change them.

Language tacked to the now-idle cable bill has requested that the spacing of C-band satellites be moved from two degrees to three degrees. And although the bill is now dead, the issue remains. But to what degree does it affect cable television? "Not much, technologically," says Wendell Bailey, VP of science and technology, National Cable Television Association (NCTA). "The trade-off occurs in terms of future programming capacity. The farther the satellites are spaced in the orbital arc, the less transponder space we have."

But there are other, more subtle issues involved. Future advancements in video compression, direct broadcast satellite (DBS) and the upcoming replacement of several major cable satellites all affect the communications cosmos with a rippling effect that starts with the satellite owners, moves through the programming side, and rests on earth with cable operators and backyard dish owners.

Where did it start?

In 1983, the FCC mandated that the spacing of satellites be decreased from four degrees to two degrees. This was because, at the time, expectations were that there would eventually be more transponder users than there was available space in the arc. Placing the satellites closer together simply meant that more could be launched. The shift was to occur between 1983 and 1990.

This year Congressman Billy Tauzin of Louisiana has decided that perhaps two degree spacing isn't such a good idea after all. The intent of the wording is to protect the backyard dish market. As it reads, "future C-band home dishes, which might be as small as four feet in diameter and still receive good picture quality from higher power C-band satellites than are used today, may be unable to reject interference from adjacent satellites spaced as close as two degrees."

Translated, this means one thing: let's look out for the backyard dish owners. This is because antenna size and beamwidth are inversely related—the smaller the dish, the wider the beam pointing at the satellite. A small dish (wider beam) is more apt to pick up interference and dual signals from adjacent satellites, as opposed to a larger dish with its designed narrow beamwidth. Also, a decision to remain at two degrees means that antennas serving the backyard TVRO market must get larger—which is, as Bailey puts it, "exponentially more expensive."

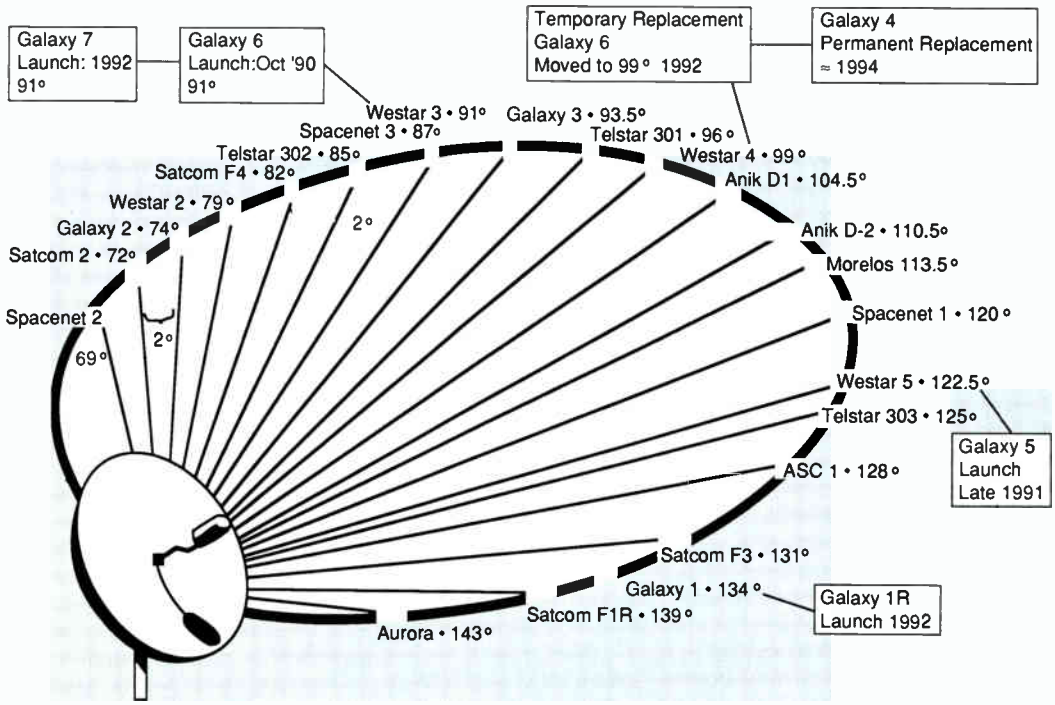
Currently, not many C-band satellites are spaced closer than three degrees. "The current configuration is a mixed bag," says Norm Weinhouse, president, Weinhouse and Associates and a satellite communications expert. "There are satellites that are two degrees apart, and there are satellites that are three, four, five, and seven degrees apart." Satcom 2 and Galaxy 2 are at two degrees, holding the 72 degree and 74 degree orbital positions, respectively. Telstar 302 and Spacenet 3 are also spaced at two degrees, at 85 degrees and 87 degrees. A quick look at the orbital arc (see Figure 1) shows the position of the satellites in space.

Effect on cable

So what does a shift from four to two and back to three degrees mean to cable television? "We've seen all the problems at two degrees and have learned to live with them," Bailey continues. "But from an engineering perspective, the spacing would be better kept at three degrees or above."

Warren Davis, National Product Man-

Scheduled Movement in the Orbital Arc



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Reader Service Number 68

The municipal connection to CATV

The coaxial cable used by CATV is a high capacity multiplex medium, capable of passing dozens of quality video signals as well as hundreds of other data, voice and telemetry channels of information. Imagine for a moment, the off-air spectrum from 5 MHz to 450 MHz, and the thousands of signals that occupy these bands. Besides 12 VHF and the bottom edge of the UHF TV bands, there are thousands of police, fire, amateur, aircraft, business band, shortwave and military channels. This tremendous capacity is available in the modern broadband coax cable, independent of the off-air spectrum.

A CATV operator normally fills the cable spectrum with TV channels. However, there are still hundreds of potential narrowband data, telemetry and voice slots typically laying idle. In addition, the return, which is often in place but "decommissioned," could be used for two-way video and interactive services.

Municipality opportunities

Municipalities use hundreds of "data" circuits for such applications as traffic light control, security systems, computer data circuits, police and fire circuits, city telephone systems and switchboards, and others. City managers are often unaware of the total number of circuits and the costs can run to the tens of thousands per month. Many of these applications could be displaced to cable at large cost savings per month, providing the CATV operators with a good profit and additional revenue streams.

In addition to the circuits that could be displaced onto cable, a whole new field of services are possible that would be virtually cost prohibitive by any other means. These include such capabilities as citywide surveillance for traffic, utility and security applications; two-way video training for fire, police and municipal employees; video "classrooms" for shut-in students; remote bulletin and schedule boards for traffic and bus schedule information.

The CATV system remains one of the largest "untapped" resources for cities to utilize to improve city services. Some cities even have vast I-nets, built to comply with franchise requirements, many of which are idle or turned off. Now that franchises are built, cable operators as well as municipalities are taking a long, hard look at the many applications of cable.

By Clifford Schrock, President, CableBus Systems Corp.

The franchise wars of the early '70s are over, and so are discussions of the multiple service capabilities of the CATV plant. Yet, the benefits of using excess capacity on the broadband cable for a host of special services can be signficant. Broadband cable can be applied to the operations of a modern city, offering cost savings over other alternatives such as leased lines and microwave.

In some cases new services can be considered that would be cost prohibitive by other means. This article does not go into the political reaons why the cable operator and the municipality may tend to have a more adversarial relationship, rather than one of cooperation and sharing of this powerful resource. With cooperation, the cable capacity could improve the quality of life and reduce expenses to the community.

A false start

The two factors that were large contributors to the demise of two-way services in the early 1980s were the poor performance of the return plant cable and the lack of high quality terminal units.

The first and foremost problem was the performance of the cable itself. System operators spent enormous amounts of money trying to keep two-way plants operating. Today, with the advent of CLI compliance and testing, much of the time and money spent troubleshooting the two-way plant because of ingress has been eliminated. The plant is tighter, connectors and drops are better, and the reactivation of two-way in systems today has been characterized as "uneventful."

The other major factor was the poor quality of the terminal units. Many major MSOs tried to commit substantial resources to security, data and telemetry systems that were unfortunately "crude" by today's standards. Older units had to be manually set up at the home or remote location, often by a technician talking to the headend where another technician had to watch a spectrum analyzer. The setup was short lived because the cable plant could change by 12 dB or 15 dB from night to day, and more seasonally.

Modems more sophisticated

Modern modems are more sophisticated and many are capable of remote setup. One master modem and PC-type computer with special software serves as a network manager and adjusts the terminals automatically as often as necessary to keep all units on line and at optimum performance levels. In essence, each remote device on the cable becomes a "status monitor" test point, not only for the particular service provided by that terminal, but also because it gives a relative indication of all data and TV services at that particular location.

Another factor contributing to the failure of many of the early two-way services was the pressure that CATV operators were under to complete the construction of the CATV plant in the franchise area. The operators had their hands full building the system, with no manpower left over to implement additional services.

Today, with better cable plant and terminals, and a commitment by operators to find other revenue sources for the cable, the time has come to take another serious look at other services on cable.

Traffic management

Traffic has become a major factor in any medium or large sized city. Central traffic light control is rapidly becoming the accepted standard for cities. Each intersection has a local controller to actually operate the signals. The local controllers are connected to a central computer that can synchronize the individual locations, upload new programs, select special time-of-day sequences and perform diagnostics of the

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Reader Service Number 71

intersection equipment.

Cities typically use leased telephone lines for the control circuits. The broadband cable is a viable alternative that has been implemented in a number of cities. The cable is a natural multi-drop environment for traffic light control, offering higher data rates and more flexibility than the leased circuits. Fifty to 100 intersection controllers can be placed on one narrowband telemetry carrier on the cable. The cost on the cable can be a fraction of the leased line cost.

Video surveillance

Another exciting traffic application of the cable is video surveillance of the street, bridge and freeway system. Envision the city police dispatch center having the capability of instantly "punching up" any one of 100 or more key locations in the city, and then remotely moving the camera and zooming in on an individual trouble spot. Video camera control systems are available that allow up to 256 cameras to share one return video channel for such an application. The cost per camera location including a color camera and a good lens is, in most circumstances, less than $4,000.

Other traffic applications offered by broadband include such capabilities as remote emergency call boxes, and sending data to large electronic signs to inform the drivers of road conditions. Combining traffic light control, video surveillance and remote signs would well provide an alternative to new road construction by better utilizing what is already in place.

Water and waste water systems

Many people don't realize what goes on underneath a city to keep the water flowing and the sewers in operation. A modern city is a maze of pumps and valves, and can contain hundreds of remote monitoring and control locations. These are usually connected via leased lines, and can easily and economically be moved to cable. Multi-drop modems can replace the slower leased line circuits and a single data subcarrier on the cable can often serve the entire city water control requirement.

Most water systems also have a system of dams, reservoirs and water towers that are candidates for video surveillance. A separate channel just for the water bureau is not usually required; instead, a few extra cameras can be added to the traffic surveillance or municipal security system.

Many city water bureaus have computerized billing and one or more satellite offices that can be connected together via point-to-point cable modems.

Municipal security systems

Cities often own and monitor their security systems for many kinds of municipal and public buildings, including administration offices, school buildings, maintenance garages, libraries, police and fire stations, convention centers and stadiums, parks and sports complexes and warehouses. Cities often require higher security than is available with dialer based alarms used in residences, and will specify multiplex type systems which can cost $40 to $60 per month just for the dedicated leased lines that connect the site to the monitoring center. Cable offers multiplex type alarm capability, at a fraction of the cost of leased lines.

Recently, for example, the City of Boston began converting 157 buildings

from an older lease line telephone system to a cable alarm system. The entire system occupies 1/24th of a TV channel and is projected to save the city $6,000 per month in leased line costs.

Security systems can also be built around the remote camera control systems. A camera and control box would be mounted at a central point for each building or site, and a motion detector or other sensor would be connected to the auxiliary inputs on the camera unit. When something tripped the input, the dispatch operator would be notified and could select and view the location, looking around for the intruder or problem. Auxiliary outputs could be switched to turn on the lights, or a siren, or to "lock" the intruder in.

> The CATV system remains one of the largest 'untapped' resources for cities to utilize to improve city services.

CATV based security systems allow powerful and cost-effective alternatives to leased line systems and have the potential to conserve manpower and improve safety by allowing a "camera investigation" of a suspected alarm or trouble location before the police arrive at the site.

Two-way training and meetings

Ongoing training and regular meetings seem to be the nemesis of the city employee. Police and fire bureaus require regular briefings and training. The expense and lost time involved can be significant.

In fire training, for example, one station may be called to backup another while the crew drives across town for classroom training.

Various options exist via the cable. Addressable converters and TVs can be used to selectively send a class or have a meeting with only one particular group. Two-way training sessions can be set up with an audio return to the instructor over the cable. One central facility can be set up with a studio, and each remote police, fire station or city office building could be equipped with a training room or auditorium. Audio return would allow roll call, questions and other interaction with the instruction.

Adding remote video cameras to each training room would allow the instructor to see the classes, and could be switched so that other locations could "see" the other classes and students. Meetings and general announcements to all city employees could also be set up on broadband cable.

The potential of using the cable for training has long-range implications. Time away from the job and associated expenses, the cost of fuel and the need for city vehicles to drive to meetings must all be considered to fully understand the benefits of using cable for

training and meetings.

School systems

Most public school systems already use a number of TV channels on the cable to send signals between schools and perhaps to the home. Additional capabilities exist for sending video and data between schools and to the home.

One of the most exciting capabilities of cable is to use remote video cameras to establish home classrooms for shut-in students. Often cities spend *large* amounts of money for specially equipped buses, and try to bring wheelchair and disabled students to school. An alternative possible with cable is to limit the number of days these students are bused, and to use a video classroom on other days. The concept uses a video camera in each special student's room, that can be remotely controlled by the instructor. The instructor is viewed by the student on a regular TV, but the instructor can individually have a dialogue with the student. In the case of a question, the instructor might switch the student onto the classroom monitors and to the outbound channel so that all the students could see their classmate.

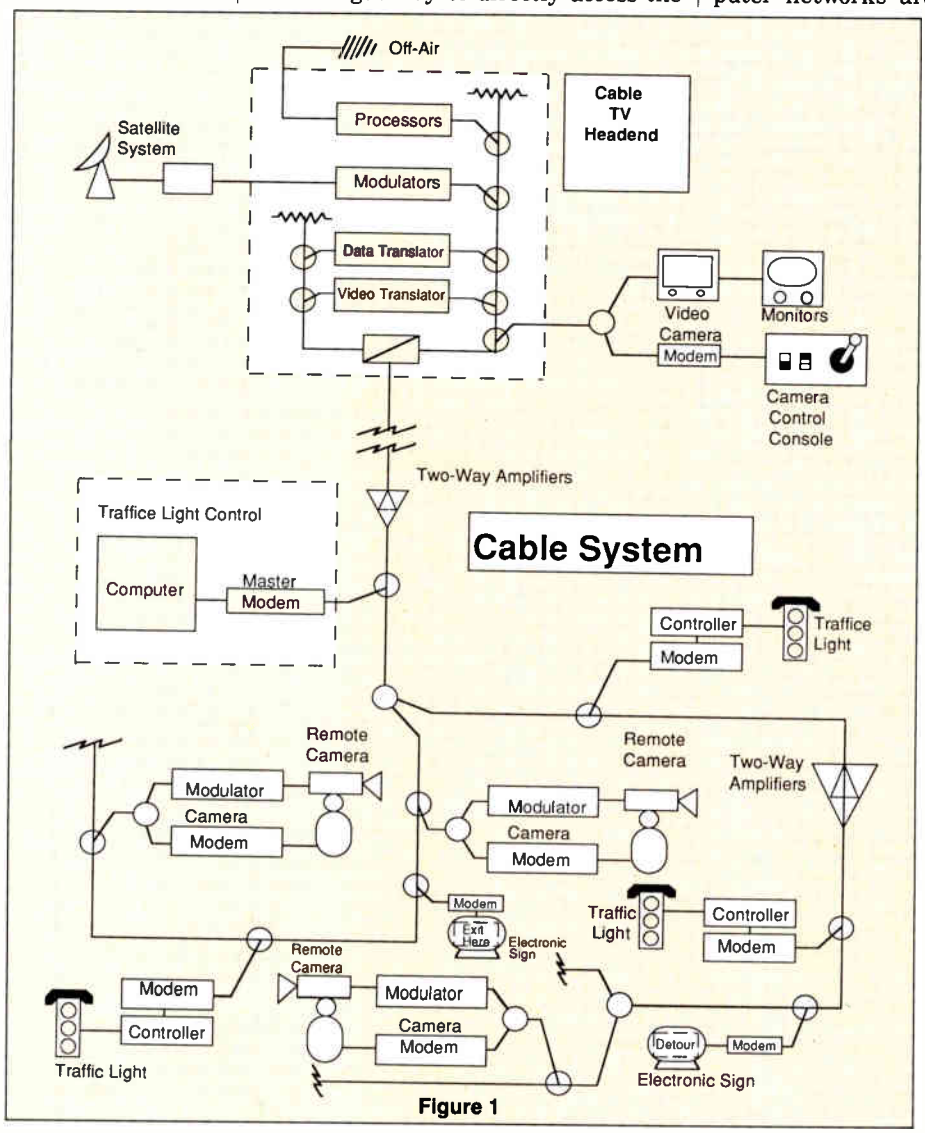

Figure 1

Passing of computer data on the cable has major educational implications. Traditionally, school administrative offices need data connections that can be handled on cable using point-to-point and networking type modems. Cost savings over using leased lines, or speed and on-line time are factors to consider.

School libraries

School libraries might have a variety of data passing requirements including the requirement to interconnect various schools and some want access to on-line database services. These database services can be expensive to use through the dial-up network. Schools might consider arranging to use the CATV satellite feed to act as a gateway to directly access the packet network, then use the cable and point-to-point modems to deliver the service to each school and library in the system.

As more students are exposed to computers, the home computer is rapidly becoming a common fixture. Low-cost cable modems are available for less than $200 each and can be used in one-way or two-way applications to deliver various types of data to the student.

One-way delivery might consist of lesson assignments, schedule updates, various types of local information and world news, and any number of other types of information. Two-way capability allows various interactive capability to be added such as database access, electronic mail, testing at home and interactive lessons.

Various configurations of home computer networks are possible, and the spectrum utilization is very efficient. For example, a one-way service could be sent citywide on one narrowband data subcarrier. Two-way interactive can be set-up with approximately 300 users per subcarrier, or approximately 7,200 in 6 MHz.

Summary

The cable TV system offers powerful cost saving advantages to the municipality it serves. Many types of service can be added to the residential network in the form of narrowband subcarriers. One or two channels of return video could be used to establish large video surveillance networks for traffic, security and educational applications.

As more applications are implemented, and produce revenues for the cable operator, the I-nets might start to be used and extended to cover larger areas of the city.

The availability of better terminal equipment, automatic modems and network management systems and the vast improvements in the cable connectors and hardware warrant a fresh look at the "other" uses of the broadband cable system.

The bottom line is financial. Cities can improve services while saving money and the CATV operators can tap into new revenue sources. Everybody wins. ■

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Reader Service Number 73

Satellites and 21st century telecommunications

Today's R&D programs will open new windows of opportunity

Two years ago, the president of GE Americom, one of the biggest operators of satellite communications systems in the world, said it: "The war is over." He was proclaiming the end of public voice services on U.S. satellite systems. It was indeed true. Today, there is still lots of U.S. satellite traffic around, but about 55 percent is video distribution, 40 percent is on private corporate VSAT networks and 5 percent is for everything else. Public telephone service is but an infinitesimal trace of that residual 5 percent.

What was wrong?

What happened? After all, some 70 percent of the revenues from the 15-satellite global system Intelsat is still coming from public switched telephone service. Dozens of developing countries are using leased or public satellite capacity for long distance voice communications.

Was there something wrong with the satellites? Was it the structure and character of U.S. telecommunications? Or both? The shortest answer is: "Yes, everything was wrong." The telecommunications management was wrong. The market was confused. And most importantly, the U.S. business user responded in a very predictable way. He retreated to an all-terrestrial strategy.

There were exceptions, of course, or the U.S. satellite industry would have been history. The first, and most important, exceptions were television broadcasters, cable television networks and specialized video carriers for entertainment, sports, news education, health and special business, economic or political interests.

A clear advantage for video

For video distribution, satellites have clear advantage over terrestrial transmission. These advantages include cost, flexibility of coverage, speed of addition on new receive or transmit sites, lack of constraints by narrowband terrestrial switches and ability to serve remote and rural sites.

Television distribution, however, was not the only exception. Specialized private business networks connected by Very Small Aperture Terminals (VSATs) were to become the other major exception. The most significant category of VSAT systems operating under the new U.S. deregulatory environment were: banks, insurance and financial institutions; retailers and distributors; manufacturers (especially auto manufacturers with a large dealer network); energy companies (especially oil companies with extensive station networks); state administrations; professional associations; and the travel/tourism industry.

By Dr. Joseph N. Pelton, Interdisciplinary Telecommunications Program, University of Colorado

Switching progress

Steady progress is being made by VSAT networks with 1.8-meter antennas which can be optimized for either X.25 packet switched operation or for full ISDN compatibility. These VSAT networks can include or be designed to offer a bit error rate (BER) of 10^{-7} or system availability of better than 99.9 percent. The public carriers, however, still feel uncomfortable with satellite because of the following concerns:

- economics,
- flow control and Asynchronous Transfer Mode,
- special protocol requirements,
- forward error correction,
- frame relay or frame switching, and
- ISDN and broadband ISDN compatibility (especially Sonet).

In some areas, the problems are still in need of resolution, but in most areas, satellite-optimized solutions exist. The above issues are detailed and complex and accordingly, will not be addressed here. There are, however, a number of technical articles on satellite transmission and ISDN quality. Two general points should be made with regard to satellite vs. terrestrial compatibility, especially with respect to ISDN standards.

First, in early November 1990, a meeting of experts was convened in Geneva, Switzerland. This was a joint CCIR/CCITT meeting to establish full compatibility of satellites and terrestrial technology. With a one-year work schedule, there is high confidence that an agreement will be reached.

The second point is that, despite this planning effort to make satellites and fiber optic systems compatible, parallel efforts are now underway to create new and improved space transmission technology for the 21st century. These research efforts are designed to increase throughput, quality of the network (to ISDN standards or better), versatility, system availability, security and robustness. These efforts are also seeking to eliminate or mitigate transmission delay.

Finally, but not least, there is the objective to reduce costs so as to be competitive with fiber optic cable. It may be surprising to those who follow fiber optic cable closely, but all of these objectives seem possible. Silica and sand are cheap, but air and vacuum in space are still free. As such, satellites still claim an economic advantage, particularly for broadcast services and very large networks.

It is also of some interest to note that the TAT-8 fiber optic submarine cable, the largest in service across the north Atlantic, is about one-fourth the size of the Intelsat VI satellite (i.e. 840 megabits/second vs. 3,200 megabits/second).

Unlocking the future

The key to the future is neither the present nor the past. Activity in research laboratories is perhaps the most important gauge. We all know that repeaterless fiber optic cable utilizing soliton pulses are now under development. Likewise, optical processors and switches are also coming along rapidly. What then of advanced communications satellites? Here too, rapid progress is being made.

Significant new effort is being de-

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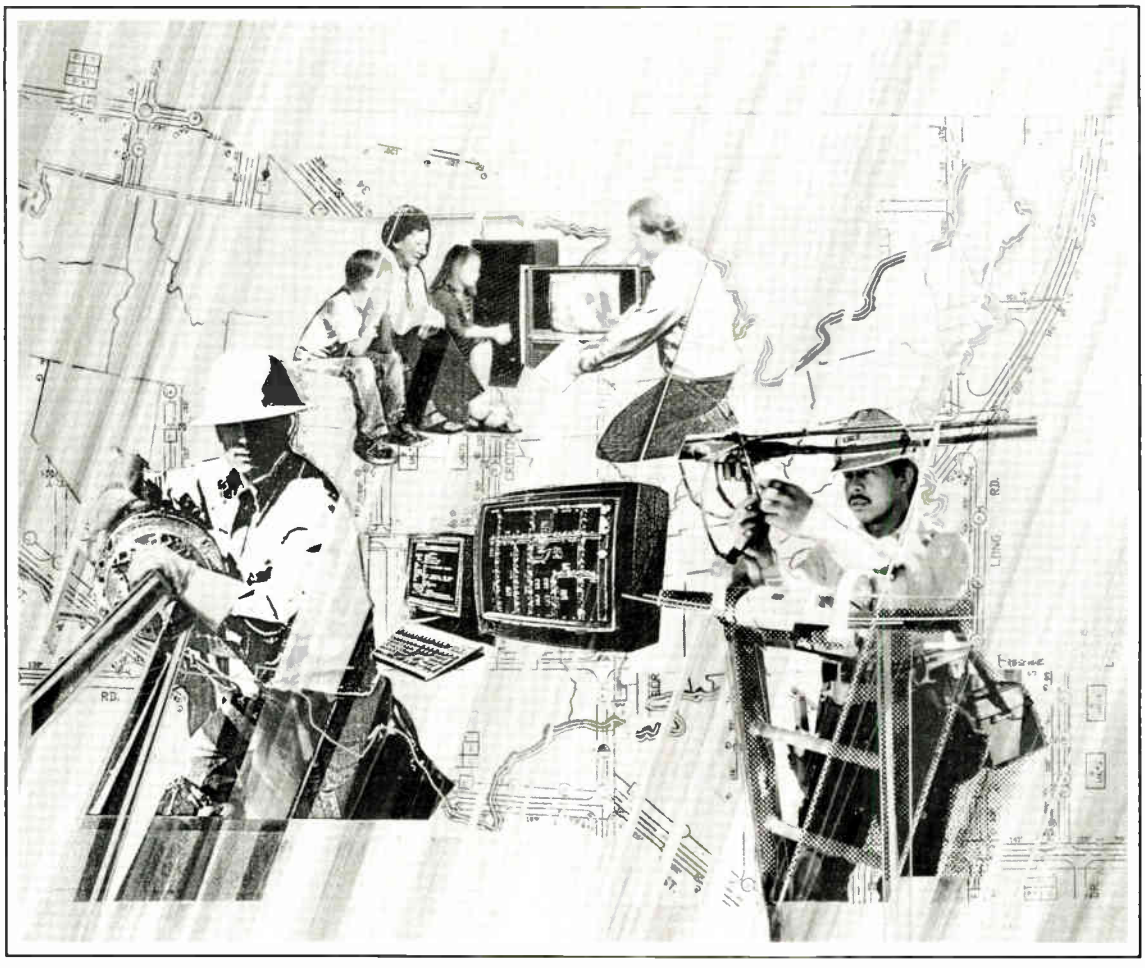

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voted to the following areas: (a) use of the Ku-band (30/20 GHz); (b) provision of on-board intelligence in the form of baseband processing and, in-time, on-board signalling; (c) development of improved microterminals (known as VSATs and Ultra Small Aperture Terminals or USATs), and personal communications devices; and (d) advanced spacecraft antennas.

In addition to these prime innovations, there are other important research areas. These include: intersatellite links, power adjustments in response to weather conditions, creative new orbits, and new concepts in orbital stabilization. These new orbits promise breakthroughs in transmission delay.

On-board intelligence. The Advanced Communications Technology Satellite (ACTS) to be launched by NASA in May 1992 is the first operational demonstration of an on-board processor. The baseband processor developed by Motorola will be able to regenerate signals and direct them to the proper beam or downlink time slot.

The potential advantages of this capability is great. The effective increase in performance is expected to be up to 9 dB. Perhaps even more importantly, the on-board processing can create large, complex networks on demand and then create another new network a millisecond later. The ability to create fully interactive MESH networks that connect all nodes in a network together is a new and unique capability. This is in contrast to limited star or hub-and-spoke networks which cannot easily connect remote to remote locations.

The promise of space links

True interconnectivity is what on-board processing truly provides. It is, in fact, only the very beginning. What an on-board processing capability represents in a whole new way of transmitting, storing, handling and distributing information. Putting a computer in a fiber-optic link for instance, doesn't make any particular economic sense, because in a point-to-point link, it can be put anywhere—the end, the middle or at the far node. With a very high capacity super computer operating on-board a satellite, the processing requirements of thousands of nodes can be met.

In short, on-board processing will initially give satellites a transmission and networking advantage and ultimately, a leveraged role in network processing. In the early 21st century, satellite-based processors capable of handling 10 billion bits per second will become operational to handle voice, data, fax, high definition television, interactive CAD/CAM, scientific visualization and telecomputer services.

Advanced antenna development. Tremendous advances are being made in both spacecraft and ground antenna design. Multi-beam antennas and their more extreme form, sometimes known as cellular antennas, show promise of more than 20-fold frequency reuse. Antennas which distribute and concentrate signals within discrete time domains, to serve various geographic regions, also hold interest. These devices, known as scanning beams or hopping beams, are, however, sometimes felt to be too complex and expensive.

Phase array antennas hold special promise for reasons that include: (a) ability to conform to any type surface, (b) configurability into tight beams, and (c) processing power that can be used to improve performance. In general, we will see satellite antennas able to send power and communications traffic to where it is most needed. This will be done by geographic beam concentration, time slot optimization and extensive frequency reuse.

On the ground, receivers will continue to shrink in size and cost as a result of greater satellite power and greater processor power on-board the satellite and in the ground terminal. Conforming shapes will also allow ground terminals to "disappear" into the roofs of houses and cars, into the sides of jet airplanes.

New orbit capabilities. Dramatic new changes are now beginning to develop from new orbital concepts. The most in-the-news concept is that proposed by Motorola for a low-orbit, 77-satellite system providing global cellular telephone service. This system, known as the Iridium System (named after the element with 77 electrons), is conceived as a breathtaking array of new technologies, including low-orbit intersatellite links, on-board processing, 37 frequency cells for spectrum use and interconnection with the global public switched network.

This more than $2-billion system may well redefine the approach to future satellite communications systems. This is because transmission delay and path loss are significantly reduced in this concept even with the addition of intersatellite links. Other systems proposing highly elliptical orbits for mobile communications systems may also be deployed and add new dimensions as well.

Finally, there are even more promising efforts to combine the elegant simplicity of the three-satellite global coverage of the Clarke orbit with the appeal of high gains and near zero-second delay characteristic of low orbit. It is easy to conclude that the laws of natural physics prevent the combination from occurring. Researchers at the University of Colorado, however, have suggested "helping" Mother Nature by using ground-based laser or microwave beams to send up sufficient energy to stabilize a small, lightweight but nevertheless high capacity satellite in artificial geosynchronous orbit (AGEO).

This concept has many advantages, but also poses several questions, such as the environmental effect of high energy radiation in space, the need for a special orbital band at 800 to 900 kilometers for AGEO satellites, etc. The physics involved are not as difficult as may be thought. In fact, the required energy to stabilize a 10- to 20-kg payload that consists of little more than microelectronics and a mylar antenna are about the equivalent of powering a Ford Escort. Although small, such satellites could handle hundreds of thousands of voice circuits or more than a billion bits per second of throughput.

Conclusion

This is an exciting time in communications and information technology. Both fields are expanding rapidly. By the year 2000 the combined economic products and services of telecommunications and computer processing will be well over $1 trillion and growing. It is clearly true that the future belongs to optical telecommunications. Enormous gains will occur in fiber optics, optical switching and optical processing. The University of Colorado, Columbia University, MIT, Northern Telecom, AT&T and others are making truly important gains in optical telecommunications performance, in terms of quality and practical applications.

The future of telecommunications, however, is not one-dimensional. Satellites with on-board intelligence, new types of antennas and perhaps with entirely new orbits and stabilization systems are defining another important dimension of the future of communications, too. Two of the most important resources we have a silica and free space. Twenty-first century communications will soon show us why. ■

WHAT'S AHEAD

SCTE

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

January 9-10 *National SCTE Conference* "Fiber Optics 1990." Hyatt Regency Grand Cypress, Orlando, Fl. Panel discussions and hands-on demonstrations to be held, focusing on "Planning and using fiber optics in your cable system today." Contact SCTE National Headquarters at (215) 363-6888.

December 5 *Delaware Valley Chapter* "Newbuild and rebuild construction." Williamsons Restaurant, Horsham, Pa. Contact Dan McMonigle, (215) 265-4233.

December 5 *Florida Chapter* BCT/E examinations to be administered. Jacksonville, Fl. Contact Keith Kreager, (407) 844-7227 or Pat Skerry, (904) 735-1571.

December 6 *Upper Valley Meeting Group* "System Powering and Design." Holiday Inn, White River Junction, Vt. Contact Matthew Alldredge, (203) 328-0640.

December 8 *Rocky Mountain Chapter* "CSR Troubleshooting," with Ron Hranac of Coaxial International and Jeff Jones of Jones Intercable. To be held at Jones Intercable, Englewood, CO. Contact Rikki Lee, (303) 321-7551.

December 11 *Desert Meeting Group* "Installation practices." Contact Chris Middleton, (619) 340-4300, extension 258 for location information.

December 12 *Big Sky Chapter* "Microwave systems," Colonial Inn, Helena, Mont. Contact Marla DeShaw (406) 632-4300.

December 12 *Penn/Ohio Meeting Group* "Construction and installation standards and practices" and "Safety." Contact Bernie Czarnecki, (814) 838-1466 for location.

December 13 *Chesapeake Chapter* "BCT/E Certification." Holiday Inn, Columbia, Md. Contact Keith Hennek, (301) 731-5560.

December 13-14 *Sierra Chapter* Northern California vendor meeting to be held, featuring tabletop demonstations and breakout discussions. Party Palace, Fairfield, California. Contact Eric Brownwell, (916) 372-2221.

December 14 *Miss-Lou Chapter* "BCT/E Category II training" with Paul Beeman, curriculm chairman, SCTE. Holiday Inn, Baton Rouge, La. Contact Charles Thibodeaux, (504) 641-9251.

FC²

Fiber Communications Corp., a certified training facility for GTE, Anritsu and Ametek Controls, is offering 5-day fiber optic splicing and termination workshops at its Sturbridge, Mass. facility. The course is college accredited, and available these dates:

December 10-14
January 14-18
February 11-15
March 11-15

For further details, call (800) 776-0518.

SIECOR

Siecor Corp. will sponsor a four-day, hands-on fiber optic training program designed for craftsmen and contractors who install, splice and test fiber optic cable in a cable television environment. Following is the date for the program "Fiber Optic Installation, Splicing, Maintenance and Restoration for Cable TV Applications." For info call (800) 634-9064.

December 17-20

Trade Shows

Western Show **November 28-30** Anaheim, Calif. Contact Trade Associates Inc., (301) 468-3210

SCTE Fiber Optics 1991 **January 8-10** Hyatt Regency Grand Cypress, Orlando, Fla. For further information, contact the SCTE National Headquarters at (215) 363-6888.

Texas Show **February 27-March 1** San Antonio Convention Center, San Antonio, Texas. Contact: (512) 474-2082.

North Central Show (NCCTA) **March 11-13** Hyatt Regency Hotel, Minneapolis, Minn. For more information, contact Mike Martin at the North Central Cable Television Association, (612) 641-0268.

National Show **March 24-27** New Orleans Convention Center, New Orleans. Contact: (202) 775-3669.

The CABLE POLL

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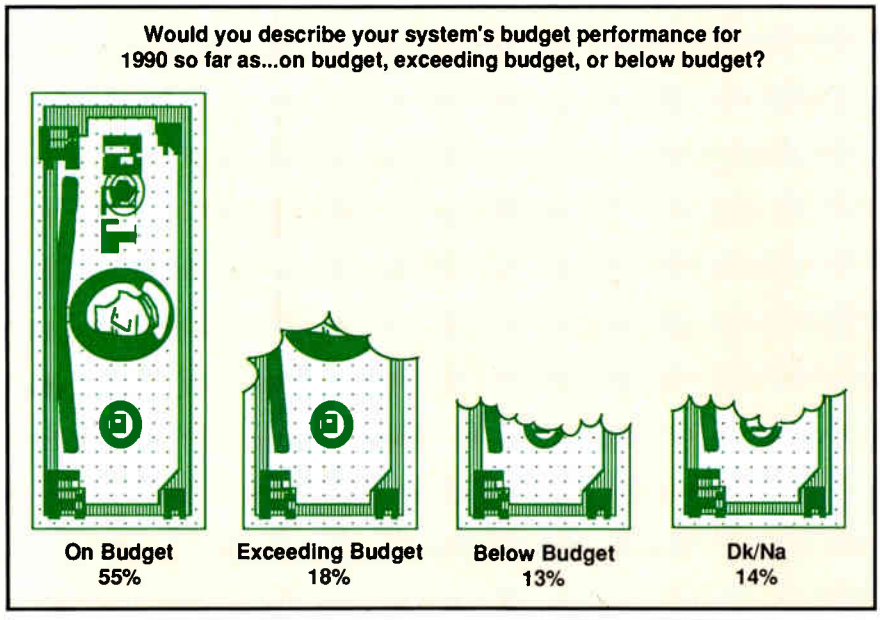
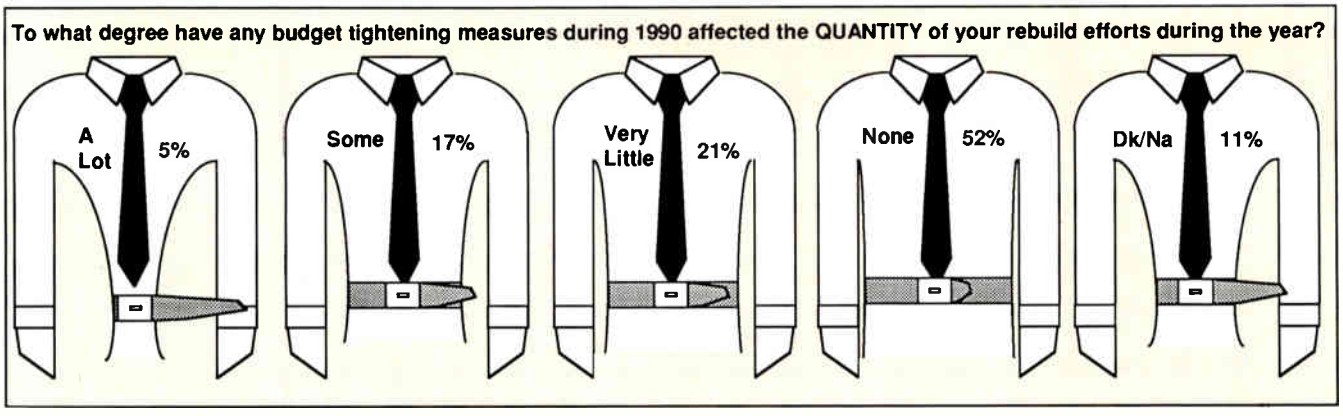
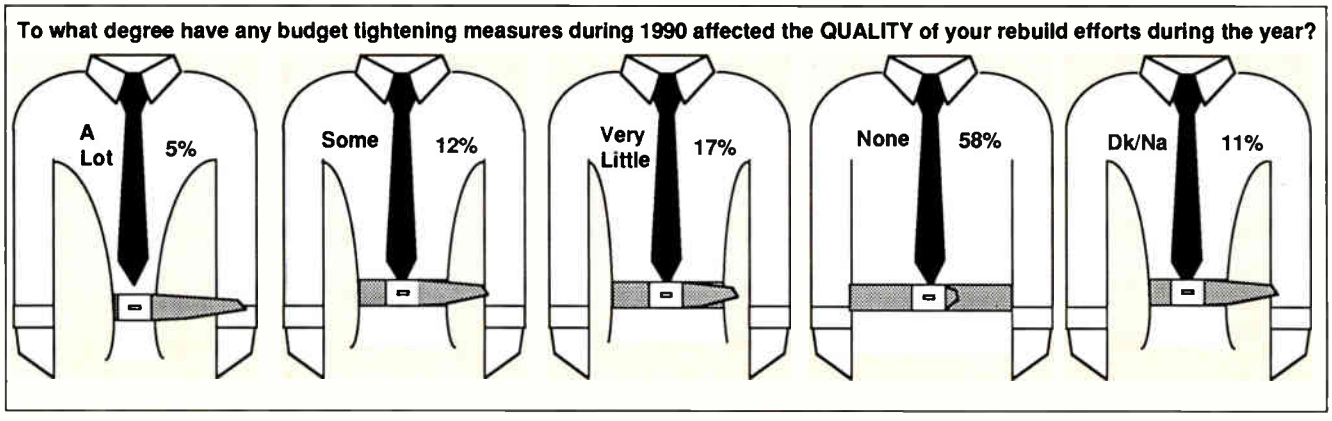


Operators say '91 capital spending should rival '90

From all the hand-wringing and furrowed brows stemming from concern about the cable industry's economic performance, one might believe that general managers are finding themselves woefully short of meeting their systems' budgetary targets. But that's not the case. In fact, a majority of general managers report that their budget performance so far this year has either met or exceeded projections.

According to the most recent Cable Poll of 402 GMs, 75 percent of those polled replied that their systems are reporting satisfactory financial results. Only 12 percent said they were below





budget. The Cable Poll, conducted in late September, is the first detailed look at GMs' perceptions since events began to intensify on the regulatory and financial fronts.

System managers don't appear to be as pessimistic as some industry analysts and vendors. They report that they've been able to meet their goals for this year, and, what's more, intend to spend at least the same amount of money next year for line items including plant and equipment.

This confidence transcends most operating areas, particularly in the equipment market. Thirty-six percent of GMs said they plan to spend more on plant and equipment in 1991 and 34 percent report they will spend the same. Only 14 percent said they will budget less to purchasing operating provisions in the next year.

Concerning the rebuild/upgrade market—another critical issue facing suppliers this year—most GMs said their 1990 budgets weren't affected by belt-tightening. Close to 80 percent said that they felt very little or no impact from cutbacks that might have been instituted this year. Meanwhile, 75 percent say the quality of those rebuild/upgrade efforts were unaffected by budgetary constraints.

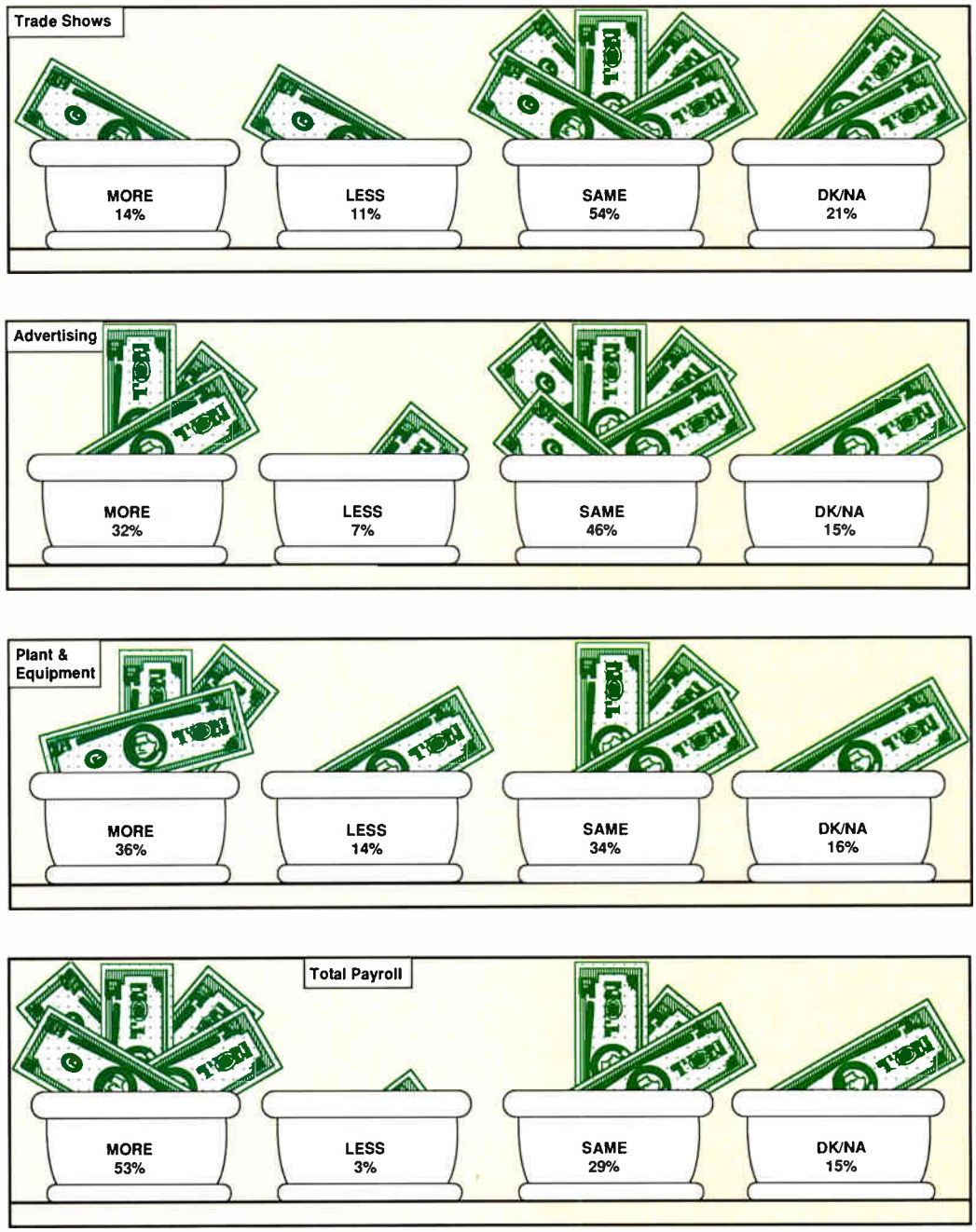
Other budgetary plans for 1991:

- Trade shows. More than half of GMs polled replied they are penciling in the same amount of money to attend trade shows next year, while 14 percent have earmarked more and 11 percent less. With air fares and other related travel expenses threatening to go even higher, however, budgets that aren't increased significantly could mean less trade show attendance.
- Advertising. Image and educational campaign allotments will be boosted by a third of managers, with 46 percent saying they will neither increase nor decrease what was allocated in 1990.
- Total payroll. As usual, employee expenses will contribute a major portion of operations, managers say. More than half expect to spend more in 1991 than in 1990, while only 3 percent figure they will devote less. About 30 percent say they hope to keep an even keel on payroll expenditures.

Finally, system executives appear to be tapping more of their own resources when it comes to planning budgets. More than 70 percent said they use top financial or accounting staffers as resources, 62 percent use engineering employees and 54 percent include marketing personnel in their financial projections. ■

—Chuck Moozakis

Does your system plan to budget more, less, or about the same for the following in 1990?



OSHA— Are you ready?

Is your OSHA Form 200 properly completed and current? Your OSHA Job Safety and Health Protection poster properly displayed? How about your written HAZCOM (Hazardous Substance/Chemical Listing) program—everything in order? Most of the respondents to an exit poll at the National Cable Television Institute's (NCTI) recent OSHA seminar responded positively to these questions. But that doesn't mean that OSHA rules are any less rigorous—which is why the NCTI sponsored the well-attended two-day seminar in Denver last month. "We essentially have an awakened giant on our hand," says Roger Keith, newly appointed director of the NCTI's seminar department. "The news is, OSHA has finally awakened after a 20-year inactive period."

Apparently, the federal government is seeking additional revenue sources, and OSHA has been targeted to serve that purpose. In fact, Keith suspects that the Department of Labor will soon triple all fines and change the current worst-case criminal charge from a misdemeanor to a felony. "This will probably happen, as there is a great push in Washington to give the OSHA organization more teeth."

Several cable operators have already been investigated by licensed OSHA inspectors. Interestingly, an informal poll of the more than 80 seminar attendees revealed that nearly half had already been inspected—some more than once.

Why me?

An OSHA investigation can be triggered by literally anyone: a disgruntled employee, a relative, or even the elderly person who looks out the living room window and notices someone working on a pole without a hardhat. "They can come at any time, and most importantly, speak with any employee privately—off the job—about company safety policies. This is why the dissipation of safety knowledge is so important," Keith explains.

What happens when an OSHA inspector arrives on your doorstep? In most circumstances, the routine is fairly predictable:

- Credential presentation. Make sure that the inspection officer can prove his or her affiliation with the U.S. Department of Labor. "Anyone who tries to collect a penalty at the time of inspection or promotes the sale of a product or service at any time is not an OSHA compliance officer," warns Keith.
- Opening conference. At this time, the OSHA officer explains the purpose of the visit and asks for an employer representative to conduct a facility tour. "Keep in mind that, if the visit is complaint specific, the OSHA officer should be taken directly to the site of the complaint," says Keith. "Anything seen during the trek to the complaint site is deemed 'finable.' "
- Closing conference. Following the inspection, the OSHA officer will conduct a closing interview to alert the employer as to the severity of the conditions found. No fines are levied at this point. "This is a time for free discussion; a time for frank questions and answers," says Keith. "It's a good time to discuss your company's safety habits, manuals or procedures."

Who gets nailed?

"The OSHA administration is adamant that responsibility go as far up the line as it may go," says Keith. "There have been cases where the top brass of an organization have served a prison term for negligent action on the behalf of their employees."

The good news is, though, cable television is an unlikely target for general and routine OSHA inspections. As yet, no cable television execs have ended up in the slammer. "We use accident statistics to find out which industries to inspect on a routine basis. Cable television has pretty low numbers," says OSHA representative Harry Borchelt, guest speaker at the seminar. "The likelihood of targeting you industry for generally scheduled inspections is nil, unless you have a fatality or catastrophe. My advice is, keep your skirts clean, and you won't see us."

One seminar attendee posed the question of who would be subject for criminal investigation in a bucket truck fatality. In the scenario, a supervisor asks his GM for funds to repair a malfunctioning bucket truck and is told that money hasn't been allocated for the repair. One week later, a technician dies when the bucket truck malfunctions. Who is responsible? "That GM better be sweating bullets," Borchelt promptly replies. "That's why it's easier to go criminal with smaller businesses. Then we have the smoking gun, as opposed to a corporate infrastructure."

According to Borchelt, an upcoming standard will require that all employers have a written safety and health program that includes general guidelines on safety measures to be used. "How soon that is going to happen is anyone's guess. I'd like to say it will be out in a year, but probably not," says Borchelt.

Not an ogre

Borchelt was quick to point out that OSHA isn't just a penalty-house, but provides a variety of genuine services, including consultations, voluntary protection programs, training programs and library resources. "OSHA has one purpose: to protect employees from unsafe conditions," Borchelt says. These services can be tapped by calling any one of the 85 regional OSHA offices nationwide. "Many people have the misconception that a phone call to a regional OSHA office will prompt an investigation. That's definitely not the case. We're here to provide safety information—for prevention, not investigation."

MSO programs

A panel discussion moderated by Midwest CATV's Tom Pritchard followed Borchelt's presentation, with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participants Ron Wolfe of ATC National Training Center, Jim Partrige of Sammons Communications, Jim Offerman of Paragon Communications and Doug Ceballos, NCTI. "Sammons has approached safety from a corporate cost-management standpoint. Safety problems are costly, and our workman's compensation figures were historically very high," says Partridge. "General managers may not understand safety, but they understand dollar savings."

Sammons developed a three-part safety approach, including risk management, management and tracking of compensation claims, and the development of a loss-prevention corporate safety committee. "If we get our systems reporting good data to us on a regular basis, that in itself would be a phenomenal success in tracking safety records." After Sammon's first year of tracking and controlling safety records, "we reduced our workman's compensation figures by 50 percent," Partrige adds.

Paragon's Offerman has had several OSHA encounters, and believes that a solid relationship with the OSHA organization is both achievable and necessary. "Always tell them what you're doing, and why. Explain the benefits. OSHA generally just wants to help." Offerman's "good faith" investment in OSHA cooperation has been of great benefit, waiving "nearly all" of citations received during inspections.

Wolfe agrees. "Safety is largely a common sense issue, but even so, ATC provides thorough safety training for all field employees. When an individual does get injured, though, we are able show that the person was trained, and chose not to operate as trained.

"There should be no conflict between what OSHA says we should be doing and what we actually are doing," Wolfe continues. "Safety is a job standard."

More NCTI announcements

For most of its 23 years, Denver-based National Cable Television Institute has been content to quietly provide its correspondence-based training courses to installers and technicians around the country.

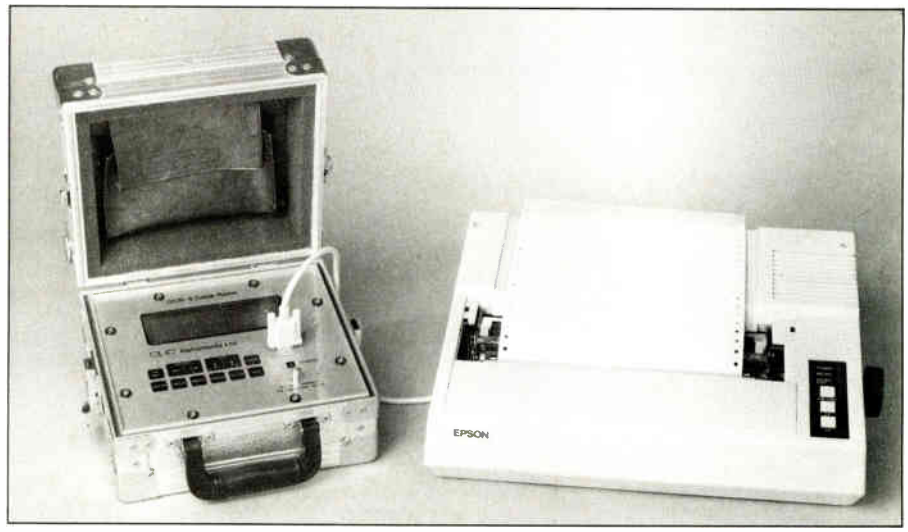
But NCTI is now beginning to shed some of its anonymity. Under the direction of president Byron Leech and GM Tom Brooksher, the company has over the past year aggressively moved to broaden its market and sharpen its training materials and presentation.

The latest glimpse into NCTI's new look is its creation of a separate seminar department that will conduct on-site training at 16 locations around the country in 1991. Roger Keith, who served as training director at Adelphia Communications in Coudersport, Pa., has been tapped to head the unit.

The move toward on-site training is a departure for the NCTI, which has primarily relied on correspondence-based training geared to technicians and installers. Brooksher said the seminar department's creation was based in part from healthy registration to a pair of seminars sponsored by the NCTI this fall.

A number of topics will be addressed by the NCTI, including a course on technology geared to non-technical personnel. The seminar will be based on a popular correspondence course that was released earlier this year. Brooksher hopes that between 1,000 and 1,500 will attend the NCTI seminars. Course fees will range from $125 to $325 per person.

The creation of a seminar department is only one of a number of markets NCTI officials hope to tap. Next on the schedule: the international market. A correspondence course written in Turkish has already been completed, and plans to boost NCTI's role in training British and other European installer/techs are now being formulated.



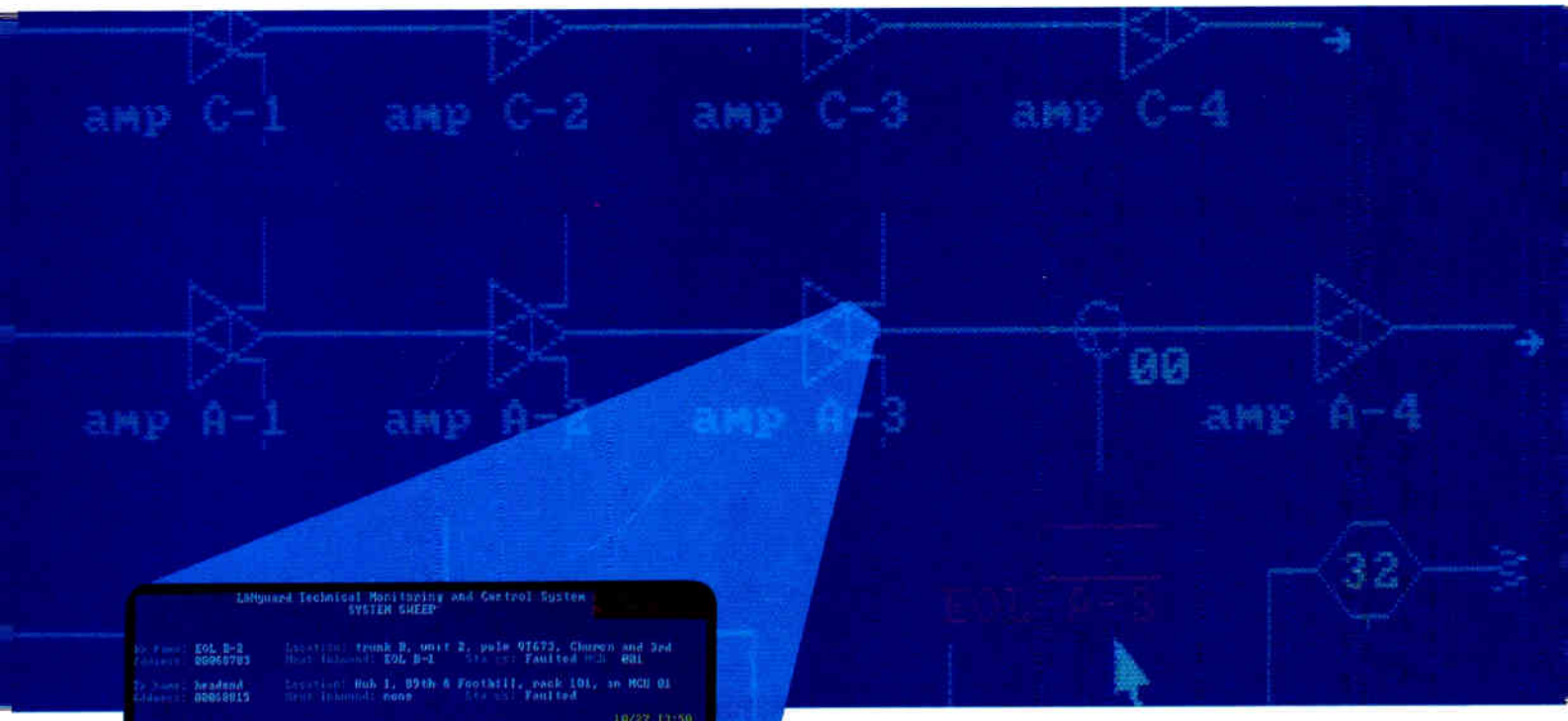
CLIC Instruments Ltd's CCR-4

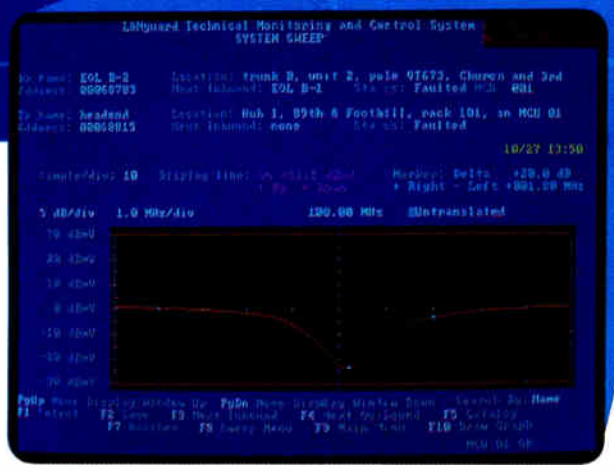
Industry news

Clic Instruments Ltd. has announced the availability of its new CCR-4 coax fault locator. The CCR-4 is a step-rise time domain reflectometer designed for CATV and LAN applications. The CCR-4 locates and identified impedance mismatches on coaxial cable with a display resolution of 3.5 inches and a maximum range to 3,000 ft. It locates taps, splitters, traps or filters, poor splices, bad connections and partial shorts.

The CCR-4, priced at $1,795, displays a line response on a graphic,

Pinpoint Potential Problems *Before* They Happen...





Actual screens from the LANguard™ system depict topology and sweep analysis displays.

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backlit LCD. Features include an extended operating temperature range, keypad control, online help information, 75 memory allocations, computer assisted calibration and analysis of cable characteristics and an RS-232 port for information downloading. For more information or a demonstration unit, call (613) 731-9030.

R-TEC System's MC50 andRK50

New from **R-TEC Systems** is the "Practically-Anything-Anywhere Remote System," a combination keypad/machine controller system that controls "practically any" type of equipment—audio/video tape machines, cart machines, screen curtains, coffee machines, or anything contact-closure controlled—via twisted pair from up to one mile away.

The system consists of the MC50 machine controller and the RK50 programmable remote keypad. The MC50's five contact closures are wired via twisted pair cable, patchbay tie lines, or DTMF link to the five function keys on the keypad. The rack-mountable controller contains 5 independent relays with a normally open contact configuration. Each of the relays can be programmed for pulse, toggle, or interlock modes. For more information, contact R-TEC at (213) 650-5256.

Univision, Inc. has unveiled its new Admagic data management software, designed to produce affidavit and performance reports for advertising sales executives. The software uses a traditional accounting package to track raw log data from multiple equipment formats. For a free demonstration disk, call Univision at (800) 729-8876.

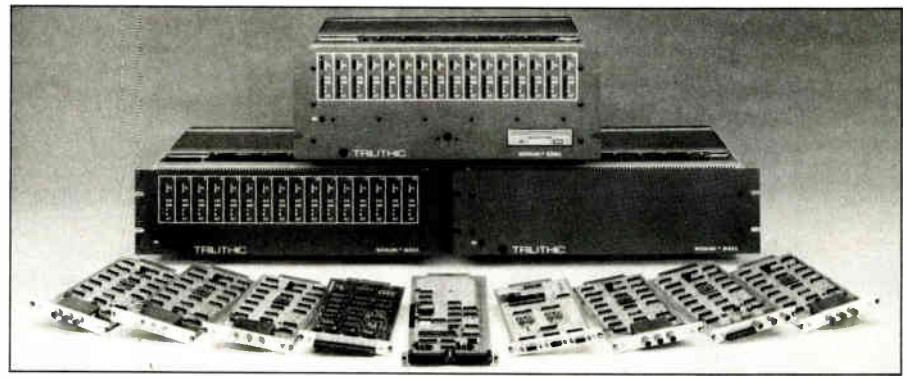
Corning Inc. celebrated it's 20th anniversary of optical fiber development with a big splash—the company plans to invest more than $100 million to increase the capacity of its optical fiber manufacturing facility more than 50 percent. "Our capacity expansion demonstrates our continuing commitment to the communications business," says Jan Suwinski, senior VP and general manager of Corning's Telecommunication Products division. The expansions, slated for construction in early 1991, will be made to the company's Wilmington, N.C. facility, and "will enable Corning to meet international and domestic needs," Suwinski said.

"General Safety and Installer Training" is the focus of a new technical training course announced by the **Mind Extension Institute**. The training, in laser videodisc format, has incorporated the most common technical standards and approaches in alignment with the regulations of the National Electric Code, OSHA and the SCTE. For more information, call (303) 792-3111.

New from **Trilithic Inc.** is the Interlink Headend Automation System, designed to automate switching, control, monitoring and measurement of headend equipment. The equipment is fully modular and includes video, IF and RF switching cards, contact closure cards, satellite receiver tuning cards, and A-to-D convertor cards for monitoring voltages and test points.

Up to 16 function cards can be installed in one 5 1/4 inch cardframe, with the ability to link cardframes for more complex applications. A software front-end, SYNAPSE, simplifies schedule entry and system control. And additional SYNTERM communications software package enables remote applications of up to nine headends from one location. For more information, contact Trilithic at (317) 895-3613.

CableReady Inc. has introduced its new High Security Backer, that meets deters theft of service or vandalism from any installed cable system. According to company officials, the High



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with Switchable Bandwidth and Low 6db Threshold

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Input Impedance	75 Ohms	Subcarrier Freq.	5–8.5MHz times 2
IF Bandwidth (3db)	24MHz/32MHz Switchable	De-Emphasis	75u sec.
Threshold C/N	6db	Audio Out. Imp.	600 Ohms, AC Coupled, Unbalanced
Output Signal	Clamped Lowpass (filtered)		
Output Impedance...	75 Ohms AC Coupled Unbal.		

Step #2

Uniden CAT 30 Agile Modulator

Frequency Range	Channel 2–W (36 Channels)	Input Impedance	75 ohm Unbalanced
Visual Carrier Output	+45dBmV Max Adjustable	Carrier Offset Frequency	Adjustable Internally –25KHz to +25 KHz
Aural Carrier Frequency	4.5MHZz +/– 5dBmV		
Video Input Level	1.0V pp for 87.5% Modulation	Audio Input	600 ohm RCA Unbalanced

Step #3

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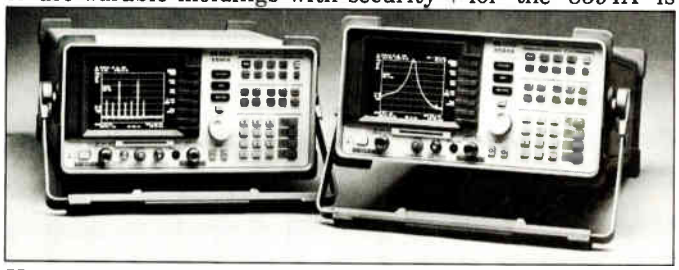
Security Backers are cost competitive and are designed to work in conjunction with the company's attachment clips to secure cable molding to any surface, including wood, brick and stone. High Security Backers are best used in high security locations and areas where theft or vandalism is prevalent.

"The cable industry has become increasingly concerned with cable tampering and theft of service," says Doug Jenson, VP. "When new high security lock boxes are installed, it makes sense to use durable moldings with security backers that are capable of withstanding problems of tampering and vandalism." For more information, call (303) 288-8107.



Hewlett Packard's HP 8594A and HP 8595A

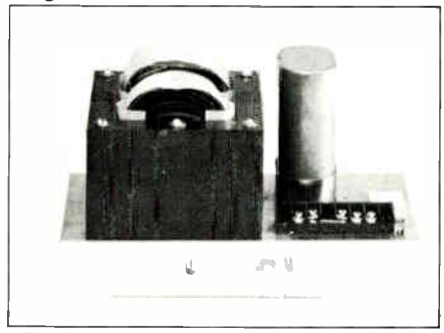
Hewlett Packard has released two new portable spectrum analyzers, the HP 8594A, which covers frequency ranges from 9 kHz to 2.9 GHz, and the 8595A, which covers the range from 9 kHz to 6.5 kHz. The new analyzers are design tools for analog and digital mobile-communication systems. The units weigh under 35 pounds. Pricing for the 8594A is $14,995. The 8595A lists at $19,760. For details, call (800) 752-0900.

New from **EXFO Systems** is the FVA-80, a variable attenuator allowing both singlemode and multimode fibers to be used out of the same unit.

Moore Diversified's Mooreguard

It features 65 dB of range, 0.05 dB linearity, 0.01 dB/step, a low back reflector option for -50 dB, RS-232 options, variable resolution and selectable 850/1300/1500 calibration. For more information, contact EXFO at (418) 683-0211.

Moore Diversified Products, Inc. has introduced a new line of metal molding—Mooreguard—designed to offer high security, and long product life. Mooreguard is offered in three varieties. The Metal Riser Guard (MRG) is flanged and prepunched for ease of installation. The higher security, two piece Metal Latch Duct (MLD) and Metal Cove Molding (MCM) are snap-lid versions supplied with mounting holes and lances for tie-wrapping. All designs are available in eight foot lengths.



Performance Cable TV Product's AC power supply

Performance Cable TV Products has announced a new ferroresonant power supply for feedforward systems. The unit is designed to provide highly

Siecor's 2100HR OTDR

regulated 60VAC power to feed forward and power doubling amplifiers. The power supply converts 12 0 VAC utility power to 60V RMS and delivers 15 amperes of current. The unit fits into standard enclosures and pedestals.

An optional cooling fan may be plugged directly into the unit to avoid the need for additional wiring, company officials say. the input is protected from surges by use of an MOV. A convenience handle is located on the chassis front. Fro more information, call (404) 475-3192.

Siecor Corp. has released a new high resolution OTDR, the 2100HR. The 2100HR OTDR line consists of a mainframe and a variety of plug-in modules. By selecting modules, the user can create an OTDR addressing their specific test needs. Upgrading is possible by adding modules. For example, an optional built-in printer prints the trace and all related information in roughly 30 seconds. Also, a standard disk drive allows for trace storage. An accompanying software package, 2001 Batch, enables full page, permanent records of traces to be printed on dot-matrix or laser printers. For more information, call (704) 327-5000.

SCTE news

The Society of Cable Television Engineers has announced the formation of an international council that will serve as the organizations cooperative forum for the support of other cable television engineering societies throughout the world. "The council was formed with the intent of helping fellow societies get established, expand their functions and objectives and meet their goals," says SCTE President Wendell Woody.

The council will consist of two ambassador delegates from each participating country. Presently, those countries include the United Kingdom, Canada and America. The structure calls for one of its members to be designated a secretariat, a position that will encompass the roles of chairmen, administrator and spokesperson.

The council is founded to foster technical training, the sharing of training materials and the introduction of qualification testing accompanying a certification program. Additionally, a second committee of the council will be devoted to developing recommend interface practices regarding equipment and measurements, and categorizing these as international practices or referencing them by their originating country. The council will also consider creating to third committee to work on the archival publication of SCTE engineering manuscripts.

New region 11 director

Diana Riley, sales manager for Jerry

Diana Riley

Conn Associates, will take up the reins for the SCTE's Region 11, succeeding Pete Luscombe. Riley will serve the states of Delaware, Maryland, New Jersey and Pennsylvania in her new role. "I'm very excited about this appointment," says the second woman to hold a regional SCTE position. "I have already contacted all of the SCTE chapters and meeting groups in my territory, and plan to go to as many of their meetings as possible."

Riley has served as president, vice president and second vice president with the Society's Delaware Valley Chapter. She is also active with the Appalachian Mid-Atlantic Chapter and is currently working with the recently formed Penn-Ohio and South Jersey meeting groups. She has served as associate director of the Maryland/Delaware Valley Cable Television Association and is currently in her second non-consecutive term as associate director of the Pennsylvania Cable Television Association.

A native of England, Riley came to America in 1970 and became a United States citizen in 1974. She joined Jerry Conn Associates as a secretary in 1977, and worked her way up to her current position as sales manager, which she has held for the past two years.

Product info

Midwest CATV made several announcements regarding product additions, management structure, and LAN (local area network) sales at an open house christening its new Denver corporate headquarters last month. First, the company announced the addition of the Antron Milenium 2000 line of taps, line passives and house passives to their distribution network.

Several infrastructural changes were announced, including the centralization of purchasing and finance functions out of the Denver corporate office and the promotion of Chuck Krone, previous manager/new business, to VP/marketing.

In a final announcement, Mary Rose Shearer, LAN group manager, announced a 200 percent increase in LAN sales over the past year. Chris Sophinos, president, closed the conference by alluding to an upcoming acquisition "which will further position us strategically." No further details were available at press time.

Triple Crown Electronics has introduced a new VA series of wideband trunk/bridger amplifiers specifically designed for high capacity fiber/coax builds. The series is based on a 862 MHz platform, which includes an eight port switchable housing. Trunk and bridger cables can be ported horizontally or vertically "to simplify installation," company officials said. The series also offers features including push-pull or power-doubled trunk and bridger, automatic lever and slope controls, bi-directional ports, removable electronics and an AM fiber receive option.

Triple Crown also announced the introduction of Intellitext, a new TV signal interception and message delivery system. Intellitext functions as an add-on unit to enable existing TV distribution equipment to be addressed and remotely controlled. It can intercept and add to (or temporarily replace) a distributed TV program for purposes such as paging, message delivery, advertising and other business or personal announcements. The system can store and distributed up to five pages of text, with six lines of 16 characters generated with a regular PC terminal. "With this capability, the system offers a true low cost information delivery service wherever the TV set is used for communication, especially within small local TV systems as well as restaurants, bars, lobbies, offices and store front windows," says Karl Poirer, VP/corporate development. The system costs from $50 to $125 per channel. For more information on these products, call (416) 629-1111.

The **BASYS Group** has acquired **LaKart, Inc.** in a move designed to produce what BASYS chairman Dave Lyon calls "totalcast capability." BASYS is known for its broadcast equipment line, notably newsroom automation and master control/editing systems. Lakart will now be named BASYS LaKart, Inc. and will continue work on its commercial insertion/headend automation product line. "With such a rapid evolution in the number of program suppliers and joint cable/broadcast ventures in the U.S., it is no longer easy to determine where 'broadcasting' ends and 'cablecasting' begins," says Lyon. "Our aim is to develop what we like to call a 'totalcast' range of services with applications across the board for all media. ■

—Leslie Miller and Chuck Moozakis

Continued from page 30

predict whether all channels should be switched, as in the now abandoned Rediffusion Dial-a-Program or Ameco Discade systems, or only designated premium channels. In any case, network architecture will almost certainly have to deal simultaneously with both analog and digital transmissions, and perhaps with a mixture of switched and non-switched channels.

The PCN

A new challenge is being presented by the Personal Communications Network (PCN). This concept, currently being tested in the U.K. and soon to be tested in the U.S., is somewhat analogous to a mini-cellular telephone. Low power transmit/receive base stations, spaced about a quarter mile apart, are controlled by computer at the headend. Pedestrians carry tiny telephones, from about the size of a TV remote controller to as small as a wrist-watch. Calls are handed-off from station to station in much the same manner as mobile cellular telephone calls, except that PCN can only function when the telephone user is stationary or moving slower than 20 mph.

As in cellular telephony, the stations must be interconnected with microwave or hardwire links. Chuck Dolan and Cox Cable have proposed tests to demonstrate that cable TV networks could provide the most logical and economical interconnection linkage for PCN.

Although PCN may use mostly digitized voice frequency transmissions, it is a full-duplex service. The cable TV network architecture needs to assure equal capacity, quality and reliability in both directions. This is a challenge.

Conclusion

There is no doubt that fiber optics will be a key element in the network architecture of the future, probably in combination with coaxial cable at or near the user terminus. Fiber cables need to be deployed in a mix of tree-and-branch, star, and ring topologies.

The analog VSB/AM optical nodes are likely to be around as long as the public continues to use NTSC TV sets. How we deal with the new players like digital TV and PCN is open for negotiation.

I confess that I hope we are not so mature and complacent that we opt for the safety of the known and pass up the risks of developing the exciting but uncertain prospects to come. ■

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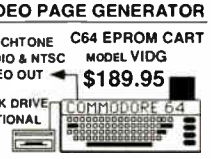

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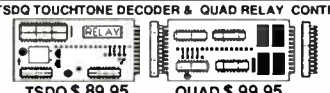

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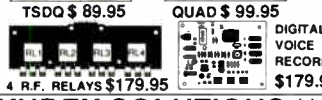

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Attack of the killer bees

I wish I could take credit for the phrase used in the title—but I can't. It was used by one HDTV proponent to describe video artifacts in another proponent's HDTV pictures. The artifacts were due to video compression of the HDTV signal so that it could fit into 6 MHz. The first proponent based his criticism on a computer simulation of the proposal. The second proponent is no longer in the race to become the national standard for HDTV. I'd like to keep such a clever phrase from being lost, so I'll apply it to artifacts I've seen in compressed NTSC.

Let's investigate the nature of video compression. We'll take it step-by-step. It may take us a while before we get to the "killer bees," but we will get there.

Seeing is (almost) believing

I have now seen compressed video in a variety of flavors and qualities. Some of what I have seen has been NTSC; some has been HDTV. Some of what I've seen has been simulation and some has involved actual circuits. Some has been almost too good to believe. Some has been so bad it was more fun to watch the impairments than the video itself. There is enough promise in what I have seen for me to be confident that commercially important video compression is possible.

The really difficult part will be to determine when the technology has progressed far enough to where there will be no further significant improvements. We need to balance the problem of being left behind because we too timidly approached the very real problem of jumping so soon that the next guy got much improved performance at a reduced price. There is no way of knowing which way to go.

Video compession

Color video starts out as equal bandwidth red, green and blue signals at the camera. For NTSC these are band limited to 4.2 MHz. HDTV signals extend to beyond 30 MHz. These signals are combined into a luminance signal conveying the brightness information and two color difference signals. These later signals are adjusted to match the eye's sensitivity to colors. Humans have an acute sensitivity to flesh tones.

At this point, the first compression of the signal takes place. The color difference signals are reduced in bandwidth because the eye's ability to resolve color is less than its ability to discriminate brightness. The NTSC standard suggests that signals carrying flesh tones be sent in a wider bandwidth than those describing colors which are most different from flesh tones. So rather than having three equal bandwidth signals, we have a wide band brightness signal, a flesh tone signal of about one-third the bandwidth, and a non-flesh tone signal of nearly 12 percent the bandwidth. Instead of a 200 percent premium to carry color, the extra amount has been reduced to only about 45 percent.

This relatively easy bandwidth reduction has been accomplished without the use of memory or storage and, for the most part, without introducing significant artifacts. This is all the video compression needed by NTSC to squeeze color into holes in the black and white signal's spectrum. This compression can be handled with circuits having relatively few active devices.

Color resolution has been reduced horizontally to match the eye's properties. The vertical color resolution has not been reduced. It too is beyond the eye's ability to utilize. If we allow for storage, we can send only one of the color difference signals per line. Vertical color resolution now more nearly matches horizontal color resolution. The eye still doesn't see any degradation. The amount of color information has been cut in half. Thus the color premium is now less than 25 percent. It would be about 12 percent if narrow bandwidth color difference signals were used. Nothing inherently "digital" has been done. It is convenient to accomplish the storage of this last step in a digital manner, but digital is not the only way to this end.

Scanning inefficiencies

It was anticipated that early television receivers would have difficulty maintaining synchronization with the transmitted picture. Thus, the creators of the NTSC black and white standard allocated relatively large amounts of transmit time to synchronization pulses. About 10.5 precious microseconds out of the horizontal lines' 63.5 are allocated to the horizontal sync pulse.

The picture tube's deflection yoke and the high voltage transformer are tuned circuits. The movement of energy between the inductance and capacitance of this circuit requires time. This time is also used to bring the electron beam back to the beginning of the line. These time requirements impose a 16.5 percent loss of information-carrying capacity. About 41 of the 525 scan lines are lost to vertical synchronization and beam retrace. Another 7.8 percent of information capacity is lost. Because of these two synchronization needs, video is carried only about three quarters of the time.

Another practical waste is the over-scan of the picture tube. At least five percent of the picture is placed on parts of the picture tube which are not visible to the viewer. This is reduced from a significantly larger number in years past. Over-scan allows for aging of components while still avoiding black bands on the picture edges.

The NTSC signal has been specified in a manner that simplifies the design of television receivers. While this was critical in the early days, it is no longer necessary. A significant amount of compression is possible if these hardware facilitating approaches are eliminated.

The strategy so far has been to avoid sending what the eye can't see. This has been done in a fixed, non-adaptive manner. Next month we'll consider some of the recent techniques which have been applied to make dramatic further reductions in the information transmitted. We'll get closer to the killer bees. ■

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

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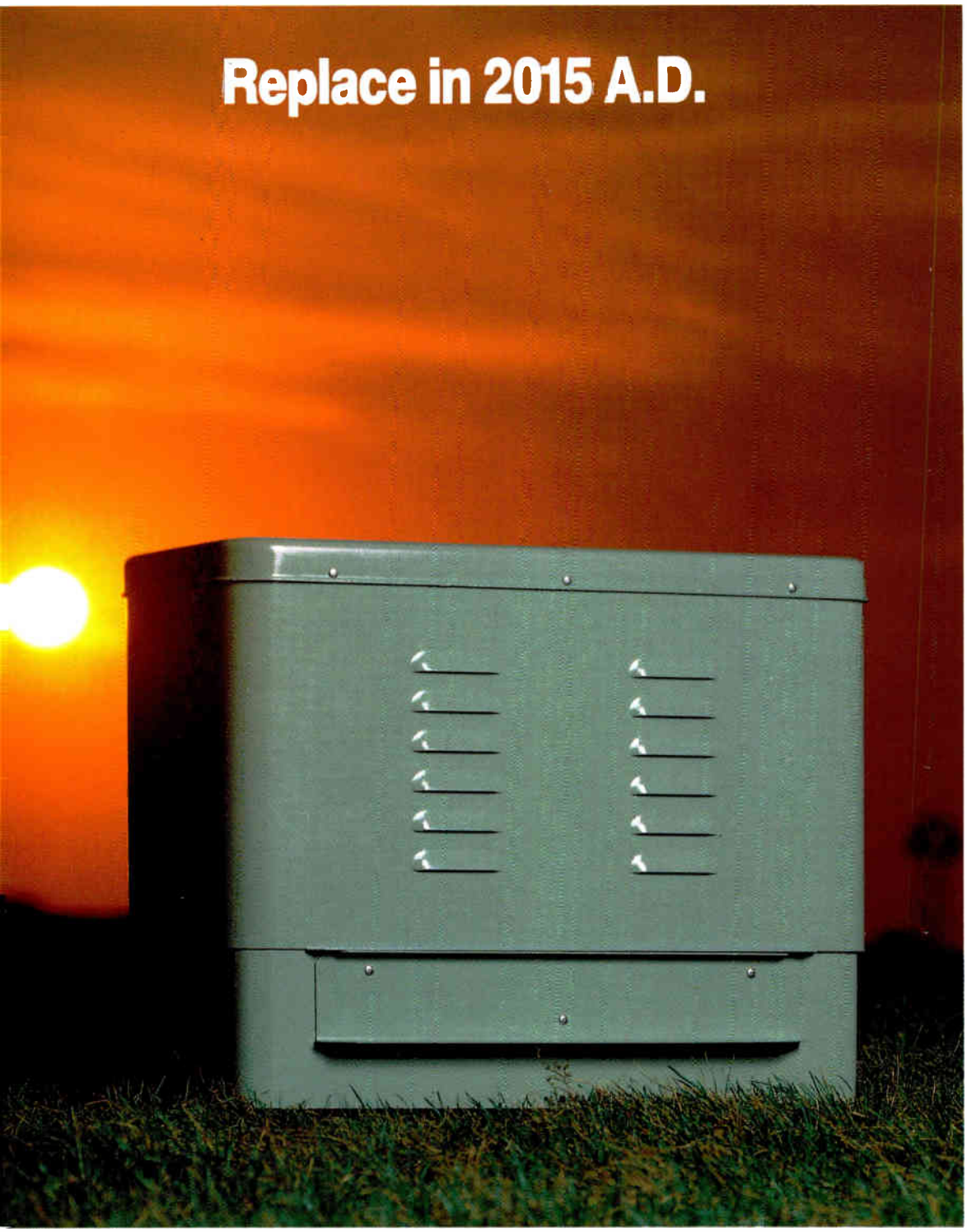

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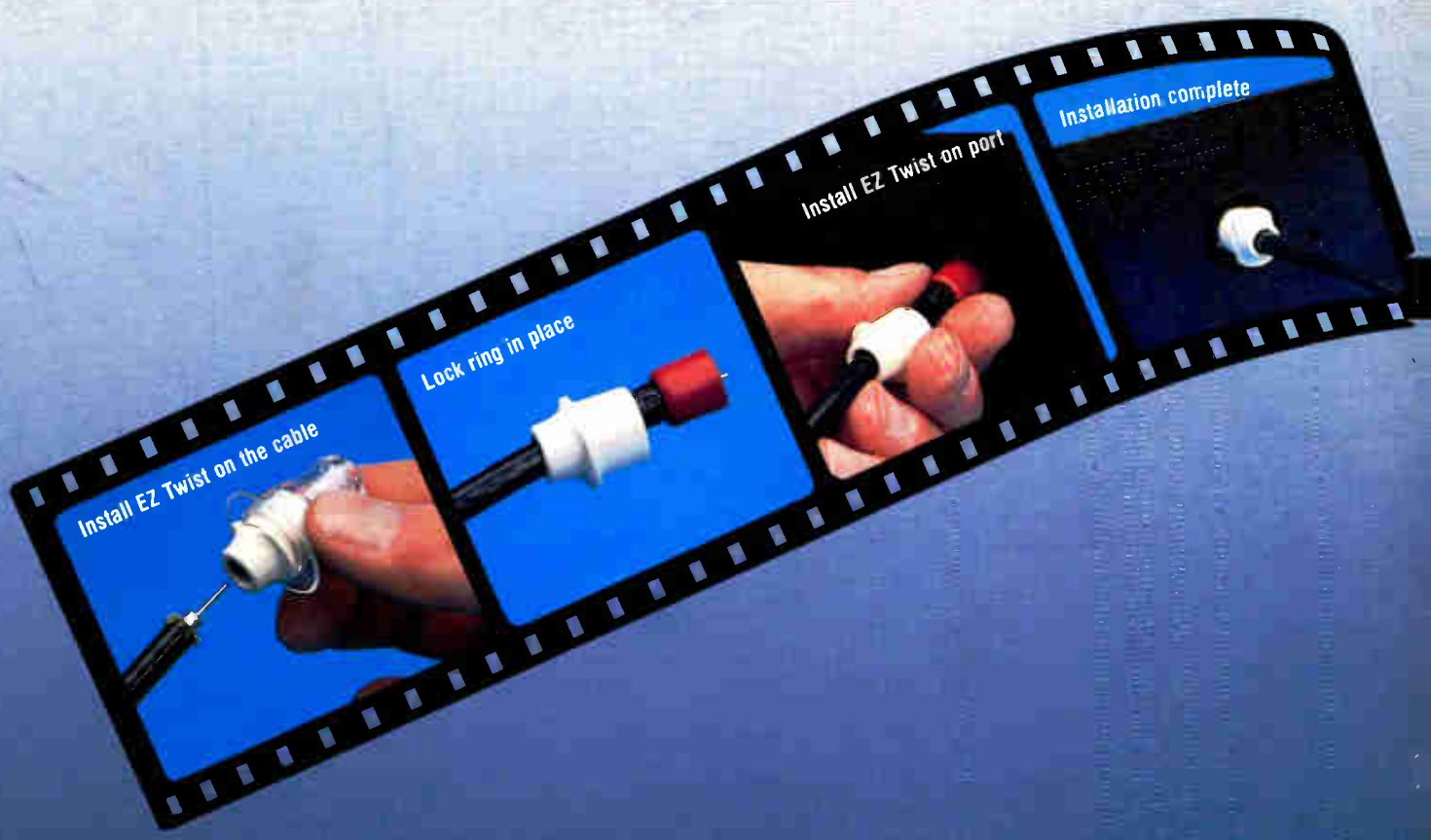

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