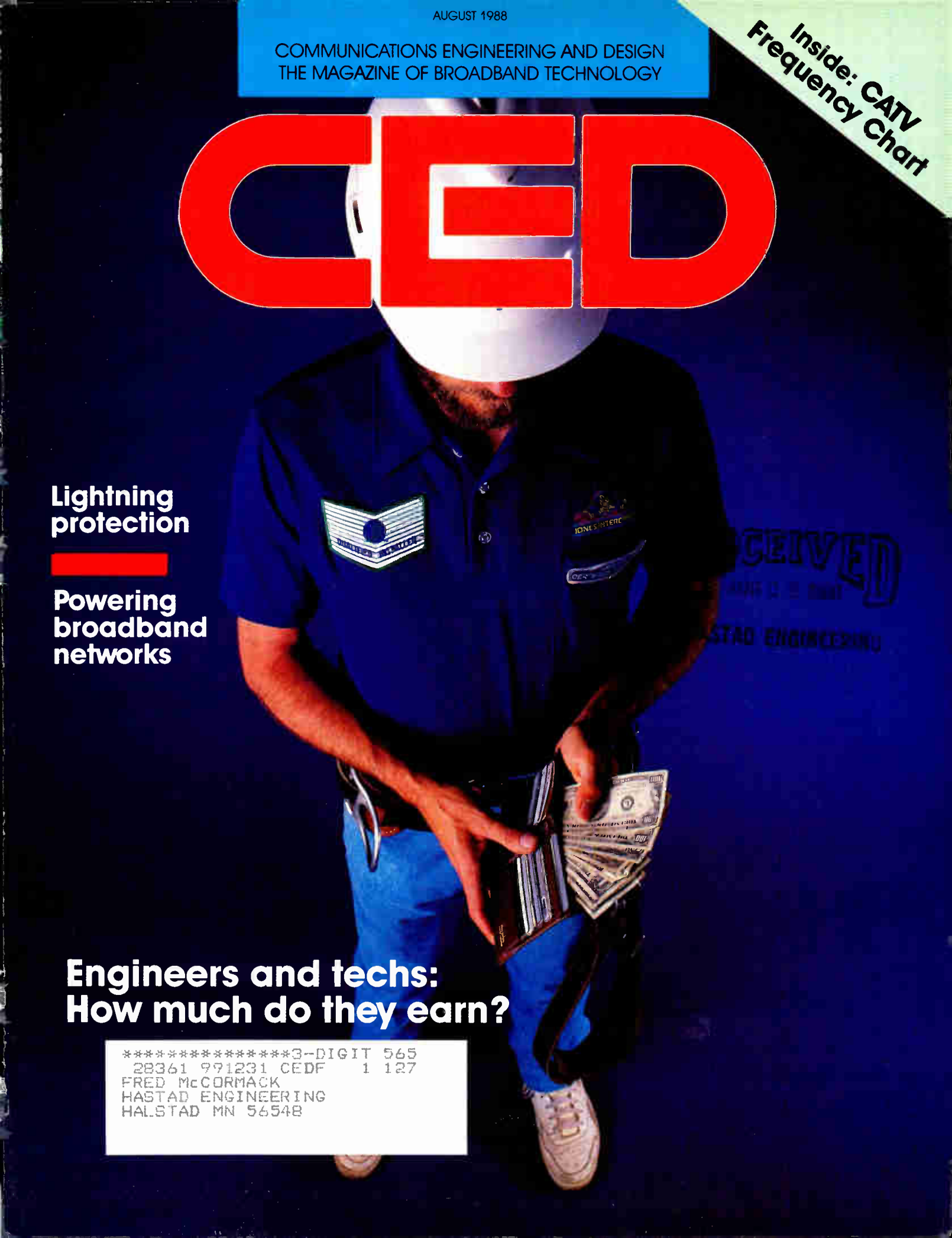
AUGUST 1988

COMMUNICATIONS ENGINEERING AND DESIGN
THE MAGAZINE OF BROADBAND TECHNOLOGY

Inside: CATV Frequency Chart

CED



Lightning protection

Powering broadband networks

Engineers and techs: How much do they earn?

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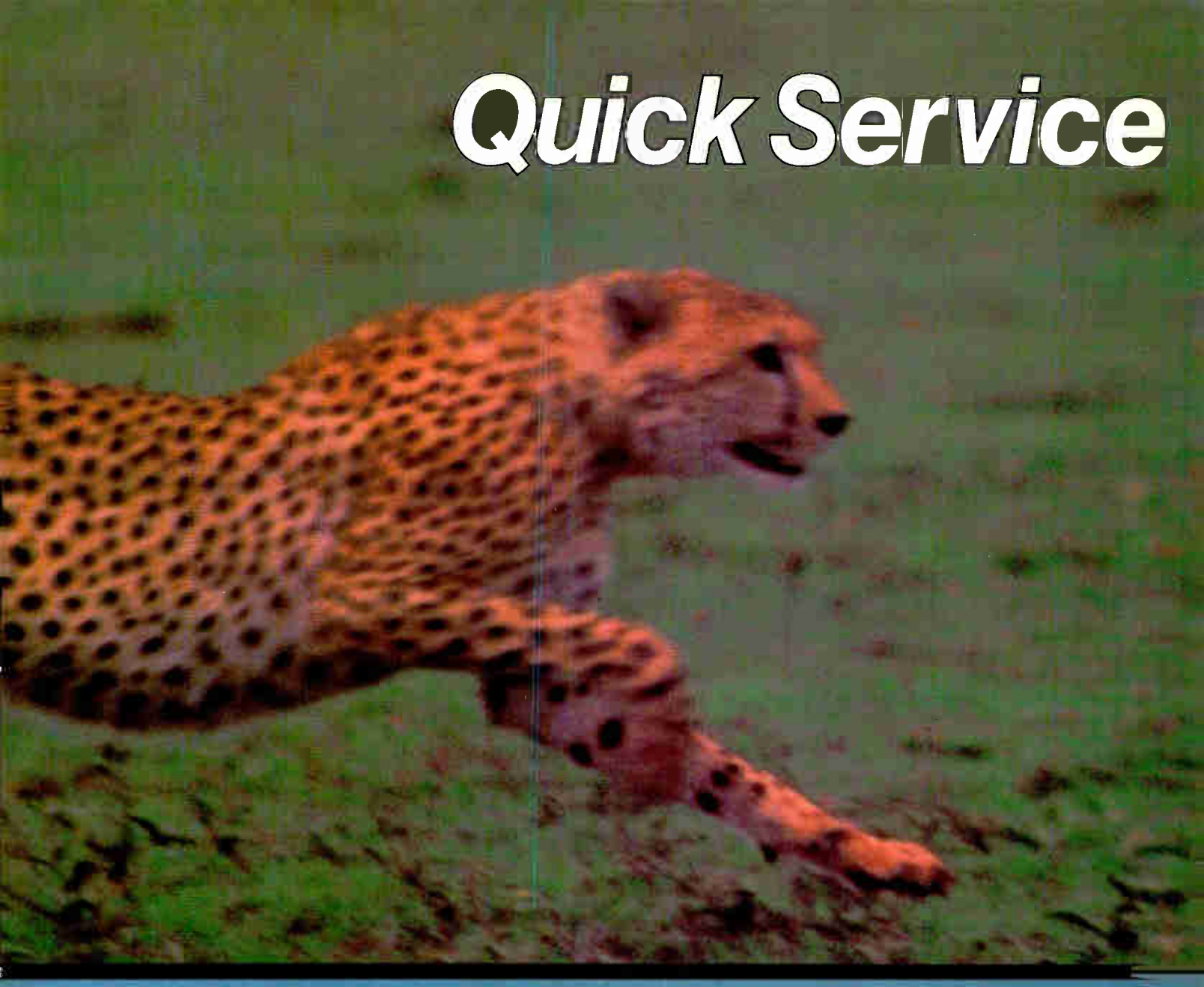
Quick Service



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CED

August 1988 Volume 14, Number 8

ITCI

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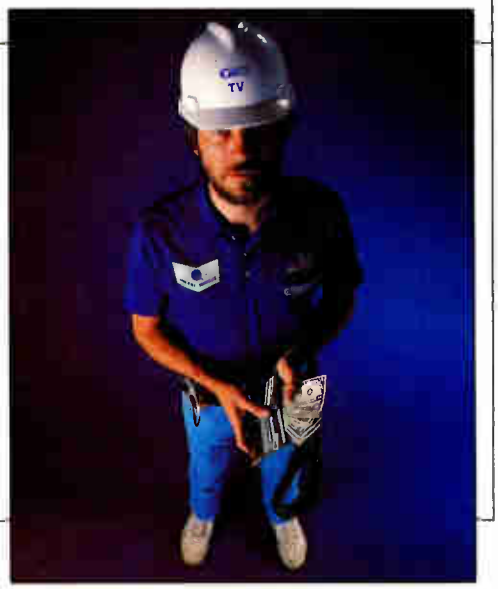

About the Cover:
CED's first industrywide salary and job satisfaction survey of technical personnel shows what the "average" employee can expect to earn. The results also show what issues are on the minds of the technical community. Photo of Jones Intercable's Bob Kanarr by Dan Hayward.

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Reader Service Number 4

Vito Brugliera

Vito and Zenith: poised for future

Planning products for use in the cable industry is a lot like trying to read minds; you have to be able to judge what MSOs are willing to pay for and give the consumer features he can use. It's not an easy job.

But arguably, no one does it better than Vito Brugliera, the affable vice president of marketing and product planning for Zenith's cable products division. You want substantiation to that claim? Just look at the variety of converter products, pay-per-view ordering and delivery schemes Zenith offers. During Vito's tenure on the cable side of Zenith, the company has continually surprised industry observers at major conventions with new, exciting product announcements.

Brugliera has been associated with Zenith since 1959, when he was hired straight out of Northwestern University, where he earned an undergraduate degree in electrical engineering. He landed at Zenith after interviewing with Motorola and IIT Research Institute. "I thought the work at Zenith would be the most interesting," he says.

His tenure at the Glenview, Ill. firm has been marked with steady advances through the ranks. He started as an engineer in the government and special products division where, among other things, he helped design a family of command receivers for reconnaissance balloons. From bench engineering he moved into managing engineers.

After the government devlopment work tapered off in the late '60s, Vito took over the government division purchasing department. In the early '70s he moved into the consumer products division as manager of value engineering. His function was to perform competitive analysis and act as liaison between the engineering and finance divisions. It was during this time that Brugliera received his Master's degree from the University of Chicago's Executive MBA Program.

In 1983, the opportunity to move into the cable industry presented itself and Vito accepted the challenge. "It looked like a neat opportunity because it combined my technical background, and the financial and analytical background, with marketing and product planning," says Vito. "It's been great fun since."

In his role as VP of marketing and product planning, Brugliera analyzes industry trends, determines what features are necessary to make products of value to both operators and subscribers, and works closely with other engineers to develop those products. He is often placed in a position most would consider precarious—devising products to sell to someone other than the end-user.

"Cable hardware vendors are an interesting breed because the end-user is not the customer," he says. "The MSO is the customer. So you've got to find out what the MSO needs and at the same time you've got to be mindful of how to make this product a value to the consumer. That's one of the neat things about working at Zenith—we're a consumer electronics company."

Those two interests play off each other to create a synergy no other cable vendor has, says Brugliera. "The TV part of the business certainly understands consumers and that experience is in many of the people who are working in the cable part of the business here."

For example, Zenith was an early proponent of baseband technology because it allowed more possibilities via remote control. "We (supported baseband) because we understood the value of remote control," says Vito. "Now everyone is putting remote control in RF product."

As one might expect, Zenith is looking toward the future and plans to lead with innovation. The company is expected to propose its own advanced television system to the FCC sometime this fall, according to Brugliera. Details are being held back for the time being, but Zenith is aware of the opportunities and risks that High Definition and other forms of advanced TV offer. "We think what's important is that enough time be taken to do it right," says Vito.

As for telcos and the race to install fiber optics, Vito believes the infrastructure is in place for cable to make it through the long haul. "Cable has the resources to beat them (telcos)," he says. "Frankly, we've been at it longer and we understand the consumer better. But, we should never underestimate them."

Cable has a bright future, says Vito, as long as value is included in the product mix. He says the industry must ultimately provide services and entertainment to the consumer in order to grow. "Pay-per-view is just scratching the surface of cable capability," he says. "PPV is starting to introduce interactivity, which is one of the big areas in which cable can expand and provide more services and value to the consumer. I think we have to go beyond entertainment."

As MSOs realize this, real-time two-way cable will make a resurgence, Brugliera predicts. And services like videotex, once written off for dead, will also again see the light of day. "People weren't ready to pay for information in the past," he says. "But they're doing it now—they just haven't equated it with information on a TV screen."

No matter which way the wind of change eventually blows, you can count on Vito and Zenith being ready. He's already proved it with PPV (Zenith offers no less than four delivery mechanisms) and Vito would love to prove it with something new. ■

—Roger Brown

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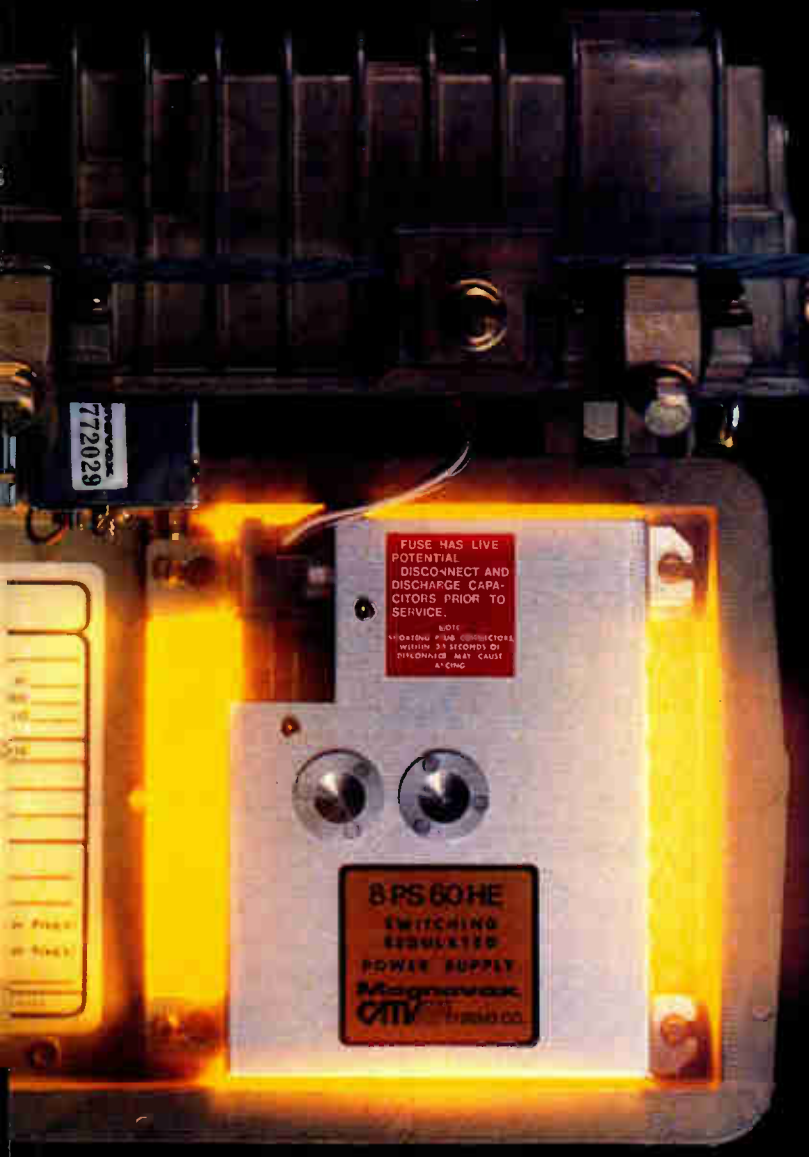

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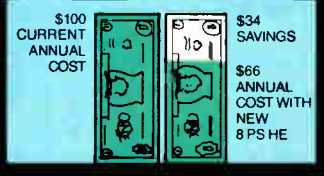

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Reader Service Number 5

Cooperation crucial to R&D breakthrough

In the June issue of *Communications Engineering & Design (CED)*, I wrote an article titled "R&D consortium: Its time has come." In that article we began to see the unfolding of the story about the formation of the cable television industry's first effort at a research and development consortium. As evidence of the dedication, commitment and interest shown by the cable industry in this endeavor, I am pleased to report that the Cable Television Laboratories Inc. (Cable Labs) is in business.

Several important milestones were passed in recent weeks. First, the entity was incorporated and (like all big businesses in Delaware) has temporary offices in Cambridge, Mass.; second, the funding mechanism for the Cable Labs has been put in place and solicitations for membership have been sent out. Solicitations have gone to multiple system operators of all sizes and they are being asked to join the consortium as founding sponsors by Sept. 30, 1988.

The commitment is for 2 cents per subscriber, per month and a rolling three-year commitment on sponsorship. In addition, the former NCTA Committee on Research and Development has been elected as an interim board of directors for Cable Labs and will conduct business for the enterprise until the founding members elect their own permanent board of directors after the Sept. 30 cut-off for initial sponsorships.

In addition, the interim board of directors has appointed an Interim Technical Advisory Committee (ITAC). This committee's job is to transition several projects which are under the trusteeship of NCTA into the administrative structures of the Cable Labs. Other issues on the ITAC's immediate agenda include the set-up of an initial meeting schedule and beginning the discussions which will no doubt continue, after a permanent committee is formed, on issues which are of primary importance to the early stages of this endeavor.

At a recent board of directors meeting, final candidates for the position of president and chief exective officer of the Cable Television Laboratories were interviewed. By the time you read this article, a chief executive will have been identified and negotiations and hiring will have taken place. Several trade magazines, certainly *CED*, will be interviewing the Cable Labs' leader to get insight on what he sees as the major technological issues affecting the industry's development for the future.

> The proper way to accomplish the goals of this consortium are through friendly cooperation with all the players of the cable industry.

The board of directors, the Technical Advisory Committee and the new president/CEO will then begin the work of staffing the cable television labs, identifying resources for work to be done before commencing the projects that are most important for the industry's future. One of the prime ways that this will be done will be via joint ventures, contracts, partnerships and other arrangements with the talented and innovative people who make up the hardware side of the cable television industry. Cable Television Laboratories is not in business to develop products; we have a vigorous and competitive set of manufacturers in cable television who are better than anyone in the world at that particular function. The very competitiveness they bring to their own efforts indicates that they are more than able to work with the Cable Labs managers on specific areas of expertise.

The board of directors and the interim management of this entity have given a lot of thought to all of the possibilities for involving the manufacturing and programming side of the industry in the R&D effort, and they have taken due notice of the problems, as well as the opportunities, that this form of interaction can entail. Suffice it to say that nobody appreciates the dedication and effort put forth by the associate members of the industry as much as the people who have put together the R&D consortium.

Every person who has asked to be involved in this effort, including those who interviewed for the top job at the new company, have unequivocally stated their belief that the proper way to accomplish the goals of this consortium are through friendly cooperation with all the players of the cable industry. Most importantly, perhaps, it is the desire of the people who formed the R&D consortium that Cable Labs work together with MSOs, equipment manufacturers and programmers as well as companies not directly related to the cable television industry—such as consumer electronic firms and other telecommunications companies—that work on similar problems.

It is our expectation that this cooperation among the wides range of interested parties will lead to the early identification of opportunities for technology transfer into the cable television industry. The technology future of cable television depends to a large extent on our early identification of technology which offers opportunities for us to do our business better. ■

By Wendell Bailey, Vice President Science and Technology, NCTA

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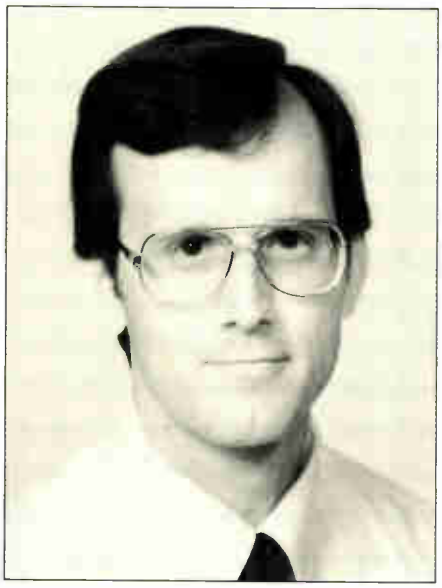

Docket 21006: A pilot's view

When FCC Docket 21006 was first released back in late 1984, it created quite a stir in the industry. Immediately, in many industry publications, articles appeared which outlined the meaning of the docket and the implications to us as an industry. Some MSOs and smaller system operators immediately began modifying equipment to ensure compliance, while others felt it was best to leave well enough alone and decided to put it off until Jan. 1, 1990. Manufacturers began shipping equipment to meet the FCC requirements.

Well, believe it or not, the 1990 deadline is rapidly approaching. If you're not in compliance with the new rules by that time, (or with the old rules by now) then you could be in for some very tough times with the FCC. As a pilot, as well as an electrical engineer who has been involved in the design of avionics (in a previous life it seems), I am highly interested in the potential hazards of cable interference to the aeronautical navigation environment. Hence this brief review.

By Chris Bowick, Engineering Dept. Manager, Scientific-Atlanta

Docket 21006 specifically outlines that cable systems may operate with carriers in the aeronautical communications and navigational bands if you adhere to a few rules.

In the aeronautical *communications* bands (118 MHz to 136 MHz, 225 MHz to 328.6 MHz, and 335.4 MHz to 400 MHz), all carriers must be offset from communications channel center frequencies by ±12.5 kHz, with a frequency accuracy and stability of ±5 kHz.

These communications bands are the ones reserved for air-to-ground and air-to-air voice communications such as approach control, air traffic control centers, control towers and Unicom. Their RF carrier center-frequencies can be located anywhere within each band, in 25 kHz increments beginning at the bottom of each frequency range.

For example, 118.025 MHz, 118.050 MHz, 118.075 MHz, etc. are all valid communications frequencies and are probably in use somewhere in the United States. The potential for disruption of voice communications between an aircraft and its Air Traffic Control facility is fairly straightforward and easily understood. If cable leakage begins to jam a communications channel, then altitude, heading and sector hand-off assignments could be missed, resulting in a potentially dangerous situation.

In the aeronautical *navigational* bands (108 MHz to 118 MHz and 328.6 MHz to 335.4 MHz), cable RF carriers must be offset from navigational channel center frequencies by ±25 kHz with a frequency accuracy and stability of ±5 kHz. These navigational channel center frequencies are spaced at 50 kHz increments beginning at the bottom of each frequency range. Therefore, 108.050, 108.100, 108.150 MHz, etc. are all valid navigational frequencies and are probably in use somewhere in the United States. As a pilot, it is the potential for the inadvertent jamming of these navigational channels that concerns me most of all. These frequencies are utilized by VHF Omnidirectional Radio Ranges as well as Instrument Landing Systems.

VORs are used by commercial, private and military pilots primarily for point-to-point navigational purposes at relatively high altitude. It may not be obvious however, that these navigational aids are also used extensively for directional guidance at very low altitudes during instrument approaches in poor weather conditions; especially to smaller airports that do not have more sophisticated ILS systems.

ILS systems provide localizer (distance left and right of runway centerline) and glideslope (distance above and below required glidepath) information to a pilot trying to land in poor weather, at *extremely* low altitudes, when he has no visual reference to the ground.

Localizer information is transmitted in the frequency range of 108.10 MHz to 111.95 MHz (40 channels, in 50 kHz steps, but only on odd-tenths of MHz i.e. .1, .15, .3, .35 etc.) while glideslope information is transmitted in the frequency range from 329.15 MHz to 334.85 MHz (40 channels in 150 kHz steps). Channel FF's video carrier, for example, falls directly on a Glideslope channel at 331.25 MHz. Accidental jamming of these navigational frequencies could have tragic consequences.

Systems operating HRC will be permitted to continue in operation providing the master oscillator frequency is set at 6.0003 MHz ±1 Hertz.

In addition to the frequency offset requirements in the communications and navigational bands, cable systems must prove compliance with a Cumulative Leakage Index as a basic signal leakage criteria, on a regular basis, by monitoring all portions of the cable system at least once every three months. This must be accomplished using either ground-based or aircraft-based (flyover) measuring equipment. A logbook detailing the leaks found (anything greater than 20 uV/m must be logged and repaired within a reasonable period of time), the date repaired and the probable cause must be retained for a period of two years, and must be made available to FCC personnel upon demand.

It was further noted that systems that were in operation prior to the adoption of the FCC order would be allowed to operate under the rules existing at the time for a period of 5 years, after which time, they must be compliant with 21006.

Are you ready for Jan. 1, 1990? ■

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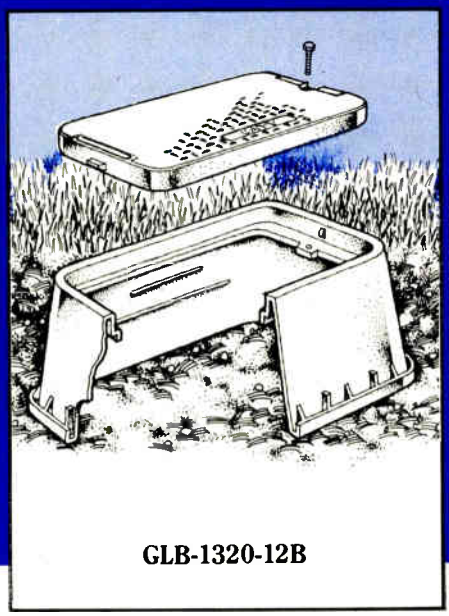
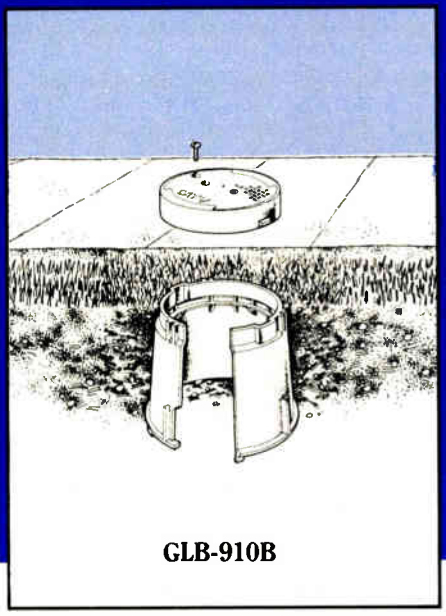


GLB-1320-12B



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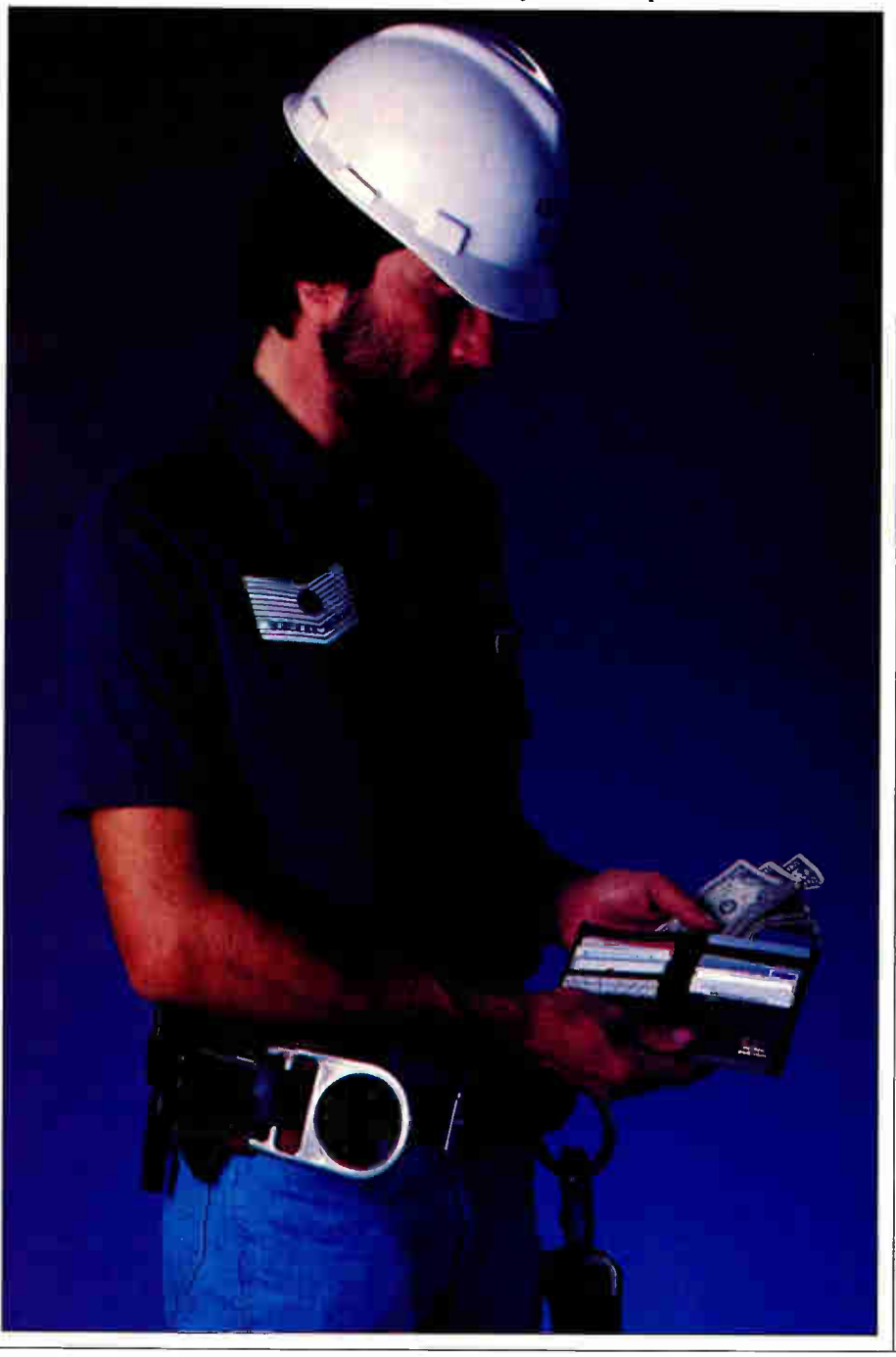
Reader Service Number 8

Engineers and techs: are they satisfied?

Low wages, lack of adequate training and looming competition from the likes of telcos and high definition TV are the three major concerns of engineers and technicians in the CATV industry, according to a national salary and job satisfaction survey conducted by *CED* magazine.

In addition to surveying engineers on their fears and concerns, the study asked respondents for information about their salaries, how long they've been employed in their present jobs and the industry as a whole and size of system for which they work. Additionally, the survey asked respondents to rate how satisfied they are with the wages they are receiving and their chances for career advancement.



In all, 483 responses were received as the result of two survey distribution efforts. First, 1,500 surveys were mailed to randomly selected readers of *CED*. Also, the survey was printed in the May 1988 issue of the magazine. Responses were categorized into one of four groups, delineated by job title: corporate, engineering, management and technical. In all, we received responses from 20 corporate personnel, 134 engineering titles, 177 management people and 150 technical employees.

The results were enlightening, if not surprising. Here are some of the highlights:

Predictably, wage and job satisfaction levels vary with job title.

- Although chances for a full-scale revolution are minimal, there is discontent among the ranks that is perpetuated by the wage/experience vicious cycle. Technical managers complain about the lack of qualified personnel, but technicians typically bemoan the low wages they receive, even when they have gained years of valuable experience.
- The technical side of CATV is without a doubt a male's world. In all, only six of nearly 500 survey respondents are female.
- Despite common complaints concerning low wages and poor or a complete lack of training, technical respondents are overwhelmingly optimistic when it comes to the likelihood of staying employed within the industry. With the exception of just 12 techs, 17 managers, 13 engineers and one corporate person, all of those polled said they expect to be employed in the cable industry three years from now. That bit of optimism bodes well for the industry as a whole as turnover may be less than expected.
- Training at the lower levels isn't highly regarded. A large percentage of

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CPH-816B Tap/Splitter Pedestal with bracket and stake pre-installed	6	12 Pedestals @ $24.80 each $297.60	6 Free CPH-816B Pedestals
CPH-1230B Line Extender, Tap/Splitter Pedestal with bracketry and ground skirt pre-installed	4	8 Pedestals @ $90.80 each $726.40	4 Free CPH-1230B Pedestals
CPH-1730B Trunk Amplifier Pedestal with bracketry and ground skirt pre-installed	1	2 Pedestals @ $159.80 each $319.60	1 Free CPH-1730B Pedestal
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Reader Service Number 9

Corporate respondents listed outside influences and regulatory concerns as the things they worry about most.

Size/Salary

	System Size					
	50000 or +	25k - 49999	10k - 24999	5k - 9999	1k - 4999	<1000
Engineering						
high	$90,000	$46,000	$53,000	$44,000	$50,000	
low	$21,320	$33,500	$23,000	$20,000	$18,000	N/A
average	$45,600	$36,763	$34,624	$30,973	$31,203	
Management						
high	$58,000	$55,000	$45,000	$42,000	$35,000	$60,000
low	$25,000	$17,000	$22,000	$20,000	$17,000	$11,000
average	$39,312	$35,732	$32,442	$29,396	$26,987	$32,150

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Reader Service Number 14

Size of system seems to correlate directly with the amount managers are paid.

present job with his current employer for between 4 years and 6 years. He, too, has an average of more than 10 years experience in CATV.

The managers typically supervise 12 people and work in a system of 10,000 to 20,000 subscribers. Respondents gave average marks for wage satisfaction and opportunity for advancement. Seventy said they were more than satisfied with their salaries while just 37 expressed dissatisfaction in that area. But managers were almost evenly split on the subject of advancement; 62 said the chances were positive while 66 were less optimistic.

Size of system seems to correlate directly with the amount managers are paid. For systems with more than 50,000 subs, managers were paid an average of just over $39,000; systems with at least 25,000 subs paid their managers an average of $35,732; managers in systems with between 10,000 and 25,000 subs earn $32,442. Managers are paid a little more than $29,000 a year in systems with between 5,000 and 10,000 subs; and almost $27,000 annually in systems with 1,000 to 5,000 subs.

Across the board, training was rated as average by the managers; higher scores were given for basic training than overall training. Specifically, 40 of the 177 respondents rated their basic training as below average while 92 termed it above average. But in the area of overall training, 32 gave it below average marks and 66 said it was above average. Seventy-nine called it average.

Technicians

The guys in the trenches. Without them, where would the industry be? They're the ones the managers and engineers look to to help safeguard the corporate image, keep customers happy by fixing problems quickly, point out potential problems during routine maintenance, etc. These are the guys who are worth their weight in gold when they're talented and universally scorned when they're not.

(In this category, we heard from a variety of chief techs, directors of technical operations, lead technicians, headend technicians, microwave technicians, line techs, site techs, bench techs, system techs, tech IIs, etc.)

This group is the lowest paid, and that fact is often lamented. According to our statistics, the average technician last year earned about $25,500 even though he's been performing the same job for the same employer for between 4 and 6 years. He's got 6 to 10 years of experience under his tool belt and supervises six other people, all of whom work with him in a system that serves between 10,000 and 20,000 subs.

Although the satisfaction scores evened out to about average, a higher number of below average marks are

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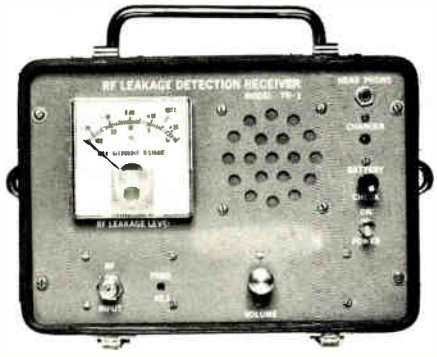

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Reader Service Number 17

Surprisingly, the complaints about lack of training were not reflected in the satisfaction scores.

visible. For example, when it comes to wages, 48 of the 150 questionnaires were marked with above average grades and 43 had below average scores. When people were asked about opportunity for career advancement, the light really grew dim; 53 answered with above average marks while 63 said their positions were dead-end jobs.

Surprisingly, the complaints about lack of training were not reflected in the satisfaction scores. For example, 39 people said their basic technical training was below par while 69 said it was better than average. But the situation is reversed when it comes to overall training (which includes management and safety training) as 49 showed dissatisfaction, compared to 42 positive responses. The implication here is that techs want to move up the ladder and desire the necessary training to do so.

In fact, that notion is directly reflected in some representative com-

Training Satisfaction

	Overall Training Satisfaction			
	below average	average	above average	Total Responses
Corporate Management percent of total	6 30.0%	4 20.0%	10 50.0%	20
Engineering percent of total	27 20.1%	54 40.3%	53 39.6%	134
Management percent of total	32 18.1%	79 44.6%	66 37.3%	177
Technical percent of total	49 32.7%	59 39.3%	42 28.0%	150

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A number of other issues weigh heavily on the minds of CATV personnel at all levels.

ments from a few respondents:

"Additional management training should be given or time off (should be allotted) to attend; like the phone and power companies do," wrote a man from California. Another wrote: "I train all the techs below me, but no one trains me. There are no seminars, no push to train the supervisors."

Industry concerns

In addition to low wages, lack of training opportunities and impending competition, a number of other issues weigh heavily on the minds of CATV personnel at all levels, and those issues, too, are directly reflected in some of the comments made on the returned questionnaires.

Customer service has become a sore spot within the industry as CEOs and other industry leaders have noted in public speeches. But no one knows better than the front-line guys whether customer service is a real priority.

"While giving lip service to customer service, no money is put where the mouths are," wrote a Michigan lead tech. Another lead tech from Florida said one of his largest concerns is the importance placed on the bottom line versus quality.

In fact, some employees are taking it personally and express deep feelings of resentment against system and/or corporate management. Many lower-level employees say they aren't getting the respect they deserve.

"It's time the industry trains and pays good people who are willing and dedicated," wrote a chief tech from California. "Being a service industry, we could grow enormously, but the bottom line asset is the employee who's influence upon cable quality and customer satisfaction is paramount," he concluded.

A lead tech working in the Northeast wrote: "I love the CATV field. All CATV training has been self-taught with very little corporate help. Training (I feel) is needed and it's time the profits are used to help train the people who actually make the profits happen. No techs—no profits."

A chief tech from New York wrote: "There still seems to be a lack of respect or concern for the tech or installer in the field. People wearing a shirt and tie seem to get all the credit."

Industry consolidation and clustering of systems also worries a number of people. A plant manager in California wrote that clustering has done nothing but add to his headaches and erode consumer happiness. "Clustering causes a lot of customer dissatisfaction. It's also getting harder and harder to find qualified personnel. So why (let go of) people you have invested so much money in when you will never be able to fill the position with someone as qualified?"

—Roger Brown

Experience vs Salary

Title Code	Years Experience: 10 yrs. +	6 - 10 yrs.	4 - 6 yrs.	1 - 3 yrs.	< 1 yr.
Corporate					
high	$100,000		$45,000	$39,000	
low	$10,000	N/A	$16,000	$39,000	N/A
average	$43,482		$27,001	$39,000	
Engineering					
high	$90,000	$162,000	$38,000	$50,000	
low	$18,000	$20,000	$20,000	$23,000	N/A
average	$40,600	$38,507	$26,930	$36,500	
Management					
high	$58,000	$45,250	$60,000	$40,000	
low	$17,000	$19,000	$20,000	$11,000	N/A
average	$34,068	$30,271	$30,145	$26,833	
Technical					
high	$43,000	$48,000	$30,000	$28,000	$19,000
low	$14,000	$12,000	$14,200	$13,520	$16,000
average	$27,846	$24,720	$21,283	$20,662	$17,500

Wage Satisfaction

	Wage Satisfaction: below average	average	above average	Total Responses
Corporate Management	5	6	9	20
percent of total	25.0%	30.0%	45.0%	
Engineering	21	51	62	134
percent of total	15.7%	38.1%	46.3%	
Management	37	70	70	177
percent of total	20.9%	39.5%	39.5%	
Technical	43	59	48	150
percent of total	28.7%	39.3%	32.0%	

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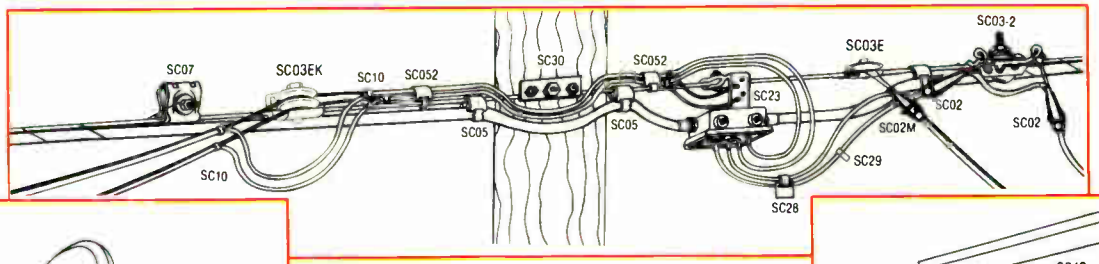

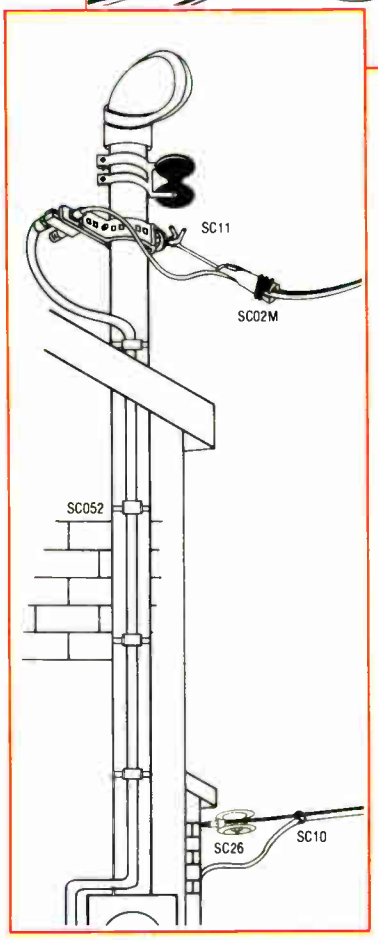

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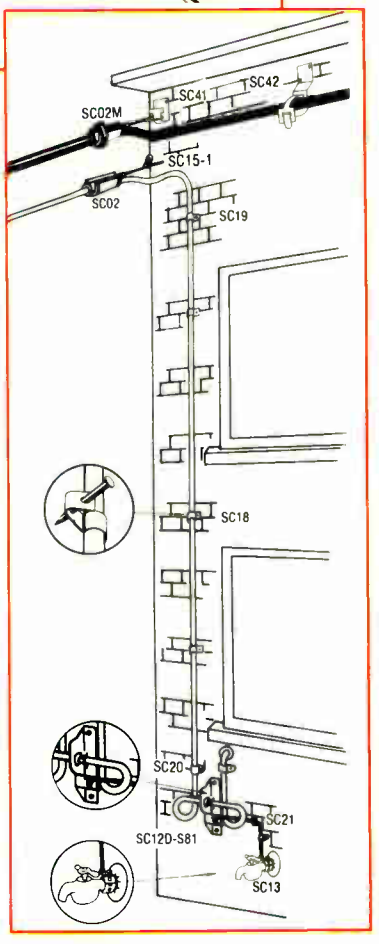

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Reader Service Number 20

Technology makes a comeback

The SCTE's 6th annual Expo was held in San Francisco in June. The show featured tech sessions on HDTV and fiber optics.

Senior industry engineers lead the forward-thinking discussions.

Despite the state's occasionally zany and free-wheeling image, California's sun-drenched iconoclasts have earned a reputation for setting national trends. So it was fitting that the Society of Cable Television Engineers held its pioneering 12th Annual Engineering Conference and 6th Annual Expo in trend-setting California.

Thrown into dramatic relief at the annual convention was a striking emphasis on the future of the business; a clear recognition of the importance of facing up to a newly competitive video marketplace; a renewed emphasis on the importance of technology as a competitive weapon in the industry's hands; and a growing maturity and professionalism on the part of the engineering society itself.

Coming from an industry not known for long-range planning, that's an earthquake whose tremors could eventually shake the foundations of far-flung businesses ranging from broadcast TV to telephone. The forward-looking tone was set early in the day as the Spring Engineering Conference kicked off with a discussion on high definition television. Then a panel of senior industry engineers returned again and again to technical issues that bear directly on the industry's ability to prosper in a newly competitive environment.

The forward-looking emphasis continued with the day's discussion of fiber optics early in the afternoon and built to a crescendo with the concluding panel of industry luminaries including Edward Allen, a former NCTA chairman; John Goddard, president of Viacom Cablevision and new chairman of the NCTA; Bill Johnson, vice-chairman and CEO, Scientific-Atlanta; and Hal Krisbergh, president, Jerrold division of General Instrument.

Wasting no time

Allen wasted no time getting straight to the heart of the matter: "We're on

Now...You, too, can have

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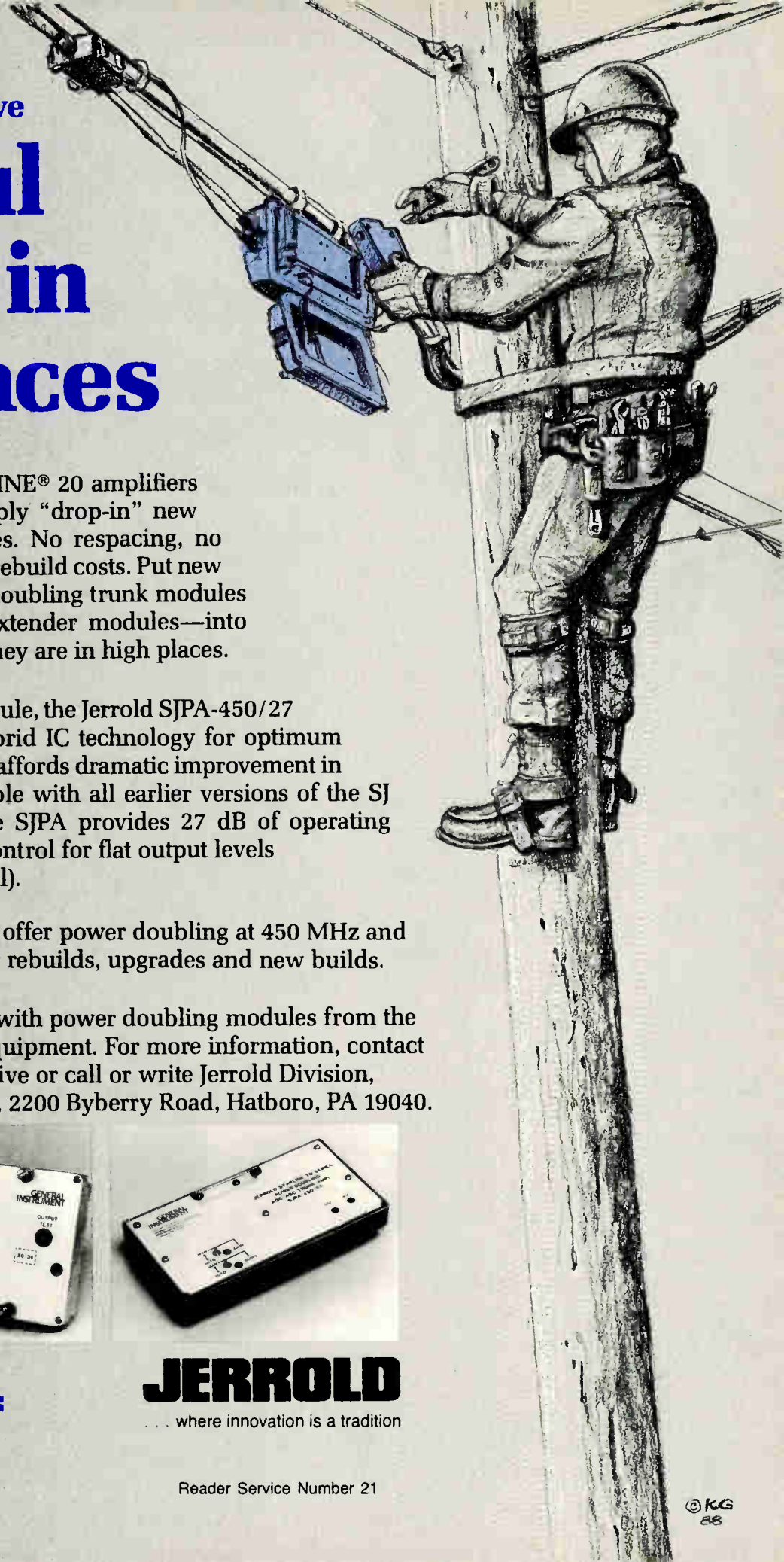

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Reader Service Number 21

He (Goddard) predicted that in five years basic penetration would be at 70 percent.

the verge of a new emphasis on engineering," he said. "Engineering is coming back to the fore." Goddard urged the audience to remember that because the CATV industry has won many great victories in recent years, it is seen as possibly having won too much: "we aren't an underdog anymore. We should expect a generally more hostile political environment in the future as well as increased competition. And 'competition' means telco to many in the Congress and FCC."

Asking the technical community to help the industry focus on unmet consumer needs, Goddard emphasized top management's need to stay current on technology and warned the audience not to "let consumer abuse stories flow up to Congress. That just gives the telcos more ammunition," he said. "Installers and technicians often are the only people in our industry with direct customer contact. You control their training." Train them well, Goddard seemed to imply.

Mike Aloisi of Viacom was named SCTE's Member of the Year.

He predicted that in five years basic penetration would be at 70 percent; entry into the industry for other competitors would be eased; more networks and local broadcasters will be in the business; telcos would be in the CATV business but allowed to operate only outside their telephone service areas; and that 15 percent of the industry's plant will have been rebuilt with fiber.

Putting things bluntly

Jerrold's Hal Krisbergh also put matters bluntly: "The future is broadband and everybody in telecommunications knows it. There will be a pipeline into the home delivering video, voice and data. The only details are when and how. It may be glass, or something else, but it will be broadband."

Mincing no words, Krisbergh added: "Cable will emerge as the future leader." Why does the industry keep hearing about telcos and broadcast networks? "Because the major players

Jerrold also is working with TCI on off-premises technology that is consumer friendly.

are trying to get into CATV; because we will be the leaders; because cable is potent." So how does the industry move forward?

In two major ways: "Do it better" (use off-premise technologies, fiber optics, advanced security, digital audio, HDTV and transactional ordering systems) is one way. "Explore whole new revenue sources" is the second way. By this Krisbergh means audio services, telephony, transactional and data services.

So what's Jerrold up to these days? It has started an Applied Media Laboratory, modeled after MIT's lab, to explore how to apply advances in technology to real-world products. It is working on fiber optics as an enhancement to existing coaxial plant. For the next five years, fiber will be introduced on an evolutionary basis in CATV. HDTV is a long-term issue, in Jerrold's view. In the interim it is working on a "Supervision" system that will deliver Super-VHS quality pictures over a CATV plant. The key issue: how much is a customer willing to pay to get better pictures?

Jerrold also is working with TCI on off-premises technology that is consumer friendly. In the security area Jerrold is revamping Starlok, the encrypted video/digital audio product the company developed in the race for a satellite encryption standard that ultimately was won by VideoCipher. In the audio arena, Jerrold believes that delivery of CD-quality sound to subscribers could "do to broadcast radio what CATV did to broadcast video." In initial field tests, Jerrold has found that about 10 to 15 percent of subscribers will buy a CD-quality, eight-channel service using 6 MHz of bandwidth.

Meeting the challenge

Scientific-Atlanta CEO Bill Johnson amplified earlier panelists' remarks. "The CATV environment now is more challenging," he said. The environment is shaped by "re-regulation, competition, more demanding customers, aging physical plant, new service opportunities and franchise renewals." CATV technology consequently must "add value (better signal quality, higher reliability, more security) and be user friendly (easier connections and control, less obtrusive security, easier installation and operation)."

Among the important technologies Scientific-Atlanta is tracking are fiber optics, HDTV, impulse PPV and off-premises systems. On the important question of HDTV transmission standards, Johnson argued that multiple standards will prevail; there will not be a common, near-term transmission standard for HDTV.

Standards for advanced TV systems will be an issue for some time—perhaps five to 10 years.

Several panelists, Johnson among them, spoke about a debate growing within HDTV circles about HDTV-compatible receivers. Known as "open architecture" receivers (OARs), such proposed TVs would be flexible, designed to receive and display regular NTSC, improved, extended or high definition format pictures by swapping out cards, much as PCs can take different network interface cards. Generally speaking, proponents of the "multiple transmission systems" school support open architecture receivers. Many manufacturers of receivers can be expected to oppose the concept, although Philips believes it can be done.

Scientific-Atlanta believes such OARs can be built inexpensively and flexibly. Bill Thomas, director of engineering and technology at ATC, made clear HBO and ATC's position that HDTV-compatible sets must be available to consumers at a cost premium of not more than several hundred dollars if widespread adoption is to occur.

Taken as a whole, comments by panelists projected a clear understanding of the changing business environment; the important role technology once again will play in CATV; and a firm grasp of the fundamentally competitive nature of the new business landscape.

Better NTSC very soon

Standards for advanced TV systems will be an issue for some time—perhaps five to 10 years. But one development seems certain in the relatively short term: consumers will be seeing better NTSC than ever before. "Enhanced NTSC systems will be inevitable as HDTV progresses, said Larry Lockwood, president, TeleResources. "It is almost certain that Super-VHS; improved definition TV and demand for larger screens by consumers will sharpen demand for better NTSC pictures."

Dave Large, director, video product planning at Raynet, projected that improvements to NTSC using the Faroudja and other techniques would appear over the next two to three years, eliminating cross-color, dot crawl and gamma effects. Circuitry to correct ghosts and enhance detail probably will appear in receivers, he added. Philips, for example, already is using line doubling, progressive scanning, buffering and filtering techniques to eliminate temporal artifacts. "Will our subscribers see those better pictures?" Large asked rhetorically.

One important implication is that consumers will be "sitting three picture heights away from screens; not 10 picture heights, as they mostly do today," Large added.

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Reader Service Number 26

Not everybody in the TV community is convinced that HDTV is a certainty or even desirable.

HDTV is inevitable

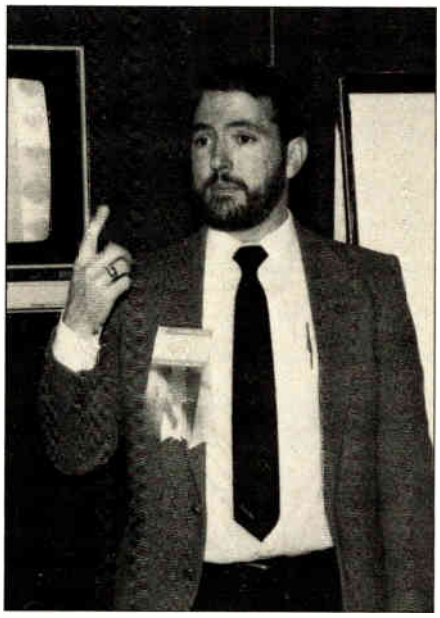
Not everybody in the TV community is convinced that HDTV is a certainty or even desirable. But HBO and ATC must be counted among those who do believe it is both unavoidable as well as a genuine marketing opportunity for CATV. ATC's Thomas defined HDTV as:

- increased horizontal and vertical resolution;
- wider aspect ratio;
- larger screen display;
- high quality audio; and
- absence of NTSC artifacts.

"Our research reveals that consumers have definite interest in HDTV as long as the premium for a receiver isn't more than a few hundred dollars," Thomas said. "The research also indicates HDTV offers the possibility of pay lift."

Thomas suggested an ideal HDTV system would include:

- at least 850 lines of resolution;



Ron Hranac of Jones Intercable was installed as the new president of SCTE.

- coexistence with NTSC in a 6 MHz bandwidth;
- no requirement for rebuilding existing CATV plant;
- capable of satellite delivery using one transponder;
- ability to upgrade and evolve the standard;
- transparent interface with SMPTE production standards;
- reception on reasonably-priced receivers;
- format recordable on VCRs or optical disk; and
- CD-quality sound.

Panelists varied in their assessments of how soon HDTV would begin appearing on CATV systems but four to six years was the concensus.

Fiber optics in CATV

Joining advanced TV systems as a subject much on the minds of leading technical personnel at the Spring Engineering Conference was fiber optics.

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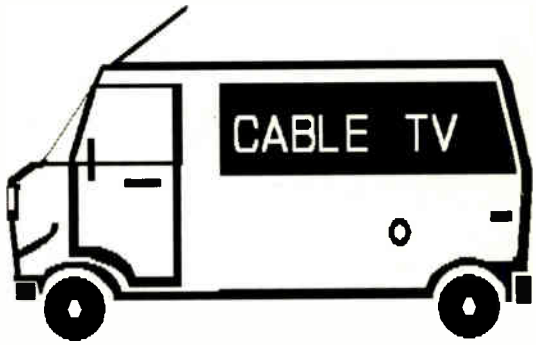

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Panelists varied in their assessments of how soon HDTV would begin appearing on CATV systems.

ATC Senior Vice President for Engineering and Technology Jim Chiddix, who has almost singlehandedly convinced a good portion of the CATV industry that fiber optics makes both engineering and business sense, appropriately chaired the panel on optical applications in cable TV. He outlined the evolutionary strategy ATC plans to use as it introduces fiber into its networks. Initially, fiber is used as a backbone trunking medium to provide greater flexibility, reliability and channel capacity.

But it isn't just the introduction of fiber that drives ATC's thinking. The larger problem is the inherently unreliable tree-and-branch architecture traditionally used for CATV plant. That architecture requires amplifier cascades that simply are too long to maintain the adequate signal levels and outage protection other architectures might provide.

"The drop and distribution portions of a CATV system aren't bottlenecks—the trunk system is," Chiddix said. So ATC wants to break its systems up into smaller subnetworks each fed from a fiber node run in home run fashion from the headend. Emanating from that node would be short cascades of between two and four amplifiers. The advantages: operators could run higher signal levels and provide better quality pictures; gain a large degree of protection from widespread outages; add channel capacity; and consider previously unthinkable programming options. Ever mindful of the competitive environment, Chiddix argued that the industry needs to move today to overhaul its networks.

Catel, which has received quite a bit of attention recently with the introduction of its TransHub AM fiber trunking system, now is developing a mathematical model that will help operators play "what if" games with their existing plant parameters, said Dr. James Hood, company president and CEO. The program takes inputs such as the number of hubs desired and their range; percentage of new above-ground and underground plant required; the number of hubs required for each 45-degree sector of plant and the percentage of fiber overlashing required to retrofit the coaxial plant. The program returns as output the cost of a given system configuration in rough cut form. A second level analysis adding the design parameters and path analysis is required to produce a more refined total system cost. The program will be available to system operators as an evaluation and planning tool soon, Hood said.

Elaborating on Catel's current vision of a "triple-star" architecture incorporating fiber optics in CATV plant, Hood suggested a first level system would run fiber to a hub serving 10,000 subscribers. A second level system using more fiber would run to hubs serving 1,000 hubs. At the third level fiber would run from the headend to hubs each serving 100 subs. At this

Chiddix argued that the industry needs to move today to overhaul its networks.

level all line extenders are eliminated and subs are fed signals directly from the hub.

Using currently available technology, Hood estimated that a level one system serving 150,000 subscribers could be deployed at a cost of $27 per sub or $1,350 per channel per hub.

A level two system using current technology could be built for $52 per sub, or $500 per channel per hub for the electronics at an additional cost of about $525,000. This system would use nine additional hubs radiating out from each 10,000-sub hub.

To take fiber deeper into the system to level three, Hood estimated that an 80-channel delivery at $125 per sub using $125 per channel per hub for the electronics was feasible, at $125,000 additional cost. Such a system would use nine level-three hubs emanating from each level-two hub.

"A level one or two system can be built cost-effectively today at about $80 per sub for an 80-channel network," Hood said. "In the near future it will be possible to build a full fiber system for about $205 per sub that delivers 80 channels."

Fiber supertrunk costs

Synchronous Communications President Vincent Borelli made cost comparisons of four methods for running fiber supertrunks. The models he compared use either: High-performance FM technology; low-cost AM using a hybrid FM/AM technology; full AM technology; or digital technology.

Borelli also evaluated systems using one, two or three hubs, running 12 miles and transporting 54 channels meeting RS-250B specs. "An FM system provides 64 dB S/N; a hybrid system provides 56 dB S/N for the AM portion and 60 dB for the FM portion; a full AM system provides 56 dB S/N and a digital system provides 57 dB S/N," Borelli said.

Per-channel costs for FM range from

Andy Devereaux received the coveted President's Award.

Continued on page 59

Recognized as Outgoing President was Jones Intercable VP Bob Luff.

Credit where it's due

A number of individuals and companies were honored at the June 16 SCTE membership meeting. Former FCC staffer Cliff Paul was inducted as the first-ever member of the new SCTE Hall of Fame in recognition of a lifetime of service to the industry and the society. Looking and feeling chipper, the usually chatty industry lion was at an uncharacteristic loss for words as he got the well-deserved award.

Region 9 director Michael Aloisi claimed prestigious Member of the Year honors. The hard-working, modest Viacom engineer has to consider the award among the highest he's received in his still-young professional career.

Andy Devereaux, the astute and gregarious outgoing board member, received the coveted President's Award.

Recognized as Outgoing President was Jones Intercable VP Bob Luff. Handed the gavel was new President Ron Hranac, Jones Intercable. Getting awards as they ended their terms as board members were Andy Devereaux, Gerry Marnell, Len Ecker and John Kurpinski.

Awards for Outstanding Achievement were handed out to Robert Dickinson, David Pangrac, Paul Arvin, Frank Genochio, Michael Gorin, Michael Gormally and Donald Lolli.

Named new Senior Members were Ben Forrester, Kip Hayes, Allen Kirby, Bill Kohrt, Charles Nydegger, Les Read, Bill Riker and Martin Walker.

Receiving charters as new SCTE Chapters were the Cascade Range, Gateway, Ohio Valley and Old Dominion meeting groups.

A special award went to the Florida Chapter for its sponsorship of the well-attended fiber optics seminar held last January.

Honored for his role as Expo Program Chairman was Pete Petrovich. His committee members Dave Large, Dan Pike and Paul Levine also got awards for their efforts.

Given plaques and thanked for their efforts in putting together the Expo seminars were Lynn Watson, John Kurpinski, Rick Cole, Mike Aloisi, Bob Vogel, Pete Petrovich and Dave Large.

Given special recognition for contributions to the SCTE building fund in excess of $500 each were Robert Dickinson, Joseph Gans, Rex Porter, American Cablesystems, General Instrument, the Lenfest Group, Tele-Communications Inc., Trilogy Communications, U.S. Electronics and Zenith Electronics.

A workshop on rebuilds and upgrades was led by Timothy Dugan, Times Fiber; and Michael Holland, Pico Macom. The workshop on signal leakage and CLI testing was led by Bob Dickinson, Dovetail Systems, and Tom Polis, RTK Communications Group. The meeting on FCC compliance was convened by Syd Bradfield of the FCC and Brian James, NCTA. ■

Per-channel costs for an AM system run from $3,283 for a single hub to $6,848 for a three-hub configuration.

Continued from page 41

$8,522 for a single hub to $20,600 for three hubs.

Per-channel costs for a hybrid system run from $6,331 for a single hub to $10,997 for three hubs.

Per-channel costs for an AM system run from $3,283 for a single hub to $6,848 for a three-hub configuration.

Per-channel costs for a digital system run from $5,329 for a single hub to $10,987 for three hubs.

Several tutorials also were part of the program. Jerrold Project Engineer Dave Grubb reported on his tests of practical transmission performance for AM fiber systems running 80 channels. Ortel Vice President for Marketing Lawrence Stark similarly discussed the limitations and performance thresholds of currently available AM transmitters and receivers.

Need to do better

But several panelists emphasized that better signal quality delivered to the subscriber is an issue now, not just for the future. "More competition is coming," said Joe Van Loan, consultant. "Improved definition TV will be in the showrooms this summer or fall so if you're thinking about rebuilding, you need to think about the quality of signals you're running," Van Loan said. "People have come to expect better pictures (46 dB or 47 dB or better) and constant signal availability.

Tom Elliot, director of research and development for TCI, reminded attendees "not to forget we have a business to run while we're looking to HDTV and fiber. We don't answer the phones quick enough. We don't let people know what we have. Our guides are incomplete or hard to read," Elliot said. "Our picture quality isn't the best and cable isn't convenient enough for consumers to use. And our pictures aren't always available all the time." True enough.

But more shocking were the numbers TCI has developed to quantify the cost of rolling trucks to service customers. Elliot estimated that "as an industry, CATV spends $454 million a year to service customers, based on direct labor costs (loaded for system overhead but not corporate overhead) of $25 to $35 an hour and trouble-call rates that run 3 percent of the subscriber base per month.

The suggestion from TCI to consider life-cycle cost rather than just initial cost might have sounded unusual at an earlier point in the industry's history. Cable operators have earned a justifiable reputation for squeezing blood out of their suppliers and skimping on investment in their physical plants. Operators never had any trouble cutting fat to help their companies run faster. But it appears they also have learned that cutting muscle can be crippling. CATV operators will need all the muscle they can muster as they line up to race with the telcos.

—Gary Kim

Powering broadband networks

Amplifiers and other active devices on broadband networks are powered by AC current inserted directly onto the cable itself by power supplies that take commercial power at 117 or 120 volts and convert it to 60 volt AC. A device known as a power inserter that acts like a directional coupler is used to couple the power to the network.

When a system is designed, the power supply placement decisions require that the loop resistance of all network cabling be known. Loop resistance, or DC resistance, is a measure of how much voltage is lost as it moves through a given cable. Loop resistance typically is specified as a number of ohms per thousand feet of cable. The amount of resistance varies with the size of the cable, type of center conductor and dielectric. Standard aluminum sheath, solid copper foam dielectric cable of 0.412-inch diameter will have loop loss of about 2.03 ohms. Similar cable of half-inch diameter will have about 1.43 ohms loop resistance while three-quarter-inch cable will have roughly 0.62 ohms loop resistance. Cable will copper-clad center conductors will have slightly higher loop resistance while air dielectric cable will have less loop resistance.

Design criteria

The basic design criteria for power supply placement is that the minimum voltage needed to power an active device like an amplifier must be delivered at all times. If the minimum required is 40 volts, then 40 volts will always be present at that amplifier location. If 44 volts is required, then 44 volts will always be available at that location. The key parameters, then, are device power draw and loop loss between each of the devices.

Typically, when power supply locations are determined, the first step is to prepare a schematic showing all cable placements and amplifier locations required. The amount of loop resistance for the cables and amplifier current draw, taken from manufacturer specifications, then is determined and noted. A calculation then can be made of current flow in each cable section, including each of the active devices to be powered. The amount of voltage reduction caused by each amplifier and length of cable then is added. Starting at the power insertion point, it then is possible to determine voltage levels at the end of each cable section by subtracting all the various voltage reductions from the input value. Each amplifier or other active device should get the minimum voltage required for it to operate. On most broadband networks, however, some form of power protection will be desirable on one or more network legs. This usually is accomplished by the use of standby or uninterruptible power supplies (UPS) that have battery backup capabilities.

Standby power

IBM says that the average computer is subjected to 128.3 power line disturbances each month. That is a pretty good argument for the use of standby or UPS powering. Standby supplies can sense loss of commercial power and will switch to battery power automatically. Typical supplies will run from two to four hours. When commercial power is again available a charging circuit in the supply will recharge the batteries.

Uninterruptible supplies go a step further and are designed to kick in within a few milliseconds of any sensing of loss of AC power. Actually, there is some confusion about what a "true" UPS is. Some units are designed to run "hot" and are actually on-line all of the time. Such a unit is safely called UPS. On the other hand, some units kick in so quickly (4 milliseconds or so) that they act as "virtual" or "fast transfer" UPS.

A virtual unit provides the same level of protection as "true" UPS, but with greater reliability, since the circuits are not cooking constantly. A good ferroresonant UPS will transfer so quickly that a user cannot even see a waveform perturbation on a waveform monitor as the switch occurs. An on-line UPS tends to be more expensive because it necessarily must contain redundancy. In essence, it must be overbuilt. Typically, on-line units are heavier, run hotter, larger and less efficient as well.

Power conditioning

UPS units also normally include power conditioning circuits. Standby units without high-speed transfer switches (which kick on within 4 to 10 milliseconds) might not prevent all loss of data. Uninterruptibles usually work fast enough that no data is lost.

Preventing power outages is important. But outages—complete loss of commercial power—are not typically the cause of most glitches for the PC user. PCs, especially some PC clones, are quite susceptible to dips from 120 volts to 100 volts, for example. In fact, most damage to computer memories isn't caused by outages. Instead, voltage fluctuations, transients and sags are the major culprits. So power conditioning and surge suppression can prevent many of the problems a PC user might encounter. Generally speaking, a PC will not lose data if the switch from AC to DC is made in 4 to 5 milliseconds or less.

Network powering, as opposed to device powering, is a somewhat more complex issue. Many amplifiers, for example, have DC switching supplies that will hold a charge for up to 150 milliseconds—nominally 75 milliseconds. That's long enough for a standby unit to kick in. So if cost is an issue, a good SPS might do the job for reliable backup powering. If data integrity is absolutely essential, a UPS is called for.

Typically, standby units for broadband come in a metal enclosure and contain batteries, chargers, square wave inverters and a high speed switch. Under normal AC powering conditions the inverter is in a state of rest. When AC voltage drops past a predetermined point (15 percent, for example), the load is switched to the inverter, which draws DC power from the batteries and converts the power to AC.

A UPS is typically on-line continuously and maintains output voltage within a percentage of nominal (possibly ±3 percent, for example). The UPS consists of a rectifier/charger, battery and inverter and normally converts commercial AC power to DC. DC is then used to charge the battery and in turn the inverter, which reshapes the DC into AC power. ■

—Gary Kim

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PERSONNEL: Fred Kaiser, President; Bob Bridge, Sales Manager
REGIONAL OFFICES: 7033 Antrim Ave., Burnaby, BC V5J 4M5, Canada, (604) 430-1476, FAX # (604) 430-8908.
DESCRIPTION: Manufacturer/ distributor of CATV standby power supplies and status monitoring systems, computer and telephone UPS and central office DC power boards. Fax #(206) 671-4936.

Control Technology . .(214) 272-5544 Inc.
WATS(National). . . .(800) 527-1263
1881 State St.
Garland, TX 75042
PERSONNEL: Charles Turner, President; Jerry Graves, Vice President; Gene Faulkner, CATV Sales Manager
DESCRIPTION: Manufactures and designs standby and conventional power supplies.

Delco Remy . . . . .(317) 646-2978
2401 Columbus Ave.
PO Box 2439
Anderson, IN 46018
PERSONNEL: John Fuhrmann, Battery Marketing Manager
DESCRIPTION: Manufacturer of Delco maintenance-free AGV-Photovoltaic, Heavy Duty, Marine/RV and Automotive batteries.

GNB Incorporated

GNB Inc. . . . . .(612) 681-5000
PO Box 64100
St. Paul, MN 55164-0100
PERSONNEL: Jim Trenter, Product Manager
DESCRIPTION: Manufacture lead-acid batteries.

Lectro Products, Inc. .(404) 353-1159
WATS(National). . . .(800) 551-3790
420 Athena Drive
PO Box 567
Athens, GA 30603
PERSONNEL: Michael Filkins, Exec. VP/General Manager; Tom Colegrove, Western Sales Manager; Mike Kearns, Eastern Sales Manager; Dennis Geltmacher, Southeastern Sales Manager
DESCRIPTION: Supplier of standby power supplies and ferroresonant power supplies of CATV and LAN distributions systems. Manufacturer of ETL Listed meter base units.

Magnavox CATV . . .(800) 448-5171 Systems Inc.
WATS(State). . . . . .(800) 522-7464
100 Fairgrounds Dr.
Manlius, NY 13104
PERSONNEL: D. Horowitz, Chairman & President; A. Kernes, Vice President of Sales; K. Weil, Marketing Director; M. Senken, Controller; R. Finnerty, National Sales Manager
DESCRIPTION: Manufacturers of a full line of amplifiers in 330, 450, 550 & 600 MHz configurations, including feedforward, powerdoubling and conventional technologies, line extenders. Also available: headend equipment, status monitoring, subscriber passives, connectors, taps (2, 4 & 8 way), and local area networks.

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WATS(National). . . .(800) 288-1507
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Auburn, AL 36831
PERSONNEL: Curt B. Cope, President; Jerry Schultz, Vice President/ Engineering; D.J. Bos, National Sales Manager
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Lightning protection: the truth and the fiction

Since the days of Ben Franklin, it has been believed that a lightning strike could be prevented. His early writing records observations of a phenomena later called "point discharge," emitted from his pointed lightning rods during a storm. However, strikes to those rods discouraged him from pursuing the subject further.

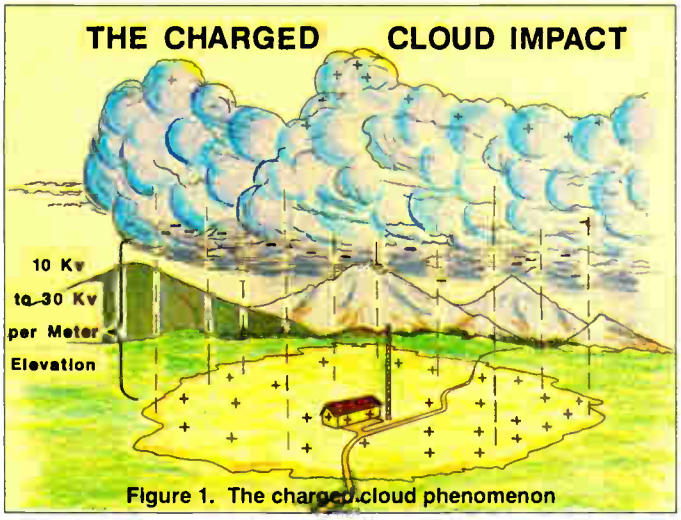

Figure 1. The charged-cloud phenomenon

Since that time, that belief has been resurrected by many, only to be disproven by one or many strikes to the test system. Further, more exhaustive studies disagree with that premise. A recent survey conducted by the author among electrical engineers who are involved in the design of protection systems revealed that about 50 percent of those engineers believed that sharp pointed air terminals prevented the lightning strike. This belief is prevalent, in spite of the fact that the standards in use today are based on the assumption that air terminals are to capture a stroke that might otherwise terminate within a given volume, to be protected.

As recent as August 1985, *Popular Science* carried an article on lightning protection wherein Professor Charles Moore presented the results of his study on sharp vs. blunt lightning rods or air terminals. In summary, he observed that sharp pointed rods tend to protect themselves; that is, reduce the probability of a strike terminating on pointed air terminals. This, he claims, was the result of "point discharge" (back to Franklin's premise). The difference is that Moore's work did not prove total prevention, only a reduction in the number of strikes.

By Roy Carpenter Jr., Lightning Eliminators and Consultants Inc.

Definition of terms

Because of the confusion that prevails within the field of lightning protection, it is necessary to define some of the terms as used herein:

Strike prevention is used to infer that there is no lightning activity within the area defined as protected. That is, there are no strikes to the protecting system or those facilities within the area of concern, defined as "protected."

A diverter is a device such as an "air terminal" that is designed to attract the stroke and thereby divert it from any so-called protected area or facility.

Hybrid systems are those protection concepts that provide some measure of strike prevention, but fail as an air terminal. That is, for a given situation, they are struck less often than a blunt diverter of equivalent scope.

Point discharge is a common electrostatic phenomena, which is the result of immersing a sharp point into an electrostatic field. The point ionizes the adjacent air molecules, causing a flow of ion current from that point into the surrounding air.

St. Elmo's Fire (natural dissipation), is a phenomena that has been known for several hundred years; and is the cause of many superstitions. Actually, it is a large volume of corona caused by point discharge, or "natural dissipation," caused by an intense electrostatic field.

Charge neutralization is the process of transferring electrons from a body with a surplus to one with a deficiency; thereby equalizing the potential between the two bodies. One example is between cloud and earth, or cloud to cloud, via lightning.

Prestroke/stroke/post stroke condition

To understand how lightning strikes

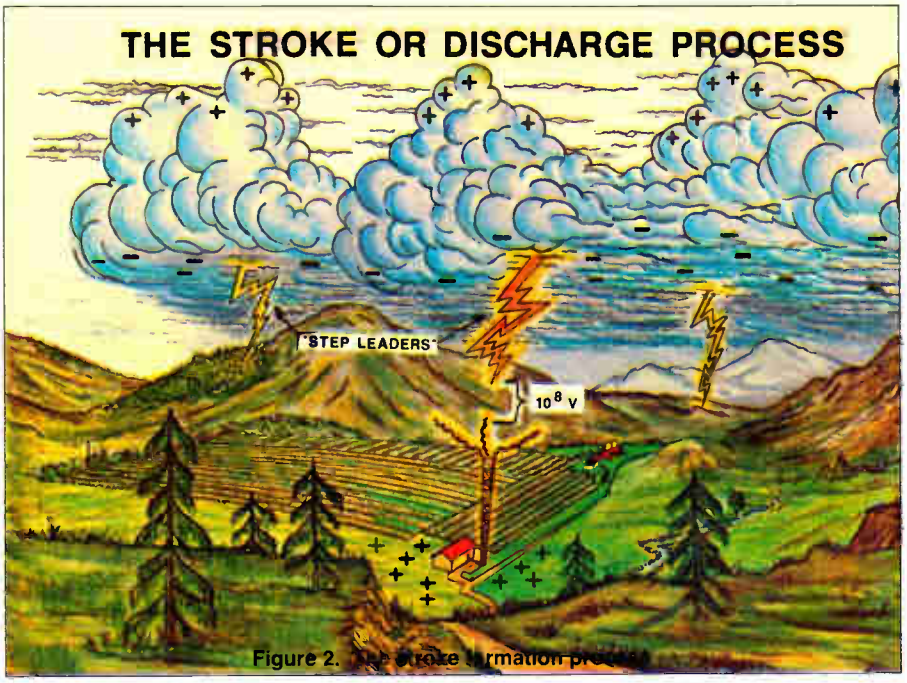

Figure 2. The stroke formation process

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To prevent a lightning strike to any facility of concern, that facility must not contain a significant charge.

are prevented, it is first of all necessary to understand the stroke mechanism, how it "selects" the terminus, and the resultant effects that influence lightning activity in general.

Figure 1 illustrates the prestrike situation. The charged cloud creates a sympathetic charge on the earth surface beneath it, and an electrostatic field between the cloud and earth. The electrostatic field achieves levels of between 10Kv and 30K per meter elevation above earth, during a mature storm.

The cloud charge creates potentials of 100MV ± an order of magnitude. The earth beneath is of opposite polarity, usually positive with respect to the cloud base.

When the cloud potential is high enough, ionized streamers are created, moving from the cloud toward earth. As they approach earth, the field near these streamers, called "leaders" by scientists, increase to over 100Kv per meter, drawing streamers from below, as illustrated by Figure 2. When one upward moving streamer closes the circuit with the downward moving leader, a conductive channel is formed and "charge neutralization" takes place. After they are neutralized, the stroke channel dissipates.

As illustrated by Figure 3, charge neutralization is the process of moving the abundance of electrons from the cloud, to the deficiency on the earth surface beneath the channel. Therefore, lightning is a mechanism used to neutralize the charge induced on the earth by the storm.

The post strike situation is a situation where the earth holds little to no charge with respect to the storm cell overhead, or its surroundings; any remaining "charge pockets" will quickly equalize with its surroundings, usually via an arc.

From the foregoing, it is obvious that to prevent a lightning strike to any facility of concern, that facility must not contain a significant charge, with respect to any passing storm cell; or, any charge it contains must be electrostatically isolated, so as not to influence any downward moving leader from the charged cloud cells.

If the site is to be electrostatically shielded, a Faraday Shield may be used. However, the shield would probably be the terminus of a strike, and permit the formation of an electromagnetic pulse. Charge elimination would appear to be a safer alternative, if it is practical.

Charge dissipation

Charge dissipation can result in charge elimination, if the charge dissipation rate can be made to equal or exceed the charging rate. Since the

Charge dissipation is the act of removing the charge from a given site or facility.

charging rate is established by the storm, the storm cell would be the ideal controlling element for the dissipating systems.

The average lightning strike transfers about 18 coulembs (ampere seconds) of charge between the cloud and earth. This is equivalent to only 0.3 amperes for one minute, or 3.3 milliamperes for the life of an average storm; not very much when integrated over a reasonable time period. If then, a system is devised that wll integrate the discharge energy (lightning) over time, then the work of a stroke would be accomplished without the ion deluge called the lightning stroke.

Although it may be practical to build a dissipating system large enough to dissipate all or a major portion of the cloud charge, it is rarely necessary and very expensive.

Charge dissipation is the act of removing the charge from a given site or facility, and leaking it off into the atmosphere via point discharge. To accomplish this, a three-element system is required; an ionizer, a collector and interconnecting wires. LEC's Dissipation Array System is one system that satisfies all the requirements.

Figure 4 illustrates but one of many DAS concepts (U.S. Patent No. 4180698). As illustrated, it is composed of three subsystems:

- The Ground Current Collector collects the charge created by the storm.
- The Service Wires provide a preferred path for the charge, from the GCC to the Ionizer.
- The Ionizer provides the interface between the system and the storm cell. Made up of many thousands of sharp points, thereby using point discharge as previously described, it ionizes the air molecules which are then motivated by the storm's electrostatic field, drawing the ions away and making room for the process to continue.

The Ionizer and the GCC are obviously key elements. The design of the Ionizer is critical and will determine the potential success or failure of the system as a strike preventor. Such factors as point shape, height, separation, number used, shape of the Ionizer, etc. are all critical and can influence the effectiveness of the DAS.

In recent years, attempts have been made to duplicate this success. These attempts have taken on similar characteristics in design and provided common performance characteristics in operation. We choose to call them hybrids because they all have failed as preventors and became air terminals.

Hybrids—fictional prevention

Of four hybrid lightning protection systems examined, three appear to be

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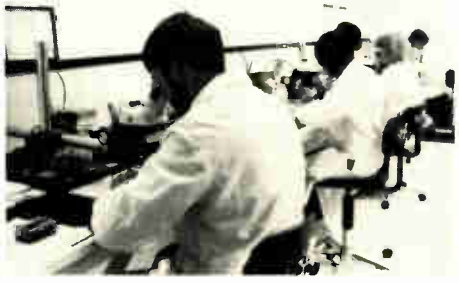

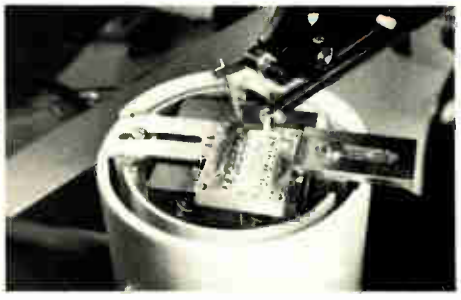

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Laser Precision's new high resolution optical time domain reflectometer for LAN applications offers a wide range of features and capabilities. The mass data storage option enables you to store the test trace of the total length of each fiber optic cable link on convenient floppy disks. Upon retrieval of a trace, you can obtain readout of dB loss and location at any point along the trace, such as at a splice or connector. You can also expand any point of interest along the trace for close analysis. This can be done on the TD-9960's CRT, or on an IBM type personal computer with the TD-958 OTDR emulation software to provide an easy method for maintaining and troubleshooting the cable system. The full ASCII keyboard enables you to add notes, such as date, location, and code, as well as retrieve any trace on the floppy disk. This convenient method for mapping the routing of the cable system also makes it easier and faster to pinpoint any location of a cable problem.

The superior capabilities of Laser Precision's LAN OTDR are to the real benefit of the user. It has the capability to zoom in on any area along the total length of the trace, without having to rescan and reaverage the data. The TD-9960 eliminates the time consuming and irritating requirement of having to constantly rescan. During splicing, only a single marker is required to establish the splicing location on the TD-9960's CRT. This position is maintained, going from fiber to fiber, during sequential splicing. No reprogramming required. The TD-9960's real-time display with continuous dB readout makes it easy to optimize the fiber core alignment prior to splicing.

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Reader Service Number 42

The hybrid systems are termed such because they break into the streamer mode and fail as a lightning collector.

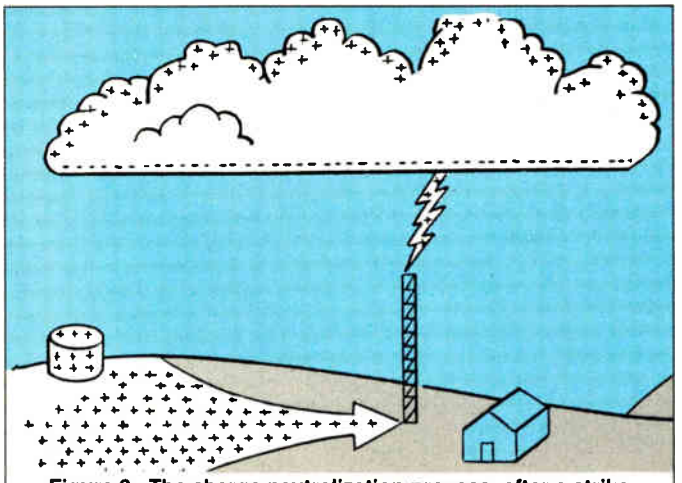


Figure 3. The charge neutralization process, after a strike

derivative of the "bottle brush" concept. They are made up of stainless steel wire brush material, most of which have been formed into a ring. One chose to use horizontal segments. They all claim to be lightning preventors, yet all have been struck; some resulting in devastating damage to the so-called "protected" equipment.

Since the DAS and these hybrids all claim to prevent lightning strikes, why does one prevent strokes while the others do not? The answer is in the configurational differences.

Any point (or other shape) passes through three modes of operation, in the presence of a varying electrosatic field:

- The passive mode: no emmission; the potential is too low (actually taken as below 10Kv).
- The glow mode: point discharge is taking place as illustrated by Figure 5, and a current flow can be measured, increasing exponentially with potential.
- The streamer mode: conductive fingers are developed under high potentials, reaching upward toward the cloud and the downward moving stroke channel, as illustrated by Figure 6.

The streamer mode is an "invitation" for a lightning strike, the glow mode is the mode during which charge dissipation is taking place, slowly. To be successful as a stroke preventor, the Ionizer must never break into the streamer mode.

The hybrid systems are termed such because they break into the streamer mode and fail as a lightning collector. The situation can best be illustrated by referring to Figure 7, whereon a plot of ionization current is presented as a function of the electrostatic potential for various forms of lightning protectors, including a rod, the DAS and the hybrids.

Note that the standard lightning rod current rises sharply into the streamer mode (lightning potential); whereas, the DAS rises and becomes assamatoptic to a lightning potential, well below the lightning potential. The hybrids fall somewhere in between; breaking through the lightning potential, in severe storms, usually when the higher energy strokes are formed. The results are often more devastating when they are struck. ■

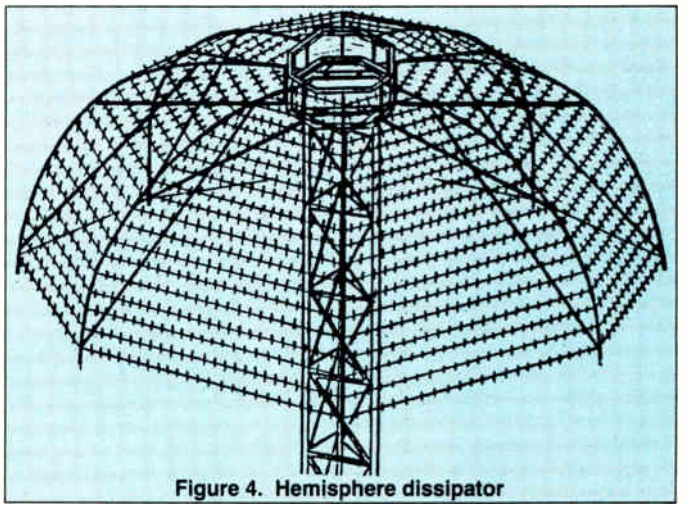


Figure 4. Hemisphere dissipator

Note that the standard lightning rod current rises sharply into the streamer mode.

Fiber conference wows the crowd

The Optical Fiber Communication Conference/Optical Fiber Sensors '88 Show was a virtual "Disneyland" for engineers. In addition to all the latest laser and fiber optic technology in the booths, the technical papers described almost unbelievable developments.

AT&T announced a 16-gigabit transmission scheme, plus the development of some highly efficient and low cost optical amplifiers.

Bellcore proposed a coherent broadcast network that could support up to five times as many receivers (subscriber drops) as a conventional fixed tap system.

About 4,000 people attended this five-day fiber optic conference and show in New Orleans, sponsored by the Optical Society of America and LEOS (Laser and Electro-Optics Society), a division of IEEE.

Unlike FOC/LAN, the major international fiber optic trade show, OFC is specialized, more technically oriented. The majority of papers presented were by AT&T scientists and engineers (about 50 papers) while Japanese companies presented slightly fewer.

The bulk of the conference papers addressed developments and technologies applicable to the local loop. These included such devices as optical switches, optical amplifiers and high speed digital multiplexing.

Lasting impact

The two engineering developments most likely to have a major impact on CATV in the foreseeable future is the development of low cost optical amplifiers and low cost optical switches. Utilization of a low cost optical amplifier in the field could permit the use of low cost optical detectors in the home with a corresponding cost savings in the electronics required at the subscriber's premise. The optical amplifiers made it possible to send a 1 GB/s signal some 400 kilometers (about 250 miles) without noticeable deterioration

Optical amplifiers and switches show signs of price reduction.

(BER minimum 10^{-9}).

The optical amplifier does not downconvert the signals from optical to electrical and back to optical like the current repeater systems, but instead remains optical throughout the entire amplifying process.

The optical switch transfers or splits an optical signal from one fiber to another or several others without downconverting or mechanical action. High speed or vertical interval switching can be obtained in this manner, without any signal degradation.

It is not known when or if these two units will be available on the market, but historically items tend to appear within 24 months of being announced.

Bellcore described a unique passive bus topology that allegedly can support up to five times as many taps as a conventional bus. (See Figure 1.)

While the technical developments should be of intense interest to CATV engineers, the announcement of more fiber-to-the-home sites by telephone companies should give every CATV company nightmares. It was almost like Christmas and a lot like Halloween for the CATV industry.

Telcos lead the charge

Two significant facts became apparent at OFC '88. The most sobering is that essentially all research and development in the fiber-to-the-home process is being funded and conducted by the telephone companies: AT&T, Bellcore, Northern Telecom, General Telephone, etc.

Secondly, the BOC's, GTE and some other independents have fiber in the ground or being installed today as this is being read, in a minimum of seven to nine separate sites throughout the U.S., carrying telephone and/or video and data to the subscribers premises.

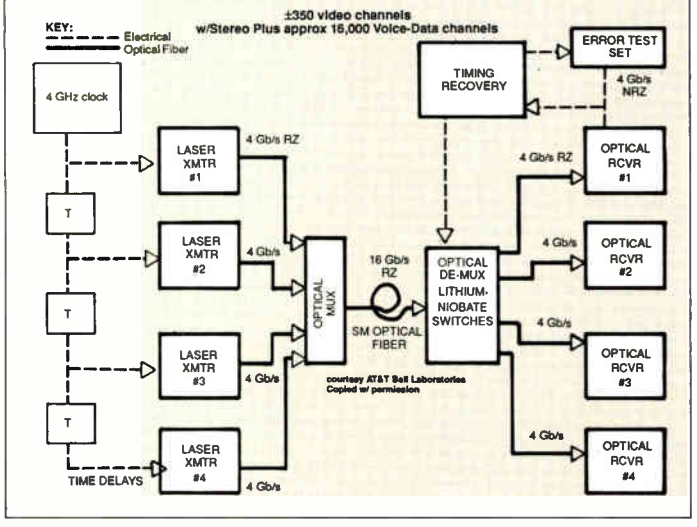
Three telephone company-owned fiber-to-the-home projects were announced at the show. These sites generally utilize mature technologies capable of providing up to 1.54 Mbt (DS-1) or 24 normal voice channels. They utilize lasers at each subscriber's residence. Most importantly, it is being done at a profit. These sites are, for the most part, within 500 miles of every cable system in this country.

The latest to be announced are: Memphis, Tenn.; Kansas City (Leawood); New Brunswick, N.J.; plus Orlando and projects by Southern Bell, General Telephone of California, Bell of Pennsylvania, Illinois Bell, Pacific Bell, Southwestern Bell, Mountain Bell, Contel and some unannounced projects by Wisconsin Bell, Ohio Bell, C&P (Bell Atlantic) and several electric/utility companies.

Bluntly stated, all the money is in digital research, not analog. The fiber now terminating in households in projects near Memphis, Kansas City, Orlando and about six other cities in the U.S. is providing digital service using SLC (Single Line Carrier) 5 and SLC 96 type units.

While U.S. companies are just starting to install fiber to the home, the most experienced company in North America is SaskTel (Saskatchewan

AT&T 16 Gbt/s Fiber Transmission System



Sasktel has a fiber backbone system feeding a three amplifier cascade delivering CATV to the home.

Telephone) for its years of experience regarding fiber-to-the-home for both telephone and CATV. Much of the equipment and research assistance is provided through Northern Telecom.

SaskTel's backbone system

Sasktel has a fiber backbone system feeding into a three amplifier cascade (maximum) delivering CATV to the home. This is simply a stop-gap system (according to sources within the company or close to the projects) allowing them to casually move into the home with fiber while maximizing profits from existing copper plant and hardware. The new technology, christened "linear photonics," is claimed to be totally compatible with the existing coaxial cable, increasing the number of CATV channels that can be transmitted using the two technologies, without duplicating facilities.

This initial installation operates on 13.1 kilometers of aerial and underground fiber cable at Regina. Sixteen NTSC video channels are modulated to channel allocations 37 to 52 and subsequently converted to an optical signal via a distributed feedback laser (DFB). The optical receiver and converter is mounted in a trunk bridger amplifier where it is injected into the local copper distribution system fed by that amplifier.

Measurements at the amplifier output are:

CTB AV = −58 dB

(During the course of OFC '88, CED *conducted separate identical interviews with several of the major forces in fiber optics. Interviewees included: Jack Brouchard, Bob Cohen and Bob Hauptner with Pirelli; David P. Wong, product specialist with Siecor; and Mike DeClerck, Southeast regional sales manager for General Cable. NOTE: The interviewees did not consider the CATV industry as a consequential "player" in the development of optical fiber in the last mile to the subscriber premise.)*

CED: *From a technical viewpoint, should the "last mile"—including drop cables—of fiber optic plant be aerial or buried?*

Siecor: It doesn't make any difference technically. However, one might favor aerial for ease of restoration with less labor in the event of an outage. Also, aerial can be installed faster.

General Cable: As a policy, burial is appealing, but there is no technical difference. Economically, everything considered over the life of the system, it's probably a wash.

Pirelli: Technically it doesn't matter. Front-end economics would favor aerial, But for surviveability, burial may be safer and more economical. Also, one has to consider aesthetics. Many neighborhoods or local governments require burial of all cables.

CED: *The dozen or so telephone company fiber-to-the-home projects utilize a "home run" architecture, sometimes connected to a switched video system. Is this due to the characteristics of the fiber or to the availability of optical components?*

General Cable: It's a matter of the opto-electronics, not the capability of the fiber.

Siecor: Optical components.

Pirelli: It's easiest. Not as many problems with the components and availability. There is some problem with the switching, but the economics make the home run architecture attractive. There are some changes coming, switched stars and variations on the hub concept, but I don't know when.

CED: *Is there a technical reason why multiple subscribers cannot be served off one feeder fiber...a tree-and-branch type architecture, maybe?*

Pirelli: It is technically "do-able." I understand some of the components are expensive, but it can be done now.

Siecor: There is a question about the cost of the couplers, the costs per subscriber.

General Cable: No reason. Technically, you might serve up to 5,000 subscribers.

CED: *Cost has been mentioned frequently. How would you define economically feasible?*

General Cable: Electronics seem to be the major hold-up, the cost, that is. I would suppose a "black box" costing in the neighborhood of $250 is what I would call economically feasible.

Pirelli: A cost of $1,000 per subscriber makes sense now. In a short range consideration, just the cost of copper and the cost of maintenance (of a copper plant) should justify fiber.

Siecor: If it costs about $500 per subscriber now with copper, then fiber should be feasible at a cost of maybe $700 per sub. The reduced maintenance should more than compensate for the difference.

CED: *What is your prediction for development of the local loop or last mile?*

Pirelli: The telephone companies have their migratory strategy in place. They want to make a graceful transition from copper to a fiber optic plant. That makes sense economically. The phone companies see themselves as the providers of technology. Fiber-to-the-home, to them, is just part of their evolutionary process.

The telephone companies see CATV people as programmers, not as a technology industry.

The technological experience, the technology itself (for the most part) all comes from the telephone industry. These "field tests" around the country are not technical, but are actually just market tests. They are serving to educate the public. Setting the stage for widespread public acceptance. By the end of 1988-89 all the major phone companies will have "field trials." By 1990-91 public acceptance will be assured and the telephone companies will continue their migration strategy.

Siecor: There will be lots of trials by '90-'92...that's when we will see real activity on the local loop. I would guess that the CATV industry has 2- to 5-year grace period for installing a fiber local loop.

General Cable: The electric utilities are in a better position to move into the local loop, in front of the telephone companies or CATV. Within two years I expect to see a significant move into the local loop in almost every major city. Probably in the more expensive residential areas first.

Pirelli: Regulations and public acceptance are significant considerations. Deregulation of the phone companies is far more of a factor than technology as far as the local loop is concerned. There is also the question of what to do with the existing plant.

—Gary Moore

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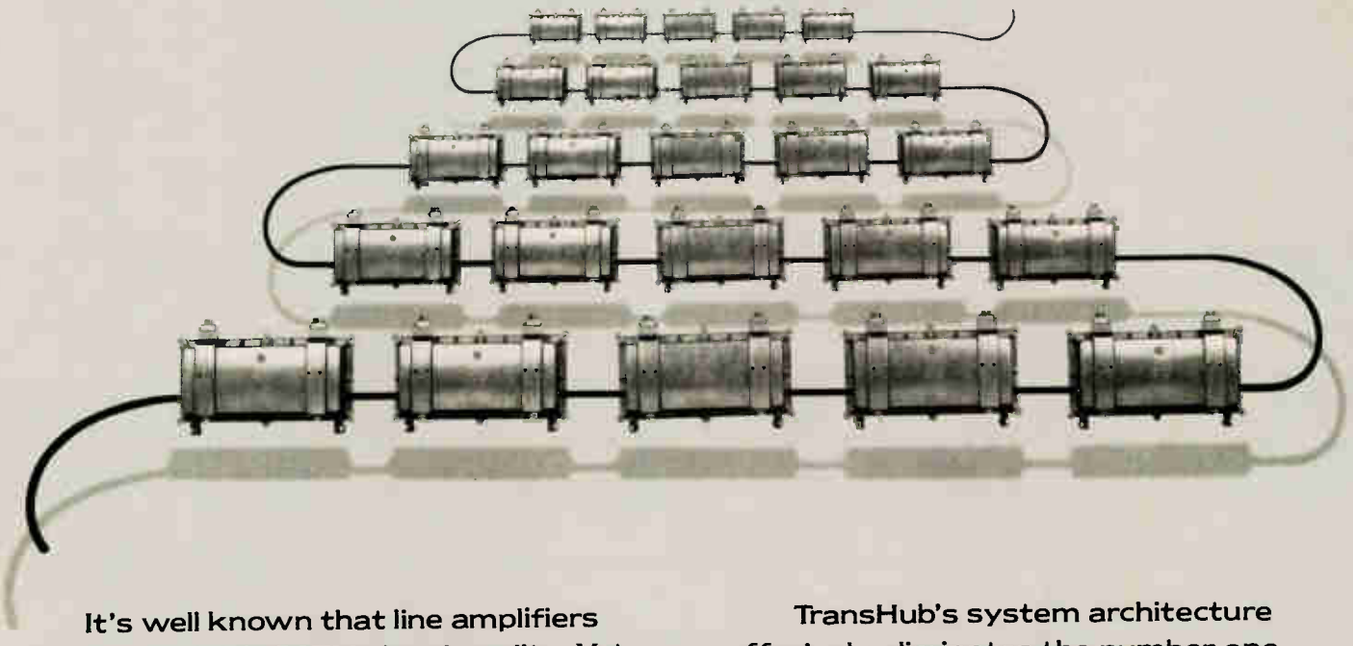

It's well known that line amplifiers directly diminish CATV signal quality. Yet today's cable distribution systems rely upon an architecture in which signals must pass through as many as 60 amplifiers before they reach a subscriber.

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By reducing the number of amplifiers per cascade, TransHub allows the brilliant signal characteristics of glass fiber to extend "deeper" into distribution systems.

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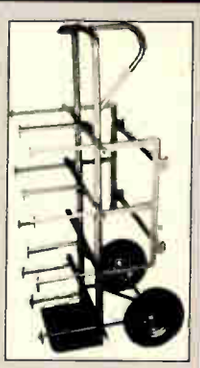

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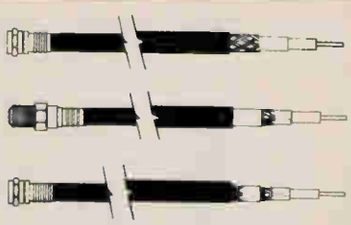

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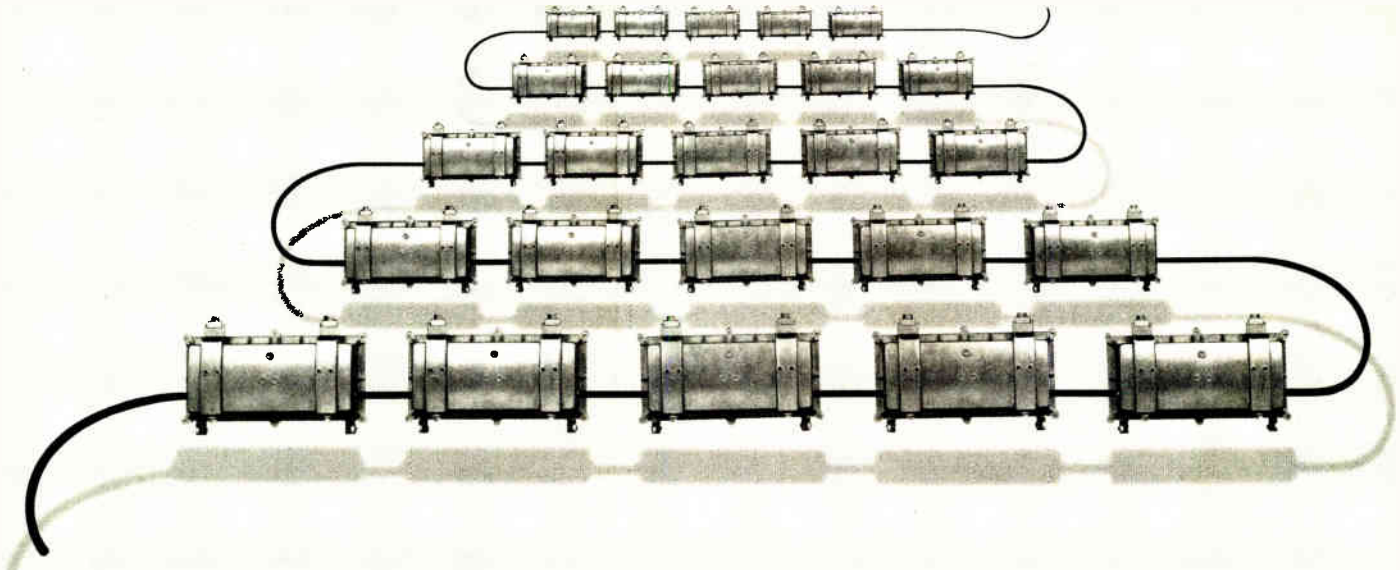

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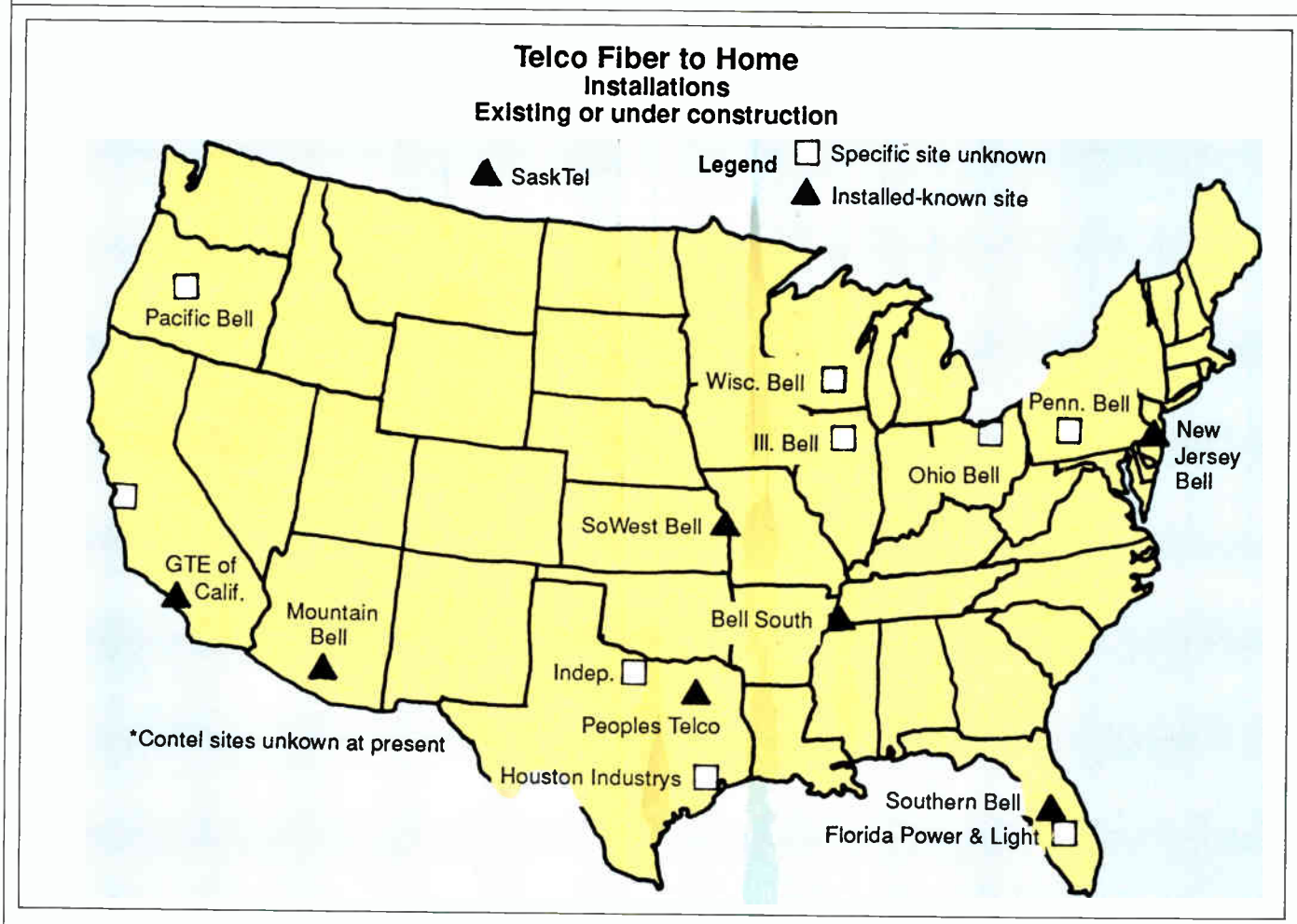
Reader Service Number 46

An economical analog receiver for customer premise installation does not exist nor is it likely to ever exist.



C/N = 48 dB.

The SaskTel/Northern Telecom system feeds a three-amplifier cascade (100 to 150 subscriber drops) for an additional cost of about $30 to $40 per subscriber. While this system is "technically" capable of carrying HDTV, its feasibility has yet to be proven or determined.

The Northern Telecom/Sasktel system, which appears technically identical or at least similar to the one being promoted by Ortel and one being considered by ATC, is not economically feasible for fiber-to-the-home applications due to the cost of receivers ($3,000 to $4,000 each), according to SaskTel/Northern Telecom engineers.

o theher fiber-to-the-home developments, although GTE announced its 60 channel AM system several months ago, they provided additional system information. GTE admitted that while this can provide a trunk/supertrunk system, it will not go to the subscriber premise due to the unavailability of an economical receiver at each subscriber's premise.

Commentary

An economical analog receiver for customer premise installation does not exist nor is it likely to ever exist. Analog technology is a mature technology, there are no "breakthrough" developments yet to be made—just improvements and better ways of doing the same thing.

Each and every CATV engineer who is advocating trying to remain with analog, or who is hoping someone somewhere figures out how to put a gallon of bandwidth into a pint of receiver, should do some serious soul searching.

All the people who invented fiber optics are spending millions of research and development dollars on digital transmission, not analog. They looked at analog and determined it is not suitable for the next generations of service to the customer.

Doesn't it make sense to quit trying to re-invent the wheel and take advantage of the billions of dollars spent worldwide for research and testing that has established that digital is the preferred and in most cases the only satisfactory (both technically and economically) means of transmitting on fiber to the consumer?

When every telephone company F/O installation in the world (especially the seven to nine sites here in the U.S.) is transmitting digital audio and/or video to the subscriber, doesn't that make you wonder what they know that you don't?

—Gary Moore

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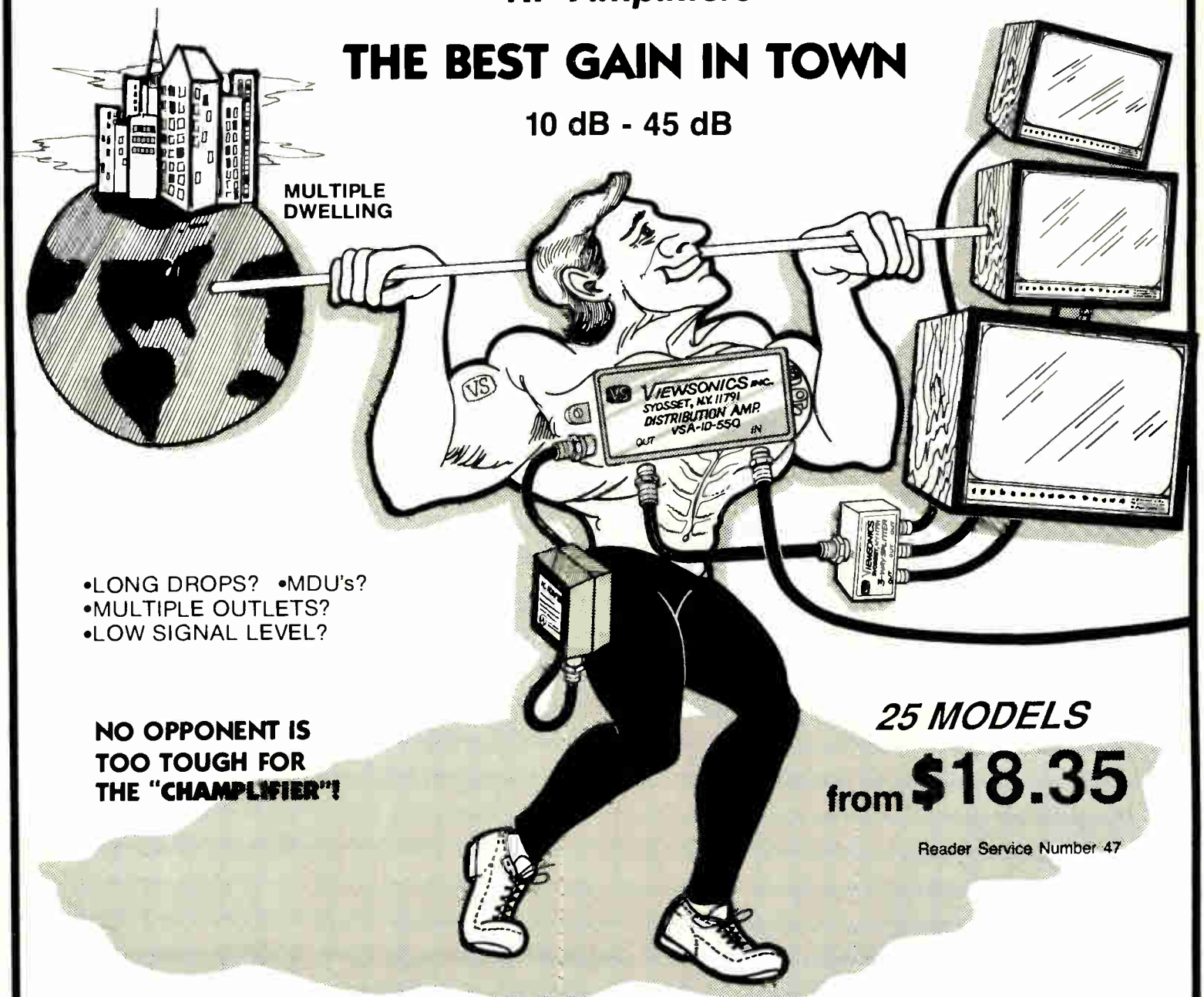

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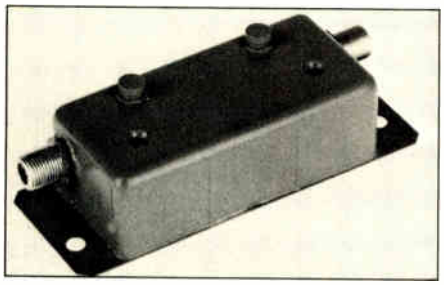
Cures for off-air TV interference

How to beat interference from paging, amateur and mobile radio.

This is the second installment of a seven-part series of articles by Glyn Bostick of Microwave Filter that tell how to diagnose and solve problems related to interference. This installment focuses on how to cure interference from radio services such as paging, amateur and mobile radio.



Tunable trap for removing overload due to adjacent carriers. Typical bandwidth is 3-6 MHz.

A number of radio services can cause interference in CATV, SMATV and MATV systems. Their frequencies range from 2 MHz (low amateur band) to 900 MHz (mobile radio band). Some of them can degrade TV channel quality by direct pick-up of system antennas while others interfere through ingress into the system by other avenues.

Who are the "bandits"?

Table 1 identifies the origin and frequency of potential interference. Fortunately, only a few of these sources account for recurring problems in the industry. This is the result of a reasonably good job of allocating the RF spectrum among the many radio services—including CATV. Because of this, we do not have to contend with direct pick-up in a TV channel of another radio service. The possible exception is TV co-channel (see July 1988 CED). However, some of these services are in the internal operational channels of CATV (sub-band, midband, superband and hyperband) and can cause interference through ingress into the system. Or they can be so near an off-air TV channel that they cause overload to pre-amps and processors. Finally, their accidental transmitter harmonic emissions sometimes coincide with a TV channel allocation.

Probably the most useful approach to discussing the problems and their cures is to look at the CATV operational and off-air bands one by one.

The CATV sub-band

Since these frequencies do not correspond to off-air TV channels, antenna pick-up is seldom the cause of interference. External interference is most likely received by the building wiring and enters the CATV equipment (T-band modulator, for example) through the power cord and power supply. The cause is likely to be a strong, nearby amateur radio transmitter operating in the 5 MHz to 30 MHz band.

The cure is often simple. Use an RFI filter at the wallplug feeding the modulator. The filters plug into the wall plate and provide a receptacle for the CATV equipment power cord. The RFI filter is lowpass and substantially blocks any interference above about 2 MHz. Suitable models can often be found at large radio stores, such as Radio Shack.

The CATV lowband

This band is the "most plagued" TV off-air band.

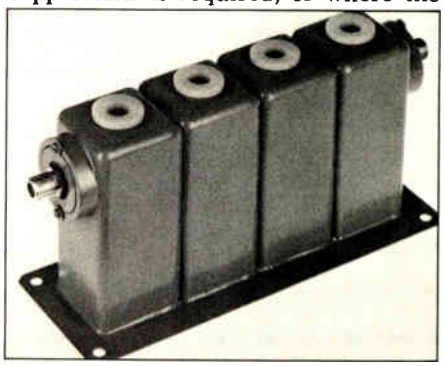
Last month's article described potential interference by strong FM transmission and recommended cures. The radio services below the TV lowband tend to be high powered and can cause overload to the lowest and sometimes all the lowband channels. And, occasionally, an emitted harmonic of the transmitter fundamental frequency will correspond to a TV channel spectrum.

Overload to lowband channels

Overload from a strong out-of-band signal causes the CATV pre-amplifier to malfunction. If the off-air antenna is broadband, receiving several lowband channels, the reception of all of them will suffer. If the emitted frequency is below about 40 MHz (the CB band and the lower parts of the bands for commercial mobile radio and paging), highpass filters work well and a number of CATV filter manufacturers offer them with type F connectors and weatherized construction for installation between antenna and pre-amplifier.

For interference above 40 MHz, such as the upper portions of the commercial paging and mobile radio bands and the entire 6 meter amateur radio band (50 MHz to 54 MHz), most highpass filters which pass TV channel 2 (54 MHz) and up give marginal suppression. For these cases, the most effective cure is a trap, or notch filter, tuned to the interference. This is also placed between CATV antenna and pre-amp.

Several brands of tunable notch filters for this general frequency range are available with about 25 dB of suppression. These filters are not always narrow band. Where greater suppression is required, or where the interference is closely adjacent to channel 2, narrow band custom cut traps may be required.



Typical selective bandpass filter for isolating a desired UHF TV channel with undesired nearby strong channels or mobile radio transmitters.

Occasionally, interference is encountered in the 72 MHz to 76 MHz band from commercial paging transmitters, radio astronomy installations or radio navigation or control equipment. Tunable traps are generally available for this band also. But sharp custom traps may be required if the interference is too close to channel 4 or 5.

By Glyn Bostick, president, Microwave Filter Co. Inc.

Several brands of tunable notch filters for this general frequency range are available.

TABLE 1
Some radio services which can impact CATV operations.

Frequency (MHz)	User
SUB BAND	
1.80 - 30.00	Amateur Radio, Regular Band
10.00 - 23.35	Aero Mobile Radio
10.68 - 31.50	Radio Astronomy
11.70 - 26.10	International AM Broadcast
12.42 - 22.62	Maritime Mobile Radio
13.56 - 40.68	Industrial and Medical Equipment
25.01 - 49.60	Industrial Mobile Radio
26.10 - 25.48	Remote Broadcast Radio
26.62	Aeronautical Radio: Ground to Ground
26.96 - 27.23	CB Radio (Low Band)
30.56 - 44.61	Commercial Mobile Radio
30.56 - 47.69	Public Safety Radio
35.22 - 43.58	Commercial Paging Band
35.19 - 43.69	Commercial Mobile Radio
50.00 - 54.00	Amateur Radio, 6 Meter Band
FM BAND	
88.00 - 92.00	FM Educational Broadcasting
89.00 - 92.00	Radio Astronomy Radio
92.00 - 108.00	FM Commercial Broadcasting
MID BAND	
108.00 - 117.97	Airport Navigation: VOR Locator
118.00 - 123.50	Misc. Airport Communication and Control
123.50 - 136.00	Aeronautical Radio, General Band
130.00 - 140.00	Radio Astronomy Radio
136.00 - 138.00	Space Research Radio
137.00 - 138.00	Space Operations Radio
143.90 - 148.15	Civil Air Patrol Radio
144.00 - 148.00	Amateur Radio: 2 Meter Band
150.80 - 161.57	Transportation Mobile Radio
150.98 - 173.20	Public Safety Radio
151.49 - 173.40	Industrial Mobile Radio
152.00 - 158.71	Public and Commercial Radio
152.24 - 158.70	Commercial Paging Band
156.80	Emergency Radio: Maritime & Aeronautical
161.62 - 170.15	Remote Pickup Radio (Broadcast)
173.40 - 174.00	Armed Forces Radio
SUPER BAND & HYPER BAND	
216.00 - 220.00	Industrial Mobile Radio
230.00 - 240.00	Radio Astronomy Radio
243.00	Survival Radio: Maritime and Aeronautical
225.00 - 420.00	Communications Radio: Gov't. & Aviation
UHF BAND	
450.00 - 470.00	Mobile Radio
806.00 - 890.00	Mobile & Cellular Radio

In the lowband, most severe interference will be seen on the lowest off-air channel.

Harmonic interference to the lowband

During the CB craze (1976 to 1978), many CATV systems experienced interference to channels 2 and 5 due to harmonic transmission from these radios. These operate at about 27 MHz, so their second harmonic is about 54 MHz (on the lower edge of channel 2) and their third harmonic is about 81 MHz (near the aural carrier of channel 5). Consequently, channel 2's picture experienced interference (herringbone or wipe-out) and the CB voice message could be heard on channel 5. Harmonic transmission from the regular amateur radio band sometimes interferes with channel 3 and commercial paging harmonics can interfere with either channel 5 or 6, depending on the specific paging channel.

It is rarely practical to trap out harmonic interference. The harmonic carrier is usually within th TV channel allocation and most traps would remove too much TV information. The most straightforward cure, and usually the least costly, is to filter the offending radio installation with a low pass filter installed between the transmitter and antenna. This is often not feasible due to difficulty in locating the offender or obtaining cooperation. When this fails and the harmonic transmission simply must be removed, then the cure is the phasing technique described last month.

Wide band noise interference

Lowband channels often experience interference due to power line problems in the neighborhood: leaky insulators or malfunctioning transformers. These interfering sources emit a wide band of RF frequencies from about 5 MHz to about 1000 MHz. However, the amplitude of the emission diminishes rapidly with frequency so it is rare that such interference is seen on channel 7.

In the lowband, most severe interference will be seen on the lowest off-air channel. Usually the symptoms are numerous white or black "sparklies" on the picture. Since the RF interference on a given channel is that part of the interference spectrum corresponding to the video carrier, filtering is not feasible and the phasing method is usually the only satisfactory cure.

The CATV midband: 108 to 174 MHz

Mobile radio and paging transmitters often cause intrference to this operational band, the most frequent offender being commercial paging transmitters in the 152.24 MHz to 158.70 MHz band. In these cases, degradation of channels F or G (19 and 20) is likely. If the interference is received by an off-air CATV antenna, the cure is quite simple: a pay-TV midband trap is installed between antenna and pre-amp. These suppress almost the entire midband (channels A through H) without affecting off-air channels.

Occasionally however, the interference is received through the common power supply, as when a hospital cable system experiences interference from its own RF pager system. Often this interference can be cured with the wall plug RFI filter (see above). A few cases defied both these cures and the cause was found to be direct ingress into the cable equipment (modulators or TV sets, for example) due to poor shielding of circuits or inadequate grounding.

The CATV highband: 174 to 216 MHz

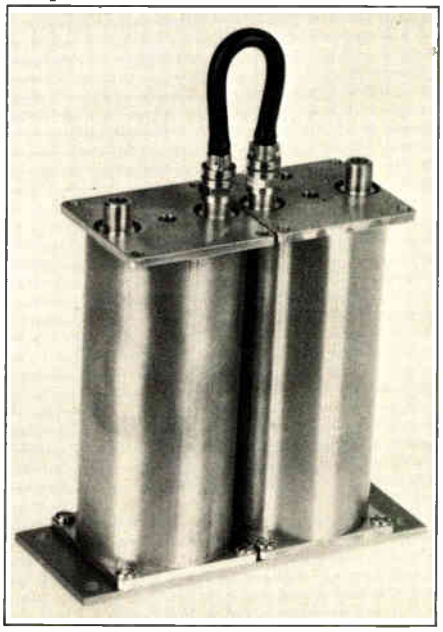
About the only overload threat from out-of-band carriers comes from the seldom encountered Industrial Mobile Radio band (216 MHz to 220 MHz), which usually affects any high band off-air channel. Because of its low cost, a retuned channel J (23) video trap should be tried. It should be installed between the CATV antenna and its pre-amp. If channel 13 is not being received off-air, this should work quite well. However, if 13 is being received, its sound will be attenuated and it may be necessary to purchase a custom-made narrowband trap cut to the offending transmitter's frequency.

Overload condition is seldom encountered on the lower highband channels due to carriers below highband. However, FM transmitter harmonics often degrade highband channel reception and overload is sometimes experienced from a strong unwanted adjacent highband channel.

In the case of FM harmonic reception on a highband channel, the only viable options are to induce the FM station to correct the problem by equipment alignment or use of a lowpass filter, or to use the phasing method.

The superband and hyperband

Like the operational midband, channel problems seldom if ever arise from off-air receptions. Of all the CATV bands, this one is more fully "covered" with potential "bandits" (see Table 1). Surprisingly, few interference cases are reported and those can usually be traced to ingress, as for the midband.



Typical sharp trap for suppressing strong UHF mobile radio or UHF channels. Resonators are machined cavities.

The CATV UHF band: 470 to 806 MHz

This band competes with the low VHF band (channels 2 to 6) for the number of off-air interference cases reported. It is bracketed on its top and bottom with strong, widespread mobile radio emissions (see Table 1), and reception of "far-away" UHF channels often encounter interference from local, stronger UHF stations. Mobile radio emissions often cause overload to the lower channels, particularly 14, from the 450 MHz to 470 MHz mobile band and the upper channels, particularly 69, are overloaded from the transmissions in the higher mobile band beginning at 806 MHz.

These 'border' UHF channels experience overload to the pre-amp. It can often be cured with bandpass filters.

These "border" UHF channels experience overload to the pre-amp. It can often be cured with selective UHF bandpass filters to isolate the desired channel except when the mobile radio emissions correspond to adjacent channel. In this case, the mobile reception must usually be suppressed with a UHF trap. Several requirements contribute to the considerable expense of these traps: narrowband, deep notch and cut to exact frequency. These requirements usually call for a machined, cavity type filter.

For interference between UHF channels within the off-air UHF-TV band,

Typical Pay TV trap for VHF channel 23, retuned to suppress commercial mobile radio at 220 MHz—to remove overload to antenna pre-amps receiving VHF high band TV channels.

a similar approach is required: a UHF channel bandpass filter for the desired channel except where the offender is adjacent. In this case, UHF traps are required. Where several UHF channels are being received and a strong offender impacts all of them, the economical approach is to trap the offender. This costs less than multiplexing the several desired channels: a filter network consisting of several UHF bandpass filters.

Occasionally, co-channel reception is experienced when attempting to receive a "far-away channel." The indicated cure is phasing. ■

Next month's article will discuss causes of and cures for interference generated within the CATV system or immediately adjacent to it—such as modulator bandspreading and the several types of elusive interference arising from other radio services often found on the CATV tower and using the same power supply.

Calculating CLI

Over the past several years, there has been a great deal written about and debated about signal leakage and Cumulative Leakage Index (CLI). However, little practical detailed procedural methodology has been presented suitable for the average small to medium system technician to get out and perform the measurements and calculate the CLI. I will present a procedure that appears workable and utilizes readily available equipment.

A detailed explanation of how to measure and calculate CLI—aimed at small systems.

Figure 1 illustrates the basic measurement set-up. It consists of a signal leakage detector, switched attenuator with 1 db steps and a dipole antenna.

Theory

Most signal leakage detectors have a calibration and indicator to read 20 μV/m. After locating the maximum signal from a leak, place the dipole 10 feet from the cable and switch in sufficient attenuation to bring the leak detector to the 20 μV/m calibration point. The value of the leak in μV/m can be calculated using the following relationship:

(1) $\frac{dB}{20} = \text{Log} \frac{\mu V/m \text{ (leak)}}{20 \ \mu V/m}$

Solving for the level of the leak:

(2) $\frac{dB}{20} = \text{Log} \frac{\mu V/m \text{ (leak)}}{20}$

(3) $10^{\frac{dB}{20}} = \frac{\mu V/m \text{ (leak)}}{20 \ \mu V/m}$

(4) $20 \times 10^{\frac{(dB)}{20}} = \mu V/m \text{ (leak)}.$

By entering the attenuation required to bring the leak detector to the 20 μV/m set point in equation (4), the value of the leak may be calculated directly in μV/m. Table 1 can be used in place of doing the calculation and gets around having to perform the 10^x calculation.

When the leaks are measured and recorded, all that is required is squaring each value, adding the sum of the squares, and placing the sum into equation (5).

FORM 1

db	$\frac{\mu V}{M}$	$\frac{\mu V^2}{M}$	
11	71	5041	$CLI = 10 \text{ LOG } [\frac{MS}{MD} \times \text{TOTAL} \frac{\mu V^2}{M}]$
14	100	10,000	
9	56	3136	
20	200	40,000	$CLI = 10 \text{ LOG } [\frac{[25.0]}{[18.6]} \times \frac{[115492]}{}]$
13	89	7921	
9	56	3136	$CLI = 10 \text{ LOG } [155232]$
12	80	6400	
18	159	25,281	$CLI = 10 [5.19]$
9	56	3136	$CLI = [51.9]$
11	71	5041	FCC REQUIREMENTS FOR CLI 64 or LESS
12	80	6400	
Total		115,492	

TOTAL MILEAGE DRIVEN [18.6] **TOTAL SYSTEM MILEAGE [25.0]**

By J. Richard Kirn
Wire Tele-View Corp.

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The first task that must be done is to calculate or measure the total strand mileage in the system.

$$(5)\ CLI = 10 \text{ Log } \frac{MS}{MD} E^2$$

E = Field strength of leak in μV/m
MS = Total system miles
MD = Miles of system measured

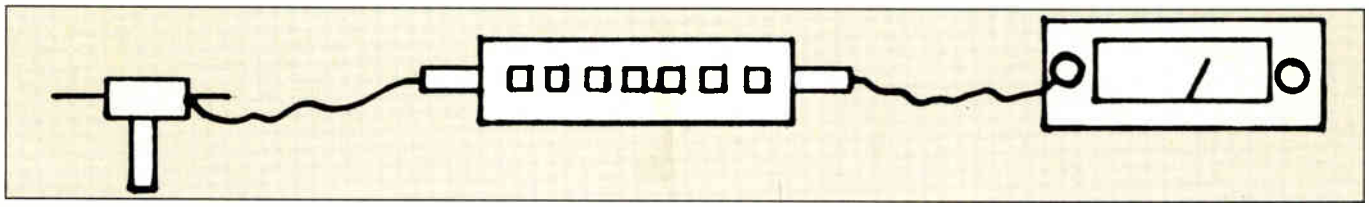
proper calibration.

Set up a schedule to drive through the system taking leakage measurements. Measurements are made with the dipole 10 feet from the cable at the point of maximum signal. Switch in enough attenuation to bring the indicator on the leak detector to the calibration point.

Note the amount of attenuation. Log the strand miles covered on Form II and any leaks found on Form I. Note: any leaks below 50 μV/m (8 dB) are not required to be recorded and any leaks in excess of 25 to 30 dB should be fixed immediately and thus not recorded. It only takes three or four high-level leaks to fail the FCC requirements. In fact, one leak of 1,600 μV/m will fail the CLI test.

The dB readings are converted to μV/m readings using Table I and recorded on Form I. Using a calculator, square each reading and record the result in Column 3 Form I. Total Column 3.

Now you are ready to plug in the values for the sum of the squares, enter miles driven for the measurements made and calculate the CLI value. The FCC requirement is a maximum of 64 for the CLI.



Procedure

The first task that must be done is to calculate or measure the total strand mileage in the system. Permanently record this value on Forms I and II. Remember to update the value if the system is expanded in the future. Check your signal leakage detector for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CLI

The FCC requirement is a maximum of 64 for the CLI.

FORM II

DATE	1/18/88	1/20/88	1/25/88
MILEAGE END	31482.6	32015.7	32822.4
MILEAGE START	31475.4	32009.2	32817.5
MILEAGE COVERED	7.2	6.5	4.9
* OF LEAKS	4	3	4

TOTAL MILEAGE DRIVEN [18.6]
TOTAL SYSTEM MILEAGE [25.0]

Sample

System Parameter:

1. Total of 25 strand miles
2. 18.6 strand miles driven
3. Leaks measured as follows:

Leak #	dB of attenuation
1	11
2	14
3	9
4	20
5	13
6	9
7	12
8	18
9	9
10	11
11	12

Plugging this information into the tables and performing the appropriate calculations results in a CLI of 51.9, which meets the FCC requirements.

If you have not begun to do CLI measurements, now is the time to sample a small portion of your system and calculate the CLI. The results will give an indication of how much work must be done between now and 1990 in order to meet the signal leakage requirements. ■

TABLE 1
LEVEL OF LEAK IN µ/m

dB	µ/m
8	50
9	56
10	63
11	71
12	80
13	89
14	100
15	112
16	126
17	142
18	159
19	178
20	200
21	224
22	252
23	283
24	317
25	356

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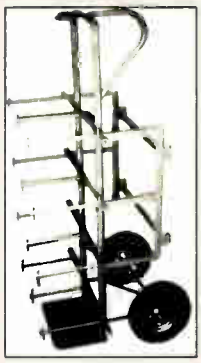

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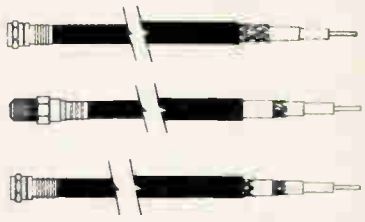

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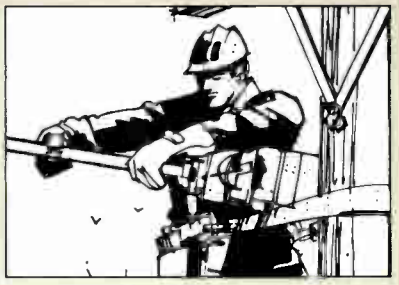

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Eastern Show 9/7 — 9/9 and Great Lakes Show 9/27 —9/29

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Jerrold's Digital Cable Radio set for field tests in three sites

Jerrold's investment in its Applied Media Lab is paying off handsomely with the first practical application of a new technology. Digital Cable Radio, a satellite delivered, compact disc quality radio service, was uplinked full-time on Satcom I as of July 1 and a field test will begin later in that month, according to Jennifer Lambert, director of new business development for the General Instrument division.

The system will be tested on three cable systems (Scripps-Howard's Sacramento system; Comcast's Willow Grove, Pa. system; and Cablevision Industries' operation in Deland, Fla.) for six months and evaluated for penetration rate, churn, quality of service, decoder acceptance by consumers, etc.

The service, priced at $6.95 per month, offers eight channels of music covering a wide variety of formats. Compression techniques allow the service to be piped down the cable in the same 6 MHz space a single video channel occupies. It is being marketed via direct mail and telemarketing to a small segment of the subscriber base initially (about 150 subs in each system) before being offered to the entire subscriber universe.

Subscribers are given a decoder, about the same size as stereo component, that is connected to the incoming cable and then to the home stereo equipment. Although the boxes are being provided without charge for the test, Jerrold expects the decoders to cost MSOs "about $50," said Lambert.

The organizational efforts of **Cable Labs** took another step forward recently with the announcement of an interim Board of Directors.

The interim board, chaired by Dr. John Malone, president of Tele-Communications Inc., is comprised of members of the National Cable Television Association's Research and Development Committee, which helped develop the plans for Cable Labs. The organization will serve as a central source for timely technological developments and facilitate technological innovations. Cable Labs is expected to have an initial annual budget of more than $7 million and will focus immediately on fiber optic and high definition television developments and implementation options.

The interim board consists of the following persons in addition to chairman Malone: Richard Leghorn, president, Eidak Corp., who will serve as board president; John Rakoske, executive vice president, Continental Cablevision, treasurer; Richard Loftus, Cable Labs, secretary; Joseph Gans, president, Cable Television Co.; Edward Horowitz, senior vice president, Home Box Office; Brian Roberts, executive vice president, Comcast Corp.; Richard Roberts, president, TeleCable Corp.; and James Robbins, president, Cox Cable Communications. In addition, Gary Bryson, former executive vice president of American Television and Communications, was originally named to the board. James Doolittle has been nominated to succeed him. NCTA President James Mooney will serve as an ex-officio member of the board.

This interim board will remain in place until September, when a full 18-member board will be established, said Cable Labs' Loftus. A number of candidates from both inside and outside the CATV industry have been interviewed for the position of chief executive officer and the position was expected to be filled after press time, said Loftus.

Headend equipment

Also new from **Jerrold** is a multiple mode headend scrambler capable of scrambling both RF and baseband CATV signals. The Modulating Video Processor is a single unit that provides all features necessary to implement impulse, plus additional security and full stereo compatibility. MVP can be used for all Starcom pay and addressable converter/descramblers as well as the Impulse 7000 series of converters.

The unit operates in both static and dynamic 6 dB and 10 dB scrambling modes and features a scene change detector which makes the decision to change in the dynamic scrambling mode based on changes in the video content. MVP is priced at $2,600 and replaces Jerrolds Digital Scrambler Encoders and Video Processor Encoders. Call (215) 674-4800 for details.

ISS Engineering has released its

ISS Engineering's FAST 1 modulator

FAST1 Frequency Agile Subcarrier Transmitter. The unit places an FSK data subcarrier on any frequency from 50 kHz to 8 MHz in 100 Hz steps. Any deviation can be selected from 1 kHz to 99.9 kHz in 100 Hz steps. Frequency generation is performed through a numerically controlled oscillator to eliminate noise and drift.

FAST1 can be used singly, combined with many units or summed with a video signal. Applications include satellite transmission, broadband, cable and LAN. Remote RS-232 control and monitoring is possible with the built-in serial port. Call (415) 853-0833 for information.

A new interdigital filter for use in wireless cable and ITFS downconverters has been developed by **Conifer Corp**. The QL-3010 features single input, dual band capability, allowing for simultaneous conversion of the MDS and ITFS bands; the QL-3030 also offers dual band capability plus dual inputs for use when separate antennas are required; and QL-1010 has been designed for ITFS spectrum use only. The new design lowers insertion losses and provides a high degree of selectivity.

With the cost of line equipment repairs soaring up to $50 a mile, it's about time someone came to the rescue.

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AVCOM has introduced a fully agile single channel per carrier demodulator.

Call (319) 752-3607 for details.

Qintar Inc. has announced that models QAC-12 and QAC-24, 12- and 24-channel amplified combiners, are now available. The combiners are designed for use in small cable systems and private cable applications where low output modulators and processors are used and high level output is desired.

Both models feature a frequency range of 50 MHz to 440 MHz. Maximum output levels are +54 dBmV for the QAC-12 and +51 dBmV for the QAC-24. Gain is ±17 dB and ±14 dB, respectively. For info, call (800) 252-7889.

Several new filters are now available from **Microwave Filter Co.** Model 6228 UHF bandpass filter prevents off-air interfernece caused by channel 56 to a channel 58 and channel 59 receive antenna. The passband is 735.25 MHz to 745.75 MHz. Rejection is 45 dB. Price is $425.

Model 6493 Bandpass Filter is for commercial satellite receivers and features flat passband with low loss. Center frequency is 70 MHz with the passband from 60 MHz to 80 MHz. Price is $250.

Two CARS band bandpass filters have been developed. Model 6384 passes 12,700.5 MHz to 13,0006.5 MHz and Model 6385 passes 13,018.5 MHz to 13,096.5 MHz. Each filter attenuates the others' frequencies by 20 dB minimum. Both are designed for use in CATV two-way AML systems to protect receive signals from transmitted signals. Model 6384 costs $850; Model 6385 is priced at $635.

Also, the new Model 6430 CARS band bandstop filter isolates the receive signal from the transmit signal to prevent interference. Passband is 12,700 MHz to 13,050 MHz and the stopband is 13,062.5 MHz to 13,150 MHz. Price is $1,475.

Finally, the Model 6324 bandstop filter is used on the cable input leg to a LAN translator to prevent undesired signal ingress. Stopband is 226 MHz to 228 MHz with a loss of 50 dB minimum. Price is $825. For info on these products, call (315) 437-3953.

Test gear

Two new pieces of hardware have been developed by AVCOM. The PSA-37D portable spectrum analyzer covers frequencies from less than 10 MHz to 1750 MHz, and from 3.7 GHz to 4.2 GHz in five bands. Frequency readout is shown in megahertz on a four-digit LCD front panel display.

The portable unit has a built-in DC block with +18 VDC for powering LNAs and BDCs; calibrated signal strength amplitude display and internal battery with charger; and selectable vertical sensitivity of either 2 dB or 10 dB per division.

Also, AVCOM has introduced a fully agile single channel per carrier demodulator. The SCPC-3000 features a synthesized 50 MHz to 90 MHz tuning module for versatility. Frequencies are tunable in 800 steps of 50 kHz each. Standard expansions are 3-to-1 and 2-to-1, with other expansion formats available. De-emphasis is switchable between 0 microseconds, 25 ms, 50 ms and 75 ms. Selectable low-pass 15 kHz, 7.5 kHz and 5 kHz audio filters are also standard. Wideband and narrowband versions of the demodulator are available. Price is $1,378. For details, call (804) 794-2500.

Leader Instruments has introduced a new 100 MHz CRT Readout Oscilloscope with cursors. Model 2100R allows the user to observe waveforms, setting conditions and measured values on a single display. Setting conditions such as scale factor, input coupling, vertical mode, main and delayed sweep time and triggering time are all displayed.

On-screen cursors provide direct reading of measured values and make the unit more friendly and simpler to operate. Two cursors provide readout of voltage and time difference frequency, phase as well as voltage and time difference ratios. Three-channel capability is offered, along with alternate triggering for simultaneous display of two asynchronous signals. Call (516) 231-6900.

Two new products were recently release by **B&K-Precision.** Model 3017 Sweep/Function Generator provides accurate signal source for sine, triangle and square waveforms, plus TTL pulse and CMOS pulse signals. The unit covers from 0.2 Hz to 2 MHz in seven ranges. Special features include internal or external sweep/source capability with continuously adjustable sweep width to a maximum 1,000-to-1 ratio.

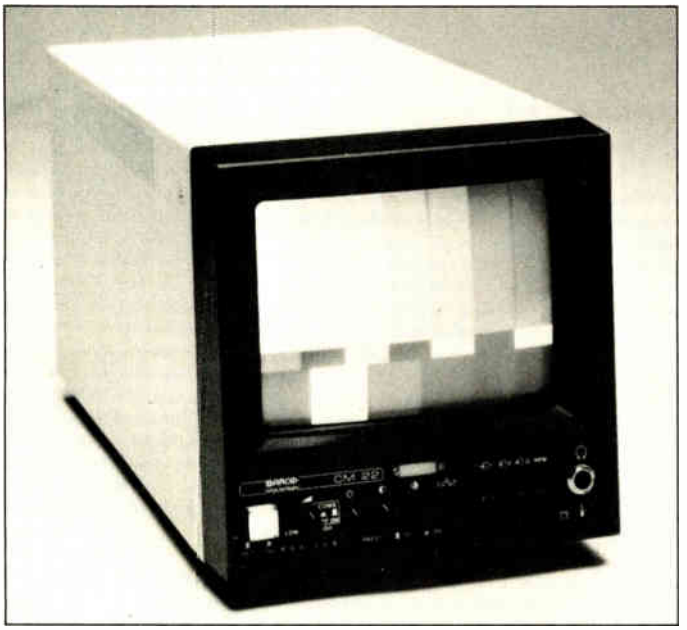
Separate outputs are available for TTL/CMOS and other waveforms. For engineering applications, a variable DC offset simulates the presence of a DC signal on the generator output. Additional features include adjustable sweep time from 0.5 seconds to 30 seconds with selectable linear or logarithmic operation. Output level is continuously adjustable.

Also, Model 2005 RF Signal Generator covers 100 kHz to 150 kHz in six fundamental bands and to 450 kHz on harmonics. Output may be AM modulated by an internal 1 kHz source or externally by any audio frequency. Features include step and variable fine output attenuation to 40 dB, variable AM modulation from zero to 100 percent and auxiliary output for the internal 1 kHz audio source. Price is $195. Call (312) 889-1448 for details.

B&K—Precisions's sweep function generator

Telcom Research also added two new products. The T900 VITC (Vertical Interval Time Code) to LTC (Longitudinal Time Code) translator is a low-cost way to convert to LTC. Features include front panel controls, no internal adjustments, an easy-to-read indicator and last-setting memory.

Broadband Engineering recently introduced the BMK-70 to upgrade to upgrade Jerrold JLE two-way line extenders.



BARCO's portable monitor

A new time code generator is also now available. The TCG 550 generates standard SMPTE/EBU time code and operates in NTSC and PAL color frame sequences. Features include 'lock' and 'line' indicator lights, large bright display, microprocessor design and low power consumption. Call (416) 681-2450 for details.

A new high resolution, portable professional color monitor from **BARCO Industries** features Automatic Kinescope Biasing to ensure color temperature and black level stability.

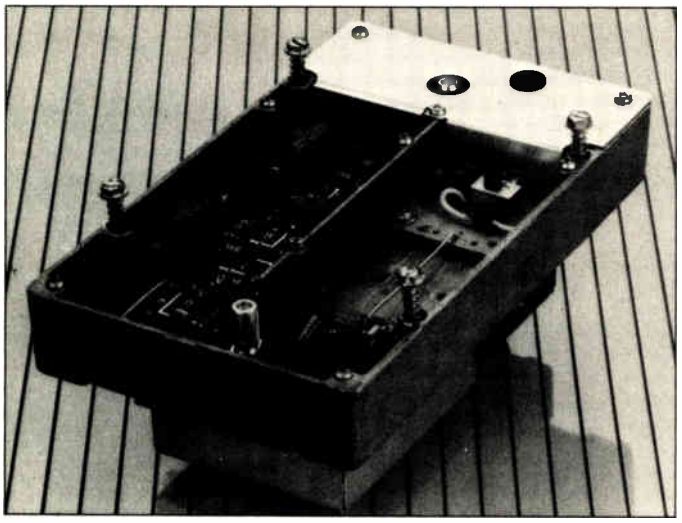
The CM 22 9-inch monitor can be line current or battery operated. Preset front panel controls set hue, brightness, chroma and contrast. Inputs for two composite video signals and one RGBS signal are provided. Call (603) 880-1430.

Amplifiers, cables

Broadband Engineering recently introduced the BMK-70 to upgrade the Jerrold JLE series two-way line extenders. The full board modification will extend the present bandwidth and improve system distortions with the latest in push-pull and power doubling technology. The BMK-70 utilizes the existing JLE chassis and DC power supply. Call (800) 327-6690 for info.

Meanwhile, **C-COR Electronics** has introduced the E-517-XX line extender to its product line. The E-517 is a one-or

A new solid state high-power AML transmitter has been introduced by Hughes Aircraft.



Broadband Engineering's BMK-70

two-output, 450 MHz, 32 dB spaced push-pull LE. It uses fourth generation hybrid chips to improve one-way performance by 4 dB in composite triple beat and cross-mod. Plug-in options (equalizers, pads, reverse kits and diplex filters) are available. For details, call (814) 238-2461.

An expanded line of RF amplifiers from 50 MHz to 550 MHz has been introduced by **Viewsonics**. The amps feature excellent noise figures, CTB, return loss and RFI integrity. There are 25 models available with gains from 10 dB to 40 dB. Among these are multiple self-contained four-, six- and eight-way splitter/amps. Power insertion models for long drops and headend rack-mount forware/reverse and bi-directional units are also available. All units carry a five-year guarantee. Call (800) 645-7600.

A new solid state high-power AML transmitter with gallium arsenide power amplifier technology has been introduced by **Hughes Aircraft**'s microwave division. Model AML-SSTX-145 operates in the CARS band and is typically used where large numbers of hubs are served or long paths may be ecountered.

Up to eight TV channels can be mounted in a single rack and each channel dissipates less than 100 watts. The new unit is compatible with all Hughes receivers and will be available in the fourth quarter of 1988. Call (213) 517-6233.

New composite cables have been introduced by **Optical Cable Corp.** Multimode optical fibers are wrapped around twisted pairs to allow more than one network media to be installed in a single cable run. For details, call (703) 389-9900.

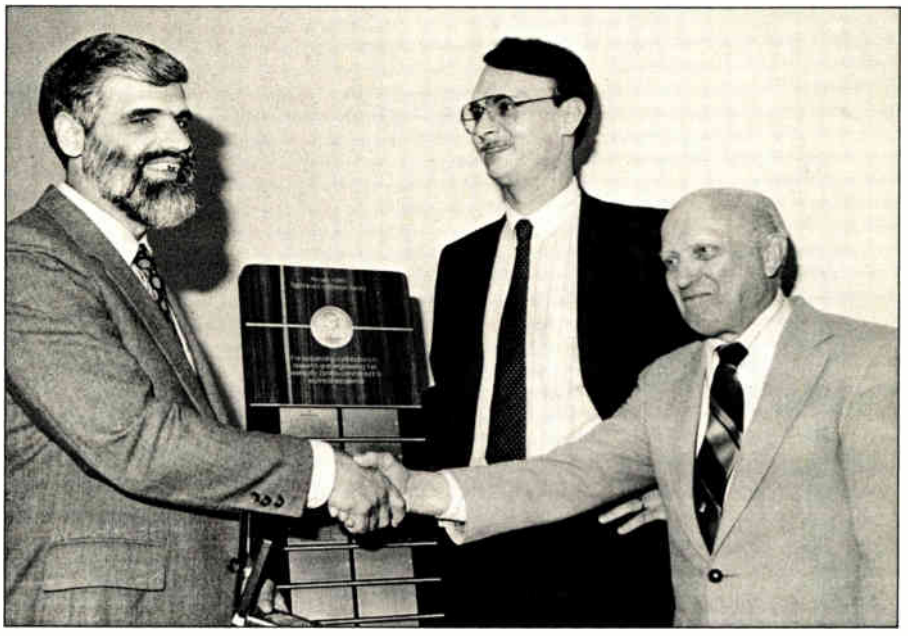
Times Fiber Communications has formally released its CATV rated drop cable. In preparation for meeting National Electrical Code compliance by July 1, Times launched CATVX rated cable and then sought Underwriters Laboratories approval for a CATV rating. Times' CATV rated cable is NEC compliant and is offered in its lifeTime versions. Call (203) 265-8500 for details.

Corrections

In the 1988 CATV Buyers' Guide, the listing for Zephyrus Electronics contained an error. What follows is the listing as it should have appeared:

Zephyrus Electronics Ltd.
(918) 834-1229
1550 North 105 East Ave.
Tulsa, OK 74116
PERSONNEL: Ted Anderson, President; Bill Johnson, Vice President; Ed Covington, Chairman
DESCRIPTION: Repair service for commercial satellite receivers and modify commercial satellite receivers for descramblers. Manufacturer of Satellite Sub-carrier receivers, audio equipment from broadcast down to Communication quality, data communications at low to high baud rates and system control.

In the June 1988 issue of CED, in the In the News section, the phone number for Qintar was listed incorrently. Qintar's phone number is (800) 252-7889. ■



Richard Citta, left, receives Zenith Electronics Corporation's Robert Adler Technical Excellence Award in recognition of his work in developing the company's RF addressable Phase Modulation decoding technology and the Z-View two-way interactive system. Contratulating him are two former Adler Award recipients: Carl Eilers, right, a pioneer in stereo FM radio and stereo TV sound broadcast technologies, and Mark Foster, inventor of several Zenith personal computer products and PC-compatible firmware.

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