CED

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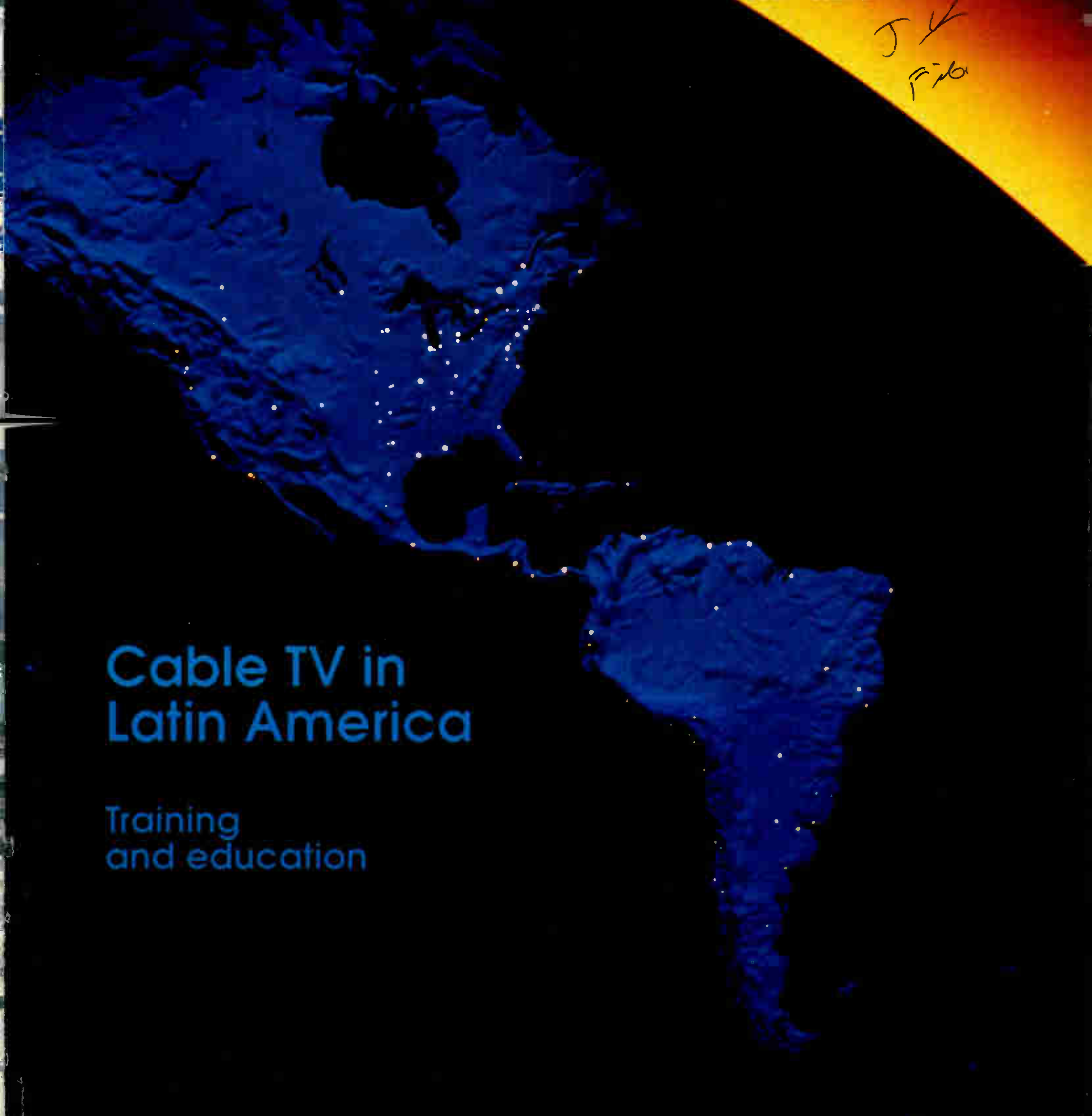
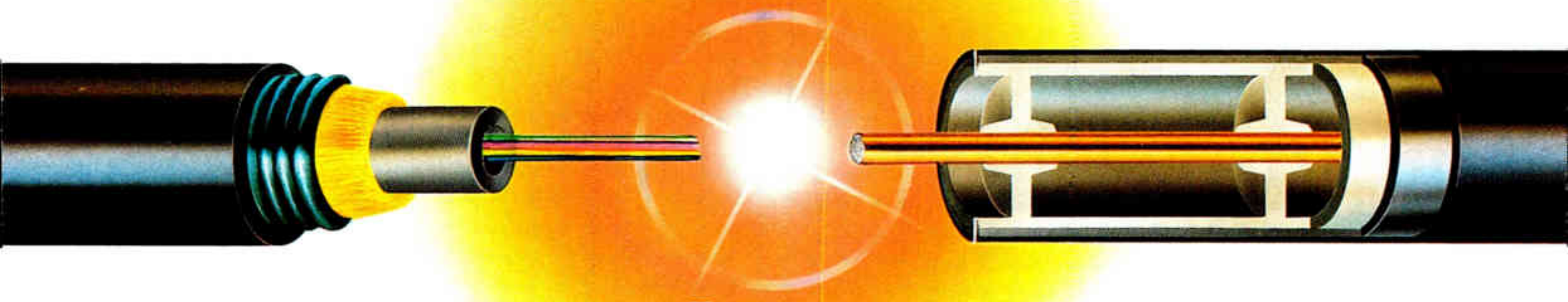
Special pull-out chart
UK CATV Frequencies



Cable TV in Latin America

Training and education

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October 1992 CED Volume 18, Number 11

Special section: International cable trends

Latin American business and technology profile 30
While some may view Latin America as an impoverished Third World country, research by *CED* Editor Roger Brown proves otherwise—at least in relation to cable television. The countries, technologies and businesses making up the Latin American cable market are the focus in this detailed article.

MMDS—How it's shaping up South of the border 36
The wireless business in Latin America closely resembles this country's efforts some 15 years ago. In this article that examines the Latin American MMDS market, *CED*'s Leslie Ellis details frequency allocation, channel capacity and MMDS hot spots.

Latin America and refurbished equipment 38
What are Latin American operators buying to provide multichannel signals to their subscribers? Gary Kim examines the overall Latin American market, including refurbished and used equipment.

Cable and telcos—working together? 42
US West and cable giant Tele-Communications—a telco and a cable company, in other words—have teamed to form Telewest, a company that is presently testing an integrated network in the U.K. that delivers video, voice and data. *CED*'s Roger Brown describes the effort.

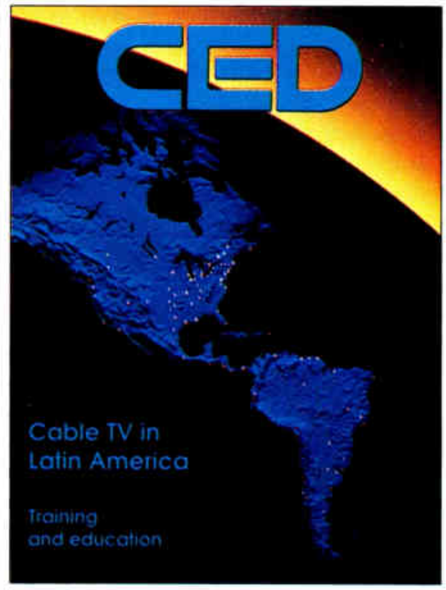
United Kingdom frequency chart 53
Once again, *CED* brings you a frequency chart developed for United Kingdom spectrum allocation. Pull out and post this invaluable engineering tool.

Special section: Training and education

How to start an in-house training program 70
If anyone knows how to knuckle down and write an in-house training program, it's Ron Wolfe. As manager of ATC's National Training Center and SCTE Member of the Year, Wolfe has designed hundreds of technical training gigs (excuse the pun). In this article, he offers a simple, eight-step program with one key point: You have to *do* it in order to succeed.

How the pros handle customer service 74
Although it may not seem like it sometimes, other industries have problems with customer service, too. Robert Gordon, president of Orion Business Services Inc., provides a lively look at how to better manage customer service.

Adaptive equalization and its place in digital compression 78
Like a roof without shingles, digital compression without adaptive equalization wouldn't perform too well. Jerrold's Joseph Waltrich details the digital filtering process, which occurs in the digital convertor to correct bit errors caused by microreflections within the cable plant.



About the Cover:
Cable heats up internationally. Photo by The Image Bank.

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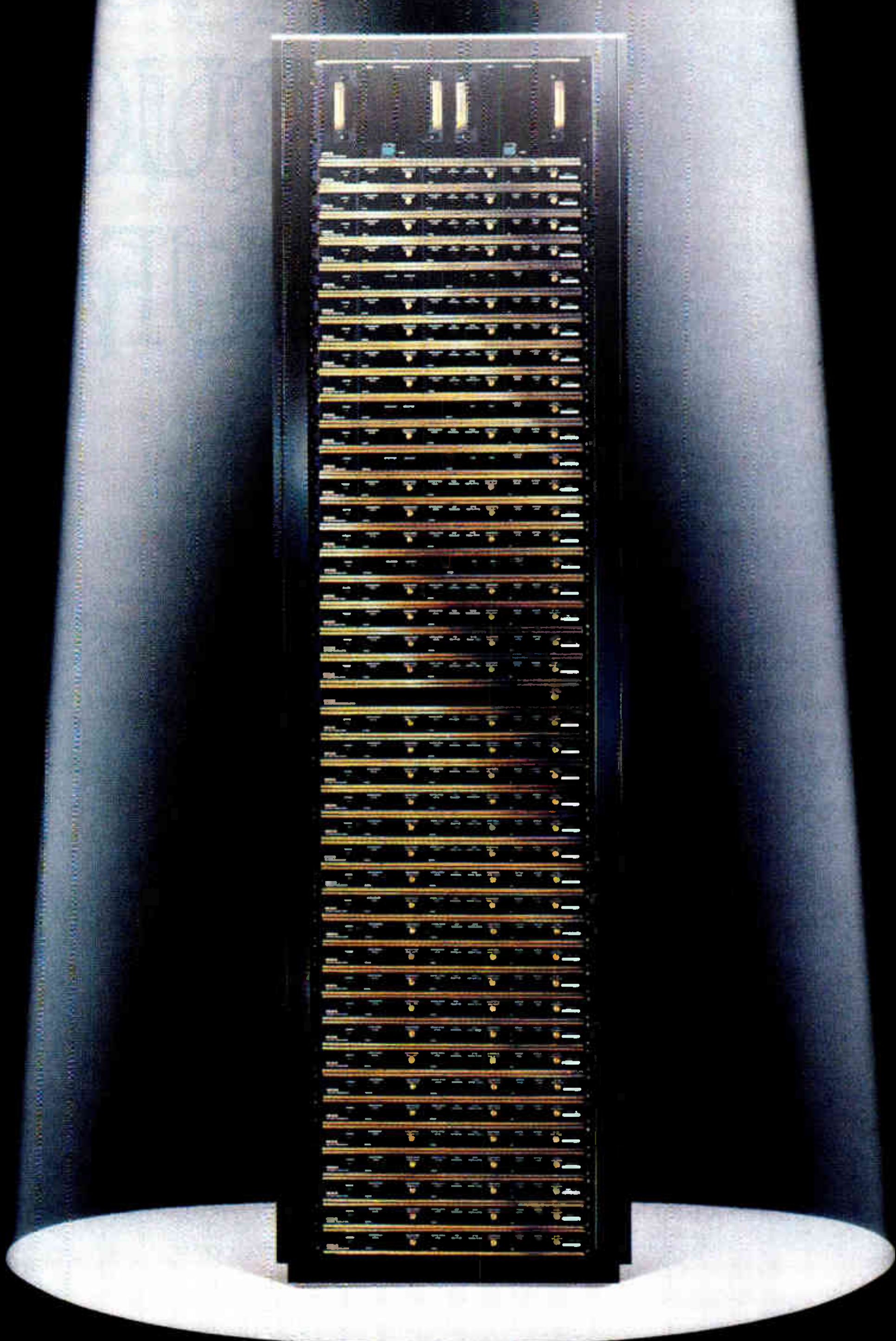

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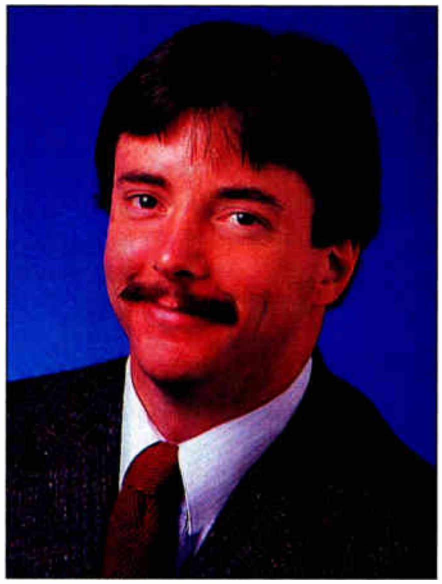
Disaster leads to lessons

Given the storied success of the U.S. space program, it always comes as a surprise to me to learn that a rocket failed in its mission to hoist a payload into orbit and had to be destroyed. Yet that is precisely what happened in late August.

One of the two engines on the second stage of an Atlas/Centaur rocket apparently refused to fire, for some as-yet unexplained reason, which forced ground officials to destroy it before it hurt something or someone. Hughes' $150-million Galaxy I-R communications satellite, which was along for the ride, also was blown up in the skies just east of Florida.

Galaxy I-R, which was planned as a replacement for 10-year-old Galaxy I, was destined to occupy the orbital slot at 133 degrees west longitude in early 1994. The new bird was going to be heavily populated with cable programming, including: HBO, Cinemax, Comedy Central, ESPN, USA, Disney and a spate of others.



Instead, Hughes will now press Galaxy VI—the in-orbit spare—into service to succeed Galaxy I. That will make sure cable operators have uninterrupted programming to pass along to their paying subscribers.

Hughes officials say the company has already committed to building and launching a replacement satellite for Galaxy I-R. That's a three-year, $150-million assurance for which cable operators should be grateful. In the meantime, Hughes still plans to launch Galaxy IV and Galaxy VII later this year to increase capacity by 48 C-band and 48 Ku-band transponders. Those birds are slated to ride Ariane rockets into space.

Two weeks after Hughes' misfortune, GE American Communications' Satcom C-4 satellite was successfully pushed into orbit. That 24-transponder bird is slated to carry Showtime, MTV, Nickelodeon, Discovery, AMC, The Family Channel and a host of others full-time by March 1993. Satcom C-3, also a cable bird, was slated for launch Sept. 10.

GE also had planned for the possibility of launch problems and designated C-1 as the in-orbit spare.

The idea of in-orbit spares, though expensive, has proven to be prudent planning by Hughes to assure that its customers (cable networks) can serve their customers (television viewers) without interruption. Cable operators could learn some valuable lessons about customer service and system redundancy from this series of events.

How many of you who are responsible for your system's technical operations have planned for major outages? Do you have written procedures? A chain of command? Is your emergency restoration kit located in an accessible location any time day or night?

If you can't answer all those questions, take a few minutes to give it some thought. After all, it was excellent planning that turned what could have been an unmitigated satellite disaster into a "ho-hum" event.

Roger J. Brown

Roger Brown
Editor

Advent of digital networks will force craftsmanship emphasis

Cable operators planning to implement digital transmission systems over the next few years will have to place greater emphasis on outside plant and subscriber design, maintenance and craftsmanship, according to an internal engineering report prepared by Tele-Communications Inc.

The report details and documents short- and long-term tests undertaken at Cable Television Laboratories in which 16- and 64-QAM (quadrature amplitude modulation) telecommunications modems operating at 45 Mb/s were used to determine if a typical cable system could reliably transport these digital signals.

The tests determined that a hybrid fiber/coax cable network with as many as eight trunk amplifiers, two line extenders, and typical drop and home distribution components could indeed pass the digital signals, provided several "safeguards" are in place, according to Ben Summers and Bill Nash, engineering executives for Western Tele-Communications Inc. WTCI is a subsidiary of TCI.

WTCI, in its role as a designer, constructor and operator of its digital microwave common carrier network and TCI's Digital Direct metropolitan area networks, has been transporting high-speed digital signals for telecom customers like MCI and others for several years. TCI, as it plans its implementation of digital transmission over its cable systems, is utilizing the engineering expertise of WTCI to help determine if complex high-speed digital signals can be successfully transported over hybrid CATV networks.

However, technicians and plant managers will have to concern themselves with keeping the plant physically and electrically tight to maintain system integrity. Loose connectors, unterminated ports and poor shielding could cause devastating effects to the subscribers' picture. Therefore, installers and service techs will have to be conscious of the effects their craft will have on the plant and digital network, according to the report.

Furthermore, hardware manufacturers will have to build in forward error correction, bit interleaving, adaptive equalization and electrostatic interference countermeasures to deal with the varying environment of the CATV distribution plant and subscribers' homes.

Although the test was conducted in a laboratory environment, Summers and Nash said it showed that CATV networks can successfully transport high-speed digital payloads for video and other applications. Despite using pre-designed off-the-shelf telecom hardware running at 45 Mb/s for the test, "we were amazed and pleased with the results we saw," said Nash. The next step is to test prototype hardware in an operating two-way cable system, something that cannot be done until test units are available. The field testing should be conducted in the fourth quarter of 1992.

Philips plans to hire 100 persons

Sure signs that life has again returned to the hardware market: Philips Broadband Networks last month announced it plans to hire 100 additional personnel by the end of 1992 in engineering research and development and factory operations.

According to Dieter Brauer, president and CEO of Philips Broadband, the additional workers will increase employment at Philips' Manlius, N.Y. facility by about 20 percent. The company employed more than 700 persons as recently as 1988, but was forced to cut back to about 500 during the recent recession.

The additional workers are needed to produce several new product lines, including fiber optic transmitters, an echo canceler, an interdiction system and a digital compression system, according to Brauer.

Last April, Philips purchased Orchard Communications, a company which assembled fiber optic components in Wallingford, Conn. That assembly process was brought to the factory in Manlius just last month, said John Dahlquist, vice president of marketing.

Furthermore, a third-generation interdiction system, known as MultiMask, is now going through final pre-production and is being prepared for market tests in at least one unidentified cable system. Philips is also preparing to build a digital video compression system based on the MPEG standard.

Philips officials also used the press conference as a platform to make a political statement on proposed cable legislation. Brauer noted that bills pending before Congress could cost the industry $1 billion in retransmission fees, which could force subscribers' monthly fees to increase between $23 and $51 per year.

That message was also delivered to Republican James Walsh, a local Congressman who voted in favor of re-regulating the cable industry. Walsh, who toured the Philips plant and met with company officials, told several hundred Philips employees gathered outside the facility (each of whom was wearing a red, white and blue T-shirt emblazoned with a "Made in the U.S.A." slogan) that legislation must "balance" the needs of the cable "ratepayers" as well as the businesses serving the industry. The cable television industry employs about 3,000 people in central New York state.

After his speech, however, Walsh told *CED* it was "highly unlikely" any cable bill would pass this year because the Bush administration has promised to veto it and it would be "very difficult" to override that veto. (Of course, since then the House and Senate have agreed on a compromise bill. As of press time, no vote had yet taken place.)

Separately, Philips officials announced a significant improvement in video compression. Philips, which has been working on a compression system based on the MPEG standard, can now compress video up to a 20-to-1 ratio. The improvements came as a result of Philips' work on CD-interactive products.

Comcast shows PCS capability

Talk about telco "bypass." Comcast Corp. last month successfully linked three cities and two continents by telephone via a combination of wireless and wired networks (including cable television plant) that completely bypassed local telephone company facilities.

Speakers in offices in London, England, Trenton, N.J. and on the streets of Philadelphia were tied into Comcast's Philadelphia corporate headquarters and conversed for 10 minutes. The demonstration drove home Comcast's viewpoint that someday consumers will have a choice of local telephone operators, just like they do with long distance carriers today. In fact, Comcast President Brian Roberts predicted that consumers could be given a chance to choose local carriers "by the end of this decade."

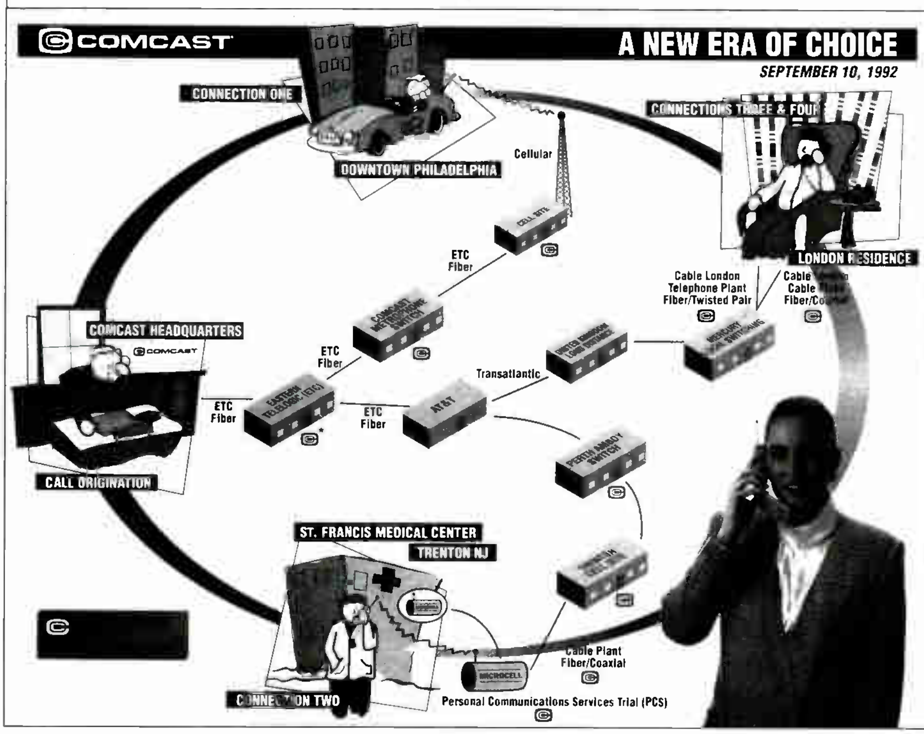
The phone call brought Roberts together with Philadelpia Mayor Edward Rendell (who was in a car parked in front of City Hall), a senior vice president of St. Francis Medical Center in Trenton (the site of Comcast's PCN testbed), and Jon Davey, director of cable and satellite for the Independent Television Commission in England.

Roberts pointed out that with PCS networks and by integrating telephony with video over cable plant, an alternative telephone network can be created without a capital investment of hundreds of billions of dollars. "We have the ability—right now— to interconnect existing wireless and wireline technologies to create a new, seamless telecommunications network," said Roberts.

To make the conversation happen, Comcast used a variety of technology and networks:

- its wireless cellular telephone system in Philadelphia,
- a Delaware Valley alternate access fiber-optic network (Eastern TeleLogic) in which Comcast is planning to acquire a majority interest,
- the experimental wireless PCS network operating in conjunction with the cable system in Trenton, and
- Comcast's joint cable/telephone system in London.

In Comcast's headquarters, Roberts was joined by General Instrument Corp. Chairman Donald Rumsfeld and John Battin, senior vice president and general manager of personal communications at Motorola. Those two technology companies were responsible for most of the hardware used during the demonstration.



CableLabs hosts digital ad forum

Cable Television Labs is scheduled to host an industry forum to help devise a new generation of advertising technology in Denver Oct. 2. Participants are to discuss a draft of a white paper that was created by CableLabs' Advertising Technology Task Force.

The paper describes the business goals, objectives, strategies and operating architectures desired by the task force. The group was established at the end of last year with the goal of guiding the development of new technology platforms for commercial and program insertion—without creating standards.

The task force is working to identify the strategic business objectives; describe the functional expectations of system hardware, software and operating architectures; identify the key points of interface within and between insertion systems and recommend communications protocol guidelines for those interfaces; and encourage compatibility with digital commercial insertion systems.

According to Scott Bachman, director of technical operations projects for CableLabs, the cable industry needs to develop a new infrastructure that serves the needs of local spot, local agency spot and regional/national spot segments of the cable ad business so that operators can increase revenue from the sale of advertising on cable networks.

Jottings

Watch for news regarding digital compression from **Pioneer Communications of America.** Pioneer acquired a research and design center in Bristol, England from California-based Brooktree Corp. Although Pioneer cable-TV officials are still sorting out the significance of the acquisition, Paul Dempsey, director of marketing and new technology, says the R&D house has a long track record in digital image processing technology. The center will now be known as the Pioneer Digital Design Center and Dempsey said he "fully expects Pioneer to utilize the facility for video imaging where required" . . . As of press time, the cable industry was still waiting to hear from the FCC regarding a final ruling on technical standards. However, during an Eastern Show panel, Cox VP of Engineering **Alex Best** said the new standards won't be onerous for his systems, just a local "nuisance." Best said an internal analysis showed the testing would require the addition of one-quarter of a person per year. However, Best said smaller operators may find the standards more of a problem if their systems aren't in order. **CED**

Compiled by Roger Brown

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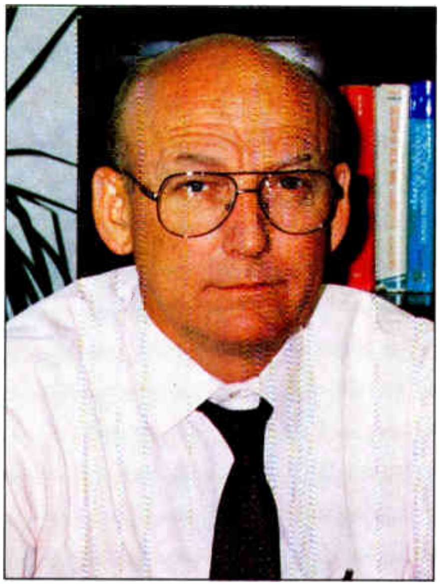


Richard Rexroat

The view from the top

In March of this year, a quiet man named Richard "Rex" Rexroat slipped inconspicuously into one of the most powerful positions in cable TV: director of engineering for Tele-Communications Inc. The seat, vacated by retiring Dave Willis, gives Rexroat direct engineering authority over the largest operator's 11 million-plus subscribers.

The man is somewhat of an enigma. In contrast to Willis, Rexroat is shy and subdued. Even his mail is sometimes a riddle, on occasion arriving on TCI's steps addressed to "Mr. Rex Roat." Throw in the fact that Rexroat's self-induced travel schedule puts him on the road four out of five working days each week, and the mystery surrounding the man intensifies.

In fact, vendors and other people in the industry, spoiled by Willis' availability and willingness to banter about TCI goings-on, wonder: Who *is* this Richard Rexroat?

Unflappable

Simply put, Rexroat is a well-seasoned field engineer whose calm and completely unflappable attitude over the past 23 years has propelled him from technician to director of engineering (with a few stops in between).

He says that largely, people don't know much about him because he's worked at keeping a very low profile over the years. Why? "I really just spend a lot of time getting things done," Rexroat says, instead of publicly discussing them.

On a personal level, Rexroat and his wife, Donna, have four children and three granddaughters. The Rexroat brood are all gone from the nest now, and Rex says none of them wants a career that puts them on the road as much as him. They also have two dogs, notable only because Rexroat says one of them accidentally bit him when he returned home late one evening from a long road trip. Ah, the joy of travel.

Rex was raised in Sheridan, Wyo., and became interested in cable television in the early '60s because, he says, he had cable TV at the time and it intrigued him. So after high school, he packed his stuff and headed to Denver, where he earned a degree in television repair/microwave theory and maintenance from the Electronics Technical Institute. He hired on with TCI in 1969 as a lineman.

Since then, Rexroat has moved his family of five to Alabama, California and in and out of Colorado during his climb up TCI's ladder. He has served the company as an installer, a technician, a chief technician and various regional directing positions. "I honestly never thought I'd ever be director of engineering," Rexroat now muses.

That's because, for one, Rexroat is yet another example of the humble engineer. Soft-spoken and deliberate, Rexroat thinks things through before answering, and doesn't often elaborate. He often speaks of his efforts as "we," when he probably means "I."

Engineer of directing?

He's also exceptionally thorough—almost to the point where one wonders if his title wouldn't be more aptly worded "engineer of directing" instead of vice-versa. He believes in seeing things through—*all* the way through, from concept to design to implementation. Even after a system is rebuilt, Rexroat remains on 24-hour call. He says it's not unusual for him to be awakened from a dead sleep three or four times a week to discuss a problem. And, as if that isn't bad enough, he says he *likes* it.

"It's important to me to know about problems, so I can resolve them before they get out of hand," Rexroat says.

With Rexroat's game plan, there's a lot that theoretically *could* get out of hand. His current goal involves upgrading all TCI systems to a new architecture, something similar to the fiber-to-the-serving-area concept but hearty enough to handle "any emerging technology that comes down the pipe in the next 20 to 25 years." That includes HDTV, alternate access, PCS, compression, interactive television, home banking—or, as Rexroat puts it, "everything and anything people can dream up."

The architecture has been under development for some three years, and Rexroat has personally overseen every rebuild and upgrade using it over the past two years. "I get actively involved in every aspect of a rebuild," Rexroat says. "As we make designs, I go out and work with the systems to make sure it works. I don't believe in handing something over, saying that it should work, while the people sit there and wonder, 'why doesn't this work?'"

"I'd say this conversion to fiber optics is my greatest challenge," Rexroat continues. "It's been going on for two years, and it continues to go on. It changes almost every day," Rexroat says.

Reality check

Rexroat says his forte is reality. While he'll discuss future technologies like digital compression, HDTV and voice services, he prefers to leave those conversations to TCI's Advanced Technology Group.

"The nice thing about my job is that the part I work with is reality, not theory," Rexroat says with a hint of a smile. "The only thing I can say is, if you take everything everyone is talking about today, which seems to change on an almost daily basis, the systems that we're building are compatible to it."

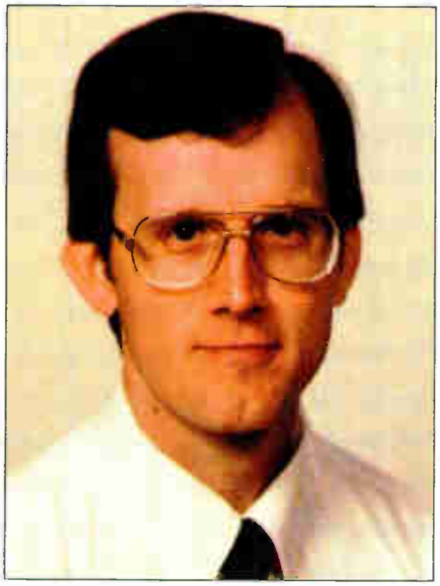
Rexroat's confidence about the architecture comes from the simple fact that he's earned it—he sets goals and achieves them. In developing the TCI architecture, for example, Rexroat set a personal goal to talk to "every one of the different communications and manufacturing companies so that they could come up with something that was compatible with what we wanted to do."

Another goal of Rexroat's transcends way beyond the design tables and into the homes of TCI's subscriber base. Calling it his "main goal," Rexroat's ultimate quest is to "put picture quality at the back of the TV set right now, with fiber-to-the-serving-area, that exceeds what the people have ever seen before."

Some may think this is easier said than done. But with Rexroat's calm, can-do attitude, it's sure to become a reality. CED

By Leslie Ellis


"Standby Power Reliability is a Team Effort."
Bob Gruenstern, Engineering Manager for Johnson Controls
Sunny McCormick, Director of Engineering for Alpha Technologies
DYNASTY



International television standards

Let's face it. Cable television's move into the international arena is happening very quickly. In some cases, its happening faster than the local or national governments can handle the growth. MSOs looking to expand their operations are beginning to focus on these markets both from a telecommunications and video entertainment perspective.

As we begin to look at these markets, one topic that comes to mind is the subject of international standards for broadcast and cable television. What are they and what are the primary differences? Well, in a nutshell, international standards are all over the map (sorry, I couldn't resist). Outlined below is a brief history and description of these "standards."

The international governing body for the creation of international standards for purposes like television broadcasting is called the International Radio Consultative Committee. It is the French translation of the name for this committee that gives us the familiar initials CCIR.

Television first came into being in the 1930s, prior to the outbreak of World War II. Unfortunately, while some thought was given to the international standardization of broadcast television prior to WW-II, the world chaos that resulted from this tragic event precluded any serious discussions.

As a result, it wasn't until 1948 that the CCIR established its first study group dealing explicitly with television. Even as this group was being formed, however, it seemed to understand the difficulty it was facing. Early on, it determined that differences in AC power and differences in frequency (spectrum) allocations for TV from country to country "may delay an agreement to a worldwide standard for a considerable time."[1]

Color coding system	Chrominance signals	Chrominance subcarrier frequency (MHz)	Chrominance subcarrier modulation
NTSC	E_I, E_Q	3 58	Suppressed-carrier amplitude modulation of two subcarriers in quadrature
PAL	E_U, E_V	4 43 (3.58 for M-PAL)	Suppressed-carrier amplitude modulation of two subcarreirs in quadrature
SECAM	D_R, D_B (line sequential)	4.41 (D_R) 4.25 (D_B)	Frequency modulation, alternating

Table 1

System	Lines and Fields per second	RF chan BW (MHz)	Video BW (MHz)	Width of VSB (MHz)	Polarity of vision modulation	Sound carrier position
B	625/50	7	5	0.75	Negative	5.5
D,K	625/50	8	6	0.75	Negative	6.5
G	625/50	8	5	0.75	Negative	5.5
H	625/50	8	5	1.25	Negative	5.5
I	625/50	8	5.5	1.25	Negative	6
K1	625/50	8	6	1.25	Negative	6.5
L	625/50	8	6	1.25	Positive	6.5
M	525/60	6	4.2	0.75	Negative	4.5
N	625/50	6	4.2	0.75	Negative	4.5

Table 2

This prophesy, of course, was for black and white television. In early 1950, an international team of experts visited a number of countries trying to find a solution to the "standards" dilemma. Unfortunately, by that time, each country had adopted its own "standard" and it was concluded at that time that an international standard simply could not be reached.

Color effects

When color television first came on the scene in the late '50s and early '60s, the CCIR again tried to find a solution for an international standard, but was unable to do so because of the ever-present political agendas and because many of the countries' color standards were so embedded within their black and white standard for reasons of "compatibility." As a result, the last great debate on international color TV standards was held at the CCIR XIth Plenary Assembly in Oslo, in 1966, without coming to a consensus.[2]

Even though the CCIR was unsuccessful in securing an international agreement on an *analog* television standard (it has been somewhat more successful on the digital front in recent years), it has done an excellent job of at least documenting the various individual standards around the globe. It is from the CCIR's documentation that I have pulled the information contained within this column.

Basic differences

The tables above outline the basic differences between the various TV systems in use throughout the world. In essence, and in somewhat of an oversimplification, the systems can be generally classified into the type of modulation and/or the frequency of the color subcarrier (NTSC, PAL, SECAM) as seen in Table 1.

They can be further subdivided, by letter designation, into the various differences between their RF channel characteristics as shown in Table 2. This leads to various combinations of the two tables and allows for a very confusing array of possibilities such as either B/G SECAM (Egypt) or B/G PAL (Australia) or either M PAL (Brazil) or M NTSC (USA). To an MSO, these differences from country to country are merely a nuisance to keep track of, but to a manufacturer of equipment, they are crucial to the evolution and flexibility of any family of products. **CED**

References

1, 2. International Telecommunication Union, "Television systems used around the world," 1986.

By Chris Bowick, Group Vice President/Technology, Jones Intercable

The splice that got away (or, Fishing for the perfect splice loss)

Picture yourself on a fishing trip with a couple of your friends. You are boating on a nice inlet with plenty of fish. Your goal is to catch as many fish as possible in the allotted time. The only rule imposed on you for the day is that you must throw back any fish shorter than six inches.

Down-home scenario

Sitting in the middle of the boat is a tackle box. Printed on the side of the tackle box is a ruler which can be used to measure the fish. You grab the first catch of the day and question whether or not it is a keeper. Before you can get to the tackle box, Terry says, "C'mon, you know that's not a keeper. It'll never measure up. Right, Chris?"

While you do have your doubts, you agree with Terry (after all, why risk letting someone know that your perception of a six inch fish is shorter than Terry's?) So, this 6.5-inch fish is thrown back in the water because no one compared it with the tackle box ruler. After all, the inexpensive tackle box ruler probably was not calibrated anyway.

By Joseph E. Schiestle, Applications Engineer, Siecor Corp. and Marc Stammer, Supervisor, Applications Engineering, Siecor Corp.

Table 1
Splice Loss Estimate Accuracy

Range between Actual Splice Loss and Estimated Loss	Percent of Splice Loss Estimates Within Range		
	Unidirectional OTDR Measurement	PAS Estimate	M-90 LID-SYSTEM Estimate
± 0.05 dB	54 %	85 %	88 %
± 0.10 dB	78 %	92 %	100 %
± 0.20 dB	97 %	98 %	100 %
± 0.30 dB	99 %	100 %	100 %

This same perfectly good fish was thrown back four more times that afternoon. The fifth time it was caught, you keep it without asking again.

One splice to go

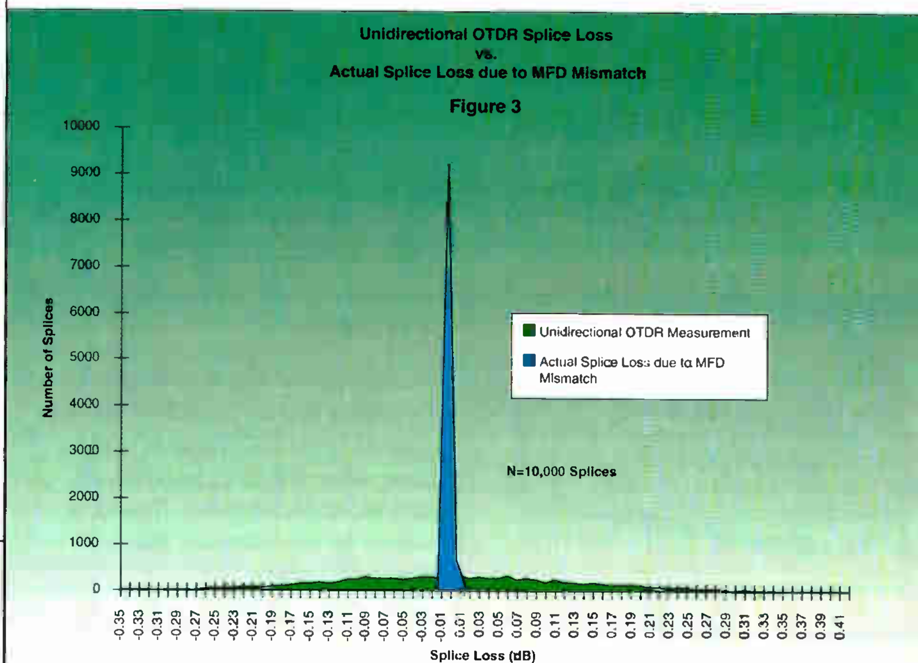
Now picture yourself bent over a fusion splicer in one of those new minivans (that just do not have the standing room the old splicing vans had). It's almost quitting time and your kid's Little League game is tonight. There's one splice to go. In order to meet your total end-to-end attenuation requirements, your average splice loss must not exceed 0.15 dB. The first nine splices in this span averaged 0.06 dB. The cleaves look good, and it seems to fuse fine. Chris radios Terry in the headend. Terry takes a one-way OTDR measurement and proclaims, "It's a 0.25 dB splice loss. We can do better; break it."

Chris points out to you that the fusion splicer estimated loss is only 0.05 dB. Instead of questioning Terry, you break the splice. After all, you're every bit as good a splicer as Terry and Terry claims to consistently get below a 0.10 dB loss on every splice. Besides, the OTDR measurement must be better than the splicer estimate.

Forty-five minutes late for the Little League game and 15 unsuccessful tries later, you head out listening to Terry tell you that fiber isn'tt not what it used to be.

The dangers of assumption

What is wrong with these pictures? In many ways, they're the same story in different settings. Terry is determined to get the best possible splicing results. But in trying to do the right thing, Terry is actually hurting productivity. The scenarios are the same because, in both cases, fairly accurate measurements (the ruler on the tackle box and the splicer estimated loss) were ignored and



perceptions were used to determine the "keepers" (fish and splices).

That's right, the splicer estimated loss (assuming a reputable splicer manufacturer) is more accurate than a one-way OTDR measurement of a single-mode fiber splice. (And there was nothing wrong with the fiber.)

How can that be, when the fusion splicer *estimates* attenuation and the OTDR *measures* attenuation? Because splicer reading is an estimate based on an indirect attenuation measurement, while an OTDR does not measure attenuation; it measures backscattered light.

The expected differences in accuracies between one-way OTDR measurements and splicer estimates are depicted in Table 1. Current industry standard requirements for splicer estimation are that for splices less than 0.40 dB, the estimate should be within 0.10 dB of the actual loss 90 percent of the time.

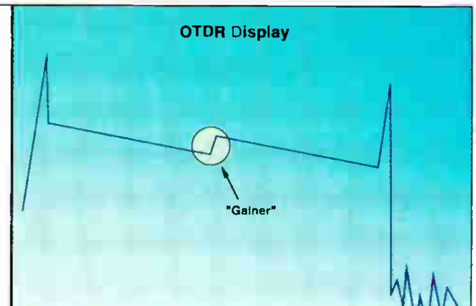


Figure 1

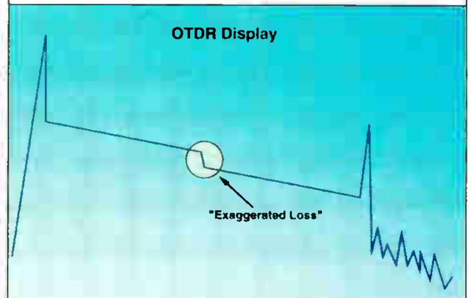


Figure 2

Testing on the profile alignment system (PAS) in the current models of two fusion splicers show that PAS estimations can meet this criteria.

Testing on the Siecor unit demonstrated that it could meet this requirement 100% of the time. One way OTDR measurements clearly do not meet these requirements.

If the apparent increase in power is greater than the loss due to the splice itself, the OTDR trace reveals this splice as a "gainer".

The data in Table 1 summarizes the inaccuracies of one-way OTDR measurements based on typical mode field diameter (MFD) variation. Note that a one-way OTDR measurement is only accurate to within ±0.10 dB about 75 percent of the time.[1,2] The inaccuracy of the one-way measurement is an inherent weakness in the technology of OTDR implementation. This inaccuracy is probably more familiar to the experienced field technician or field engineer as a "gainer."

In general, OTDRs do a very good job of estimating attenuation by measuring backscattered light. To do this, the OTDR assumes a constant percentage of light is being backscattered along the length of a fiber. This is generally a good assumption along the length of a fiber, but not necessarily a good assumption at splice points.

The amount of light backscattered is related to the MFD. Our testing has proven that the minor variations in MFD, found in commercially available fiber, do not have an effect on actual splice loss.

However the OTDR confuses these minor variations and produces an erroneous "splice loss measurement" known as a "gainer." This effect is shown in Figure 1.

In physical terms, what is occurring is the sum of two effects seen by the OTDR. The first effect the OTDR sees is the actual loss of power due to splicing misalignment, etc. The second effect seen is related to minor differences which occur in the backscatter coefficients (MFD variation) of the fibers. The OTDR measures the percentage of light scattered back to it (backscatter). The OTDR assumes that this percentage of backscattered light is constant along the length of the fiber.

As discussed above, this is generally a reasonable assumption. However, if the magnitude of light being backscattered from the fiber immediately after the splice is greater than the magnitude of light being backscattered from the fiber immediately preceding the splice, the OTDR displays an apparent increase in power. If the apparent increase in power is greater than the loss due to the splice itself, the OTDR trace reveals this splice as a "gainer" (please see Figure 1).

If the splice which is seen as a gainer by the OTDR is observed from the opposite direction, it will appear as an exaggerated loss (please see Figure 2).

The size of the exaggerated loss is equal to the "gain" in the opposite direction. The "gain" and exaggerated loss will cancel each other out if the OTDR readings from both directions are averaged, leaving only the actual loss. This is why the Electronics Industries Association's FOTP-61, "Measurement of Fiber or Cable Attenuation Using an OTDR," states that OTDR measurements of single-mode fiber splice loss must be measured from both directions and averaged if an accurate splice loss measurement is to be made.

Figure 3 shows a distribution of calculated splice losses which would be caused by MFD variations found in commercially available fiber. Actual splice loss due to MFD mismatch is plotted with the values that would be obtained by evaluating these splices with one-way OTDR measurements. A significant difference exists. Splices in Figure 3 ranging between 0.00 dB and 0.04 dB in actual loss can generate unidirectional OTDR readings between -0.26 dB and 0.33 dB.

This is more than enough to cause conscientious installers like Terry and Chris to bang their heads against the wall!

Thumb rules

So how do we minimize the bruises on

Remake Rules for Single-mode Fiber Splicing

1. An acceptable splice must:
   Have a splicer estimate of 0.20 dB or less (LID-SYSTEM or Profile Alignment)
   or
   Have a unidirectional OTDR splice loss of 0.20 dB or less.*

2. If after three attempts, you are unable to get a splice with a unidirectional OTDR measurement of 0.20 dB or better, accept the next splice that is within 0.10 dB of the lowest of the first three tries.

3. Splices that are kept after three attempts should not exceed 0.65 dB by unidirectional OTDR measurement.*

**Limits of 0.20 dB and 0.65 dB for unidirectional OTDR readings are used when splicing fiber from the same manufacturer, or after applying the thumb rules in Table 3 when splicing fiber from different manufacturers.*

Siecor does not advocate uni-directional OTDR measurements. Accurate splice loss measurements can only be achieved with a fusion splicer's splice loss estimation or other splice verification set, a bi-directional OTDR measurement, or a power-through measurement.

Table 2

their heads? Simple. We provide them with some thumb rules and a convenient means to verify that their fusion splicer is accurately estimating splice loss.

The verification can be done with a jumper, transmitter and power meter which can easily be brought to the splice location. A power-through measurement is made on the jumper which is then cut in half. The two halves of the jumper can then be spliced together. A second power-through measurement is taken, and the difference between the two is the splice loss.

The splicer's estimated loss for the splice can then be compared to the power-through measurement to ensure that the splicer is accurately estimating splice loss.

And how many innings was all this trouble worth? Well, if you, Terry and Chris are installing an "average" system, you are probably working with a 30-fiber cable. Now, let's assume that you have this type of difficulty with 5 percent of your splices. (Remember, from Table 1 and Figure 3, about 95 percent of all unidirectional OTDR readings are accurate to within 0.20 dB, and about 75 percent are accurate to within 0.10 dB of the actual loss! Or, one in 20 unidirectional OTDR measurements are off by more than 0.20 dB and one in four are off by more than 0.10 dB.)

Assuming that there are ten splice points, and you are remaking each of these "problem" splices three times, that's 45 extra splices, or about one-and-one-half extra splice points! (Or 110 percent of the work, which means at least 10 percent less time for Little League games!)

Handling gainers

What do you do with a gainer when you get one? First you understand that a gainer is nothing more than a limitation of the OTDR's measurement method. So if the splice is completed, keep the gainer and get on to the next fiber. And if you are using the OTDR to optimize your splice, then you want to maximize that gainer. That's right, the bigger the gainer, the lower the loss.

Common sense

It's just good common sense. A larger splice loss will "hide" that gainer (i.e. the actual splice loss will cancel the "gain" the OTDR is seeing). A lower splice loss will not mask the gainer as well, so a bigger gainer means a better splice with truly lower loss!

Speaking in defense of your friends (on the splicing issue; fishing is their problem), they were probably set up for misinterpretation. Their OTDR panel is probably labeled "splice loss" with no warning stated about its inaccuracy. If Terry did meet the test equipment supplier, the supplier probably explained how accurate the unit was without explaining the assumptions necessary for that accuracy.

Often, Terry is set up by a requirement that the one-way OTDR measurement splice loss must be less than or equal to 0.15 dB. Well, we can point

Thumb Rules for Splicing Dissimilar Fiber

When two different fiber types with different nominal MFDs are spliced together, the exaggerated loss or gainer will be larger than when splicing similar fibers. If it is desired to take the risks associated with uni-directional OTDR measurements, use this simple thumb rule. This thumb rule was developed to use when splicing Corning to AT&T fiber:

When performing OTDR splice loss measurements in one direction on a splice composed of AT&T and Corning fiber, make the following correction:

1. When the OTDR is reading from Corning to AT&T add 0.25 dB to the splice loss to compensate for the apparent gain.

2. When the OTDR is reading from AT&T to Corning subtract 0.25 dB from the splice loss to compensate for the exaggerated loss.

Note: It is important to remember that splice loss is reported as a positive number.
Siecor does not advocate uni-directional OTDR measurements. Accurate splice loss measurements can only be achieved with a fusion splicer's splice loss estimation or other splice verification set, a bi-directional OTDR measurement, or a power-through measurement.

Table 3

fingers in many directions (*you* have the most to complain about; after all, you caught the same fish 6 times and finally got to the game during the seventh inning stretch!).

Instead, let's work together to spread the word and educate the industry. After all, in addition to earning a buck, we are all trying to advance the information age and make America more competitive. Here is how to get started:

Suggestions

1. Recognize the usefulness as well as the limitations of the OTDR. Verify proper operation of your splicer's loss estimation system, then stop breaking splices which the fusion splicer says are good. This will increase your productivity without hurting system performance.

2. Recognize the bottom line in attenuation performance is the end-to-end system attenuation, not each individual splice loss. With today's fiber quality and splicing technologies, it is easy to achieve average splice losses less than 0.10 dB in your spans.

3. If limitations require that you use one-way OTDR measurements to check splice loss, set reasonable re-make rules. We recommend the rules listed in Tables 2 and 3, based on field experience, data, and reasonable risk.

4. If using one-way OTDR measurements for splice loss assessment while splicing fibers of different nominal MFDs (e.g. fiber from different manufacturers), understand that thumb rules can be used to even the risks of error in assessing splices of dissimilar fibers. These thumb rules are given in Table 3.

> If limitations require that you use one-way OTDR measurements to check splice loss, set reasonable re-make rules.

And what if Terry cannot be convinced of these technically correct and practical ways? Then Terry runs the risk that your company's competitor will get FTYC (Fiber to Your Customer) faster and at a lower installation cost than you (while you continue to miss your kid's games). Happy Splicing! CED

References

1. Warner, Brad, "Unidirectional Single-Mode OTDR Measurements," *Siecor Applications Note.*

2. Mettler, Stephen C., "Monte-Carlo Analysis of the Effect of Mode Field Diameter Mismatch on Single-Mode Fiber Splices," *NFOEC Proceedings*, 1992.

3. Lief Bjerkan, "Optical Fiber Splice Loss Predictions from One-Way OTDR Measurements Based on a Probablility Model," *Journal of Lightwave Technology*, March, 1989.

However, cable systems located in the interior of Argentina still often use refurbished gear, according to Cullen Davis, who sells coaxial cable in Latin America for Times Fiber. That's where you'll find systems using RG-59 cable in the feeder and RG-11 in the trunk.

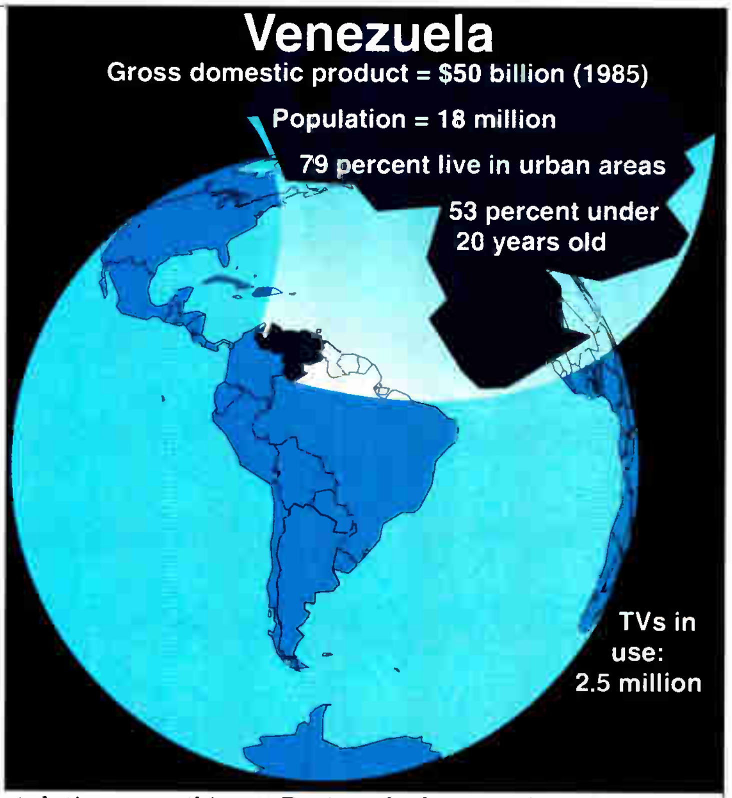
But clearly the trend is away from older equipment, says Davis. Whereas five years ago probably 80 percent of the hardware being purchased was used, today it's probably 60 percent new gear being bought.

Wireless market

As mentioned above and in a separate story, Latin America is latching on to wireless MMDS technology as well. Ross and others familiar with the region say the market is evenly split between wireless and wireline equipment.

But make no false assumptions; developments related to digital compression and fiber optics are also being tracked closely by Argentine operators, says Ross. The advent of digital compression would help unlock market sluggishness by alleviating a critical shortage of satellite transponder capacity in the area, according to both Ross and Davis.

While Latin American cable systems have access to movies, news, sports and general entertainment services via the satellite, there is not a wide assortment. "Programming drives everything—just like in the U.S.," says Davis. "When ESPN, CNN, TNT and HBO came on (in Argentina and elsewhere), it created a huge interest in coaxial cable products," he adds.



So did a relaxation of import duties—something completely unrelated to technology. Davis and others say Argentina in the past slapped duties in excess of 700 percent on items shipped from the United States. Consequently, a lot of equipment has found its way to cable systems via alternative methods—some of which weren't necessarily legal, some say.

Interestingly, there seems to be little interest in two-way systems or pay-per-view. Ross says it's too early in the development cycle for that.

Chances of success high

In spite of the difficulties related to language barriers, import duties and unclear governmental policy, several U.S. hardware suppliers are working hard to cultivate a nascent industry in Latin America. Davis is just one of many who believe the region holds the greatest short-term promise—provided economic and political stability remain part of the equation.

If the trend toward greater democracy and improved standards of living continue, Davis says the international market will be as big as the U.S. market in as few as five years—when just five years ago it didn't exist.

"Latin America has the chance to learn from our mistakes," says Davis. "Most of the smart (operators) are learning. I think the growth curve down there will be a lot steeper." CED

By Roger Brown

Wireless cable and Latin America: A south of the border update

If one were to take a snapshot of the Latin American MMDS business today and compare it to a similar image of the United State's wireless industry some 15 years ago, the two would look remarkably similar.

Generally speaking, the process, technology and learning curves are the same, regardless of what soil a wireless business is planted in. The only difference, of course, is the timing. While U.S.-based wireless operators, with several years of experience under their belts, have taken a much higher place on the learning curve, their counterparts south of the border are generally considered to be in an infancy stage.

"The atmosphere (in Latin America) right now is similar to the way it was in the U.S. 10 years ago," says Jay Hope, VP of sales for dB-tronics. "They're purchasing anything they can get their hands on, especially name-brand equipment."

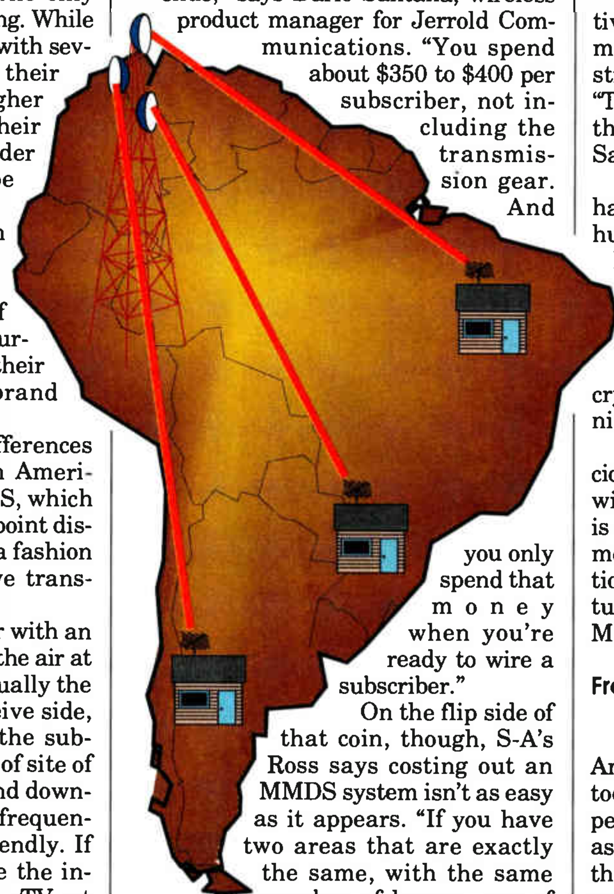
Few, if any, technological differences exist between U.S. and Latin American wireless operations. MMDS, which stands for multichannel, multipoint distribution systems, operates in a fashion similar to standard microwave transmission.

On the transmit side, a tower with an antenna sends signals through the air at pre-designated frequencies, usually the 2.5 GHz spectrum. At the receive side, which is generally on top of the subscriber's home and within line of site of the transmitter, an antenna and downconvertor process the MMDS frequencies to signals that are TV-friendly. If the operator chooses to secure the incoming signals, a box on top the TV set descrambles the secured channels.

As in the U.S. (or anywhere else, for that matter), certain areas are better suited for MMDS operations than others. In fact, the technology itself is highly dependant on topography, in that a wireless operation requires unobstructed line-of-sight transmission. If a given terrain is hilly or has tall buildings or even excessive foliage, an MMDS system is destined to have problems.

Then again, there are certain areas that, because of their unique topography, are perfect for wireless cable—like Caracas, Venezuela. "Caracas kind of sits in a bowl," explains Doug Ross, VP of marketing and new business for Scientific-Atlanta. "It's one of the few cities in the world that is idea for MMDS."

Most experts agree that a wireless configuration is initially chosen for economic reasons. "One advantage wireless gives is a good match between expense and revenue," says Dario Santana, wireless product manager for Jerrold Communications. "You spend about $350 to $400 per subscriber, not including the transmission gear. And you only spend that money when you're ready to wire a subscriber."



On the flip side of that coin, though, S-A's Ross says costing out an MMDS system isn't as easy as it appears. "If you have two areas that are exactly the same, with the same number of homes, one of the things that makes it difficult to prepare the cost is how dense the people are," Ross submits.

"If the area is densely populated, then every foot of a cabled network passes a lot of people. In that case, the advantage the microwave distribution has tends to decrease," he continues. "The general conclusion people have come to is that MMDS has to be less expensive—that's not necessarily so."

Hot spots

What *is* necessarily so is that Latin American operators are buying and implementing the equipment necessary for MMDS delivery. Santana's data shows Mexico as a particularly hot spot. "Mexico City has the biggest wireless operator in the world, with close to 100,000 subscribers," Santana says. "They have about 20 channels of video, and digital audio services."

Also, Santana said, the operator (Multivision) recently entered into an agreement with parent company General Instrument to use its DigiSat technology. "They want to sell their programming to the rest of Latin America and Mexico," Santana explains.

Zenith's VP of Sales Bob Cunningham also views Mexico as a potentially huge market. "Mexico has huge populations in its larger cities. As I understand it, MMDS and CATV operations will be required to scramble channels, for copyright protection reasons. That kind of mandated encryption will open many doors," Cunningham says.

S-A's vision for MMDS hot spots is decidedly broader. "Most of South America, with the exception of Argentina, which is already wired, is virgin territory at the moment," Ross says. "It's more a function of where the big cities are, which in turn leads you to Brazil, Venezuela and Mexico."

Frequency allocation

Perhaps the biggest bottleneck Latin American MMDS operators are facing today is spectrum procurement. Most people familiar with the process, when asked about frequency allocation, shake their heads. The word "slow" invariably comes from their mouths.

No one would say, however, exactly how "slow" the process of winning MMDS frequencies in Latin America actually is. Jerrold's Santana says this: "Generally speaking, there is an agency (within each country) that is similar to our FCC, called the Ministry of Transport and Communications. In most cases, that's the authority that rules over these matters."

But, he adds, Latin America isn't a homogeneous area, as is the United States. "There are different traditions, history and modes of government that have evolved differently in different countries. Therefore, each country looks at these matters in a different light. It's not an easy process, by any means. It's lengthy and involved."

One manufacturer who prefers not to be identified relates that obtaining spectrum is the single biggest problem in Latin America. "It's going very slowly," he says. "In a country like Brazil, they have no regulation at all."

The holdup, he continues, is a haze of bureaucracy and political game-playing. "In the States, you pretty much know what is going on (when applying for frequency space). In South America, the guy who has political power may get a license. The next guy, who has no political power, doesn't. This is how things, even things like spectrum, are bought in South America—either by money, or by power. It's corrupt, yes. But that's how it works, in some cases."

However, the frequencies that are being allocated are dovetailing with U.S. MMDS frequencies, says Ross. "The fact that MMDS equipment—transmitters, particularly—are being made for certain designated frequencies in the U.S. is leading the South American countries to make the same frequencies available," Ross explains. "So it wouldn't make sense for them to pick oddball frequencies for which nobody makes transmitters."

Capacity

Because the MMDS frequencies are highly coveted, channel capacity is correspondingly low. Santana says he's seen systems featuring anywhere from two channels to 20, with an average of six to seven channels.

"People think that programming is the limiting factor in Latin America. That's not entirely true—they're limited in channel capacity, as well. If they have four channels available to them, they'll use all four. If they have 12, they'll use 12."

Because of that, Santana and Ross agree, digital compression could well play a significant role in Latin America's future. "The MMDS operators that have two or three channels have that many because that's the maximum number of frequencies they've been able to obtain, not because that's the only programming they could obtain," Santana says. "So if you can come in and compress 4-to-1, then you've gone from three channels to 12."

Learning from mistakes

Still, though, it seems Latin American operators have several other fish to fry before dealing with multiples of compressed channels—like coming up a few notches on the learning curve of how not to anger potential customers.

"Latin American operators are making all the same mistakes that (the U.S.) made in its early days, and their penetrations are suffering because of that," Ross says.

For example, Ross says, in an attempt to recoup some of the hardware costs nesting on the potential subscriber's rooftop, some operators are charging upwards of $75—just for the installation. "As a result, the new operator that hasn't learned yet tends to put a high entry barrier on his service, and discourages his subscribers," Ross says.

If only the U.S. cable and wireless industries had a penny for every mistake *they* ever made in the quest to keep subscribers happy while still turning a buck. Latin American operators would have a fairly healthy library to learn from, and a lot of U.S. companies would be wealthier . . . . **CED**

By Leslie Ellis

Smaller suppliers looking South

Argentina, Brazil head list of "hot" markets

Over the past two years, sales of televisions in Argentina, the most heavily-cabled country in South America, have leapt by 280 percent. Lots of those sets are connected to TV cables supplied by over 1,000 cable TV systems. It's no surprise then, that even for some small U.S. cable TV hardware suppliers, Argentina may be the locomotive pulling business in the rest of the region along.

Altogether, Latin America represents about 65 to 70 million television households, of which 20 to 25 million are in Mexico and Central America.

Looming giant

And though Argentina has so far been the biggest cable TV market, looming on the horizon is Brazil, seen as "the next big market" by some suppliers.

It's not hard to see why Brazil attracts attention. As South America's largest country, Brazil claims nearly 150 million residents, about 70 million of whom live in the big cities. Sao Paulo alone, for example, claims 17 million residents. And the five biggest cities probably represent about 40 million residents. Indeed, Mike Holland, Holland Electronics Corp. president, argues that five million to 10 million cable TV passings is a realistic possibility in Brazil.

Difficult market

At present, there may be 100 cable TV franchisees in Brazil today, and possibly 20 to 30 multichannel microwave distribution systems (MMDS) in place or starting up, says Scientific-Atlanta Vice President, New Business Doug Ross. But many of the franchisees haven't begun system construction yet.

Altogether, existing systems may be able to claim 50,000 to 100,000 subs. Still, it's a market that will likely take some years to develop, says Ross. "The demographics, government influence and significant duty barriers make it a difficult and expensive market." But make no mistake, additional franchises are being granted in Brazil. "There may be several hundred additional franchises being applied for to serve smaller cities," said Ross.

By Gary Kim, Technical Editor, Multichannel News

Funded by media

So far, the indigenous industry has been funded in large measure by publishing, broadcasting and real estate interests, including the Globo TV network, which now broadcasts four channels of programming on the BrazilSat II satellite. Before that bird launched, some Brazilians had been installing eight- and 16-foot dishes to pick up signals from U.S. cable TV satellites, said Holland.

But BrazilSat has allowed use of smaller reflectors, creating a sort of "SMATV" market that is expected to lead to wiring of 500- to 800-unit high-rise residential units, says Holland. Then, at some point, some observers see connecting the various standalone networks to create a cable TV network on a wider scale. That model could develop in Sao Paulo, for example, where protected living units of about 1,000 residents each are springing up on the outskirts of the city.

Strand sales

Holland estimates that 10,000 to 20,000 new passes a month is a reasonable description of how fast the market is developing. "People are flying hundreds of thousands of feet of strand down there," says Holland. "We flew 50,000 feet of strand down there ourselves." In some cases, downlinked satellite signals may be relayed using MMDS

called Cable Loop Carrier. What these two products make possible is voice service via coaxial cable.

Although the two products will work in different ways, both provide intelligent in-home modems that allow telephones to talk to each other without going through a central switch.

Langenberg predicts this approach will spread quickly to other cable and telephone operators: "Cablephones will soon become the preferred telephone technology for cable and telephone operators alike when they're building new plant or rebuilding old plant." However, the devices currently on the market still must undergo extensive testing to "insure they operate as reliably (as traditional telephones) in today's environment," Langenberg added.

Evidence that Langenberg's comment could be right on the money isn't hard to find. According to Andy Paff, president of ONI, the company has received "a lot of interest (from cable and telephone companies) in this product in both the U.S. and the U.K." Interest in America seems to be driven by multimedia, PCN and other applications, said Paff.

Quite simply, this new integrated network, which features digital telephony and cable TV in the same cable sheath, is the most advanced in the U.K. Others, including Langenberg, suggest it's the prototype of tomorrow's network.

"What's going on over there (in the U.K.) is just awesome," says Langenberg. "It will revolutionize the industry over there by making (a hybrid fiber/coax integrated network) cost effective." The Telewest approach is cost-effective because each subscriber re-

Quite simply, this new integrated network, which features digital telephony and cable TV in the same cable sheath, is the most advanced in the U.K.

quires only incremental expense—which is offset by the revenue generated by that subscriber.

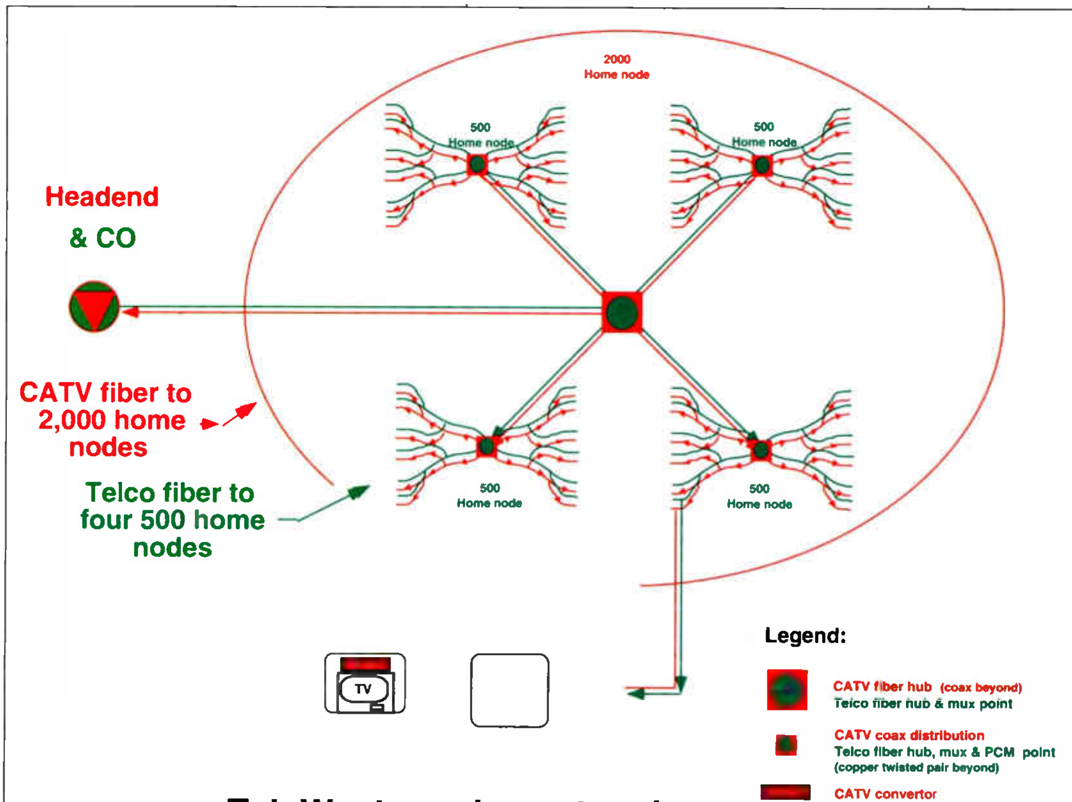
Horatio Egnoto, managing director of Jerrold Communications in Europe, agrees that Telewest is a pioneer. Egnoto says network design is "evolving almost weekly" in the U.K., and Telewest has taken the lead position in getting fiber closer to the home via small nodes, he adds. (Jerrold markets the Personal Xchange system in the U.K. for FPN.)

How the network works

Telewest has taken a novel approach to the design of its integrated system. Following the network in a reverse direction (from the subscriber back to the head-end/central office), this is how it works:

A "Siamese" drop, consisting of twisted pair and RG-6 coaxial cable, runs from the home back to the distributed two-, four- or eight-way tap.

Video signals are then routed on coax cable back to a fiber node location that serves 2,100 homes. From there, it is



TeleWest overlay network

Figure 2

converted to light and sent via fiber optics back to the headend in analog form.

The twisted pair telephony cable, on the other hand, runs back to the line extender location, where it is cross-connected to a 50-pair cable, which in turn is connected to a trunk/bridger location that serves 500 homes. From there, the signals are pulse code modulated into digital signals.

It is here that 30 analog voice circuits are converted into E-1 signals running at 2.048 Mb/s. Several E-1s are then upmultiplexed to 8 Mb/s, transported via fiber to distributed major multiplexers, multiplexed with more 8 Mb/s channels and again upmultiplexed to 140 Mb/s and transported on fiber to the central office.

At the CO, signals are converted back to E-1 circuits and handed to Mercury for switching.

While the number of fibers used to transport all that information "continues to evolve," according to Langenberg, today it takes eight individual fibers for telephony (two active, two "hot" standby and four spare) and four more for CATV (one forward, one reverse, one forward for future switched telephony and one spare).

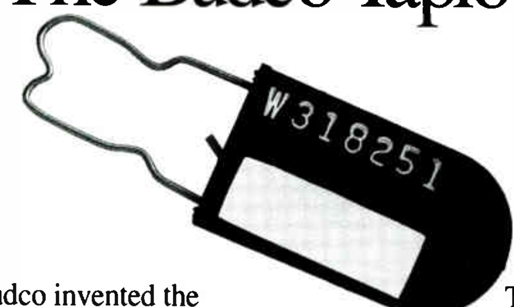
Langenberg admits that's a lot of fiber, but he says the day isn't far off when everything could be sent on a single fiber by using three operating "windows" and an almost infinite number of wavelengths.

Langenberg also predicts there will someday be at least two broadband wires into the every American home and at least two multichannel over-the-air competitors (MMDS, DBS, etc.) Meanwhile, telephony will come to mean a combination of wireline, PCN cordless and cellular components.

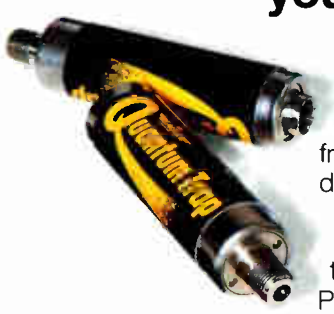
So what took a former CATV-now telephone/cable engineer so long to realize that the traditional tree-and-branch network design is the most efficient and cost effective? Langenberg sums it up this way: "Once in a while some of the hats we wear are too tight."

Touche. CED

By Roger Brown



That's about how much lower channel audio interference you'll hear with our new **Quantum Trap**™.



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PERSONNEL: Giles Mortimer
DESCRIPTION: A system integrator of complete fiber optic networks for video, voice and data, ANTEC INTERNATIONAL develops innovative products with manufacturing partners worldwide, and provides a wide range of services in conjunction with international distributors to meet the specific needs of each individual customer. Services include system design, project management, contract splicing, training courses, technical support and emergency restoration.

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A Division of Integral Ltd.
FAX 44 (0) 276 692198
Pilgrim's Well
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Camberley, Surrey
England GU15 3HZ
PERSONNEL: Rob Portwood, Sales & Marketing Manager
DESCRIPTION: Integral Network Systems specializes in network products and systems for telecom and broadband underground networks, including network design services. Their products include Cablecon fibre optic cable installation systems; Cablecon pre-installed cable in duct for metallic, coaxial and fibre cables; Lubaduk advanced cable pulling lubricant; preformed underground access chambers and aboveground pedestals and enclosures for both CATV and telephony plant. Network Owners have reduced their infrastructure construction costs 20-25% by using integrated Network Solutions from the Integral Group.

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DESCRIPTION: Manufacturer of full line of cable television equipment, including COMMANDER® and S-Series satellite receivers and modulators; Cableoptics® fiber optoelectronics, including STARBURST system architecture; STARLINE® amplifiers, line extenders and taps; IMPULSE 7000 and TOCOM impulse-capable addressable converters; STARCOM® plain converters; and computerized addressable headend equipment, including signal scramblers.

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A division of Philips Broadband Networks, Inc.
FAX 44-296-395-298
Unit 4 Bridgegate Business Park
Gatehouse Way
Aylesbury, Bucks, HP19 3XN
PERSONNEL: Alan Whitlock, Operations director; Alan King, Engineering director
DESCRIPTION: Magnavox CATV Systems, U.K., Ltd. a division of Philips Broadband Networks, is a leader in the supply of broadband distribution equipment for use in cable television and business data networks throughout the United Kingdom. In addition to supplying Magnavox brand equipment including Spectrum 2000 amplifiers and line extenders, MagnaHub and MagnaReach fiber optic transmitters, AXIS interdiction equipment, MLM status monitoring equipment and 750 MHz taps and passives, the company handles brands manufactured by Blonder-Tongue, Calan, Gilbert, Hughes, Lambda, Power Guard and Wavetek.

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PPC U.K. Ltd. 0773 513373
Production Products Company
FAX...0773 513356
Butterley Croft
Peasehill Road
Ripley
Derbyshire DE5 3QL
PERSONNEL: Barrie Sweeting, Managing Director
DESCRIPTION: PPC is a high quality manufacturer of aluminum connectors for fiber optic applications as well as coaxial trunk and distribution equipment, brass universal "F" fittings, a new indoor reusable push on "Quik-Lok F" connector, and a full range of negative and positive notch filters in the low band, mid band, high band, and superband ranges. The Distribution Center in Derbyshire serves as a stocking warehouse, offering immediate availability of connectors and notch filters for the U.K. cable industry.

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Texscan Limited (CATV Division) 04 776060
FAX 0494-773397
Watermeadow House
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PERSONNEL: UK: Rex Alexander, Sales Manager, Europe; Donna Jarman, Customer Service Supervisor; US: Ray Pastie, VP, Sales & Marketing
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PERSONNEL: John Robertson, Director of Sales & Marketing - Europe
DESCRIPTION: Manufacturers of coaxial trunk, feeder and drop cables for CATV. TFC also manufactures "TeleDrop" cables for combined CATV and telephony service.

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FAX....................................44-442-891132
Unit 3E, Tring Industrial Estate
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PERSONNEL: Barry Reavill, managing director; Jonathan Rigby, sales and marketing manager
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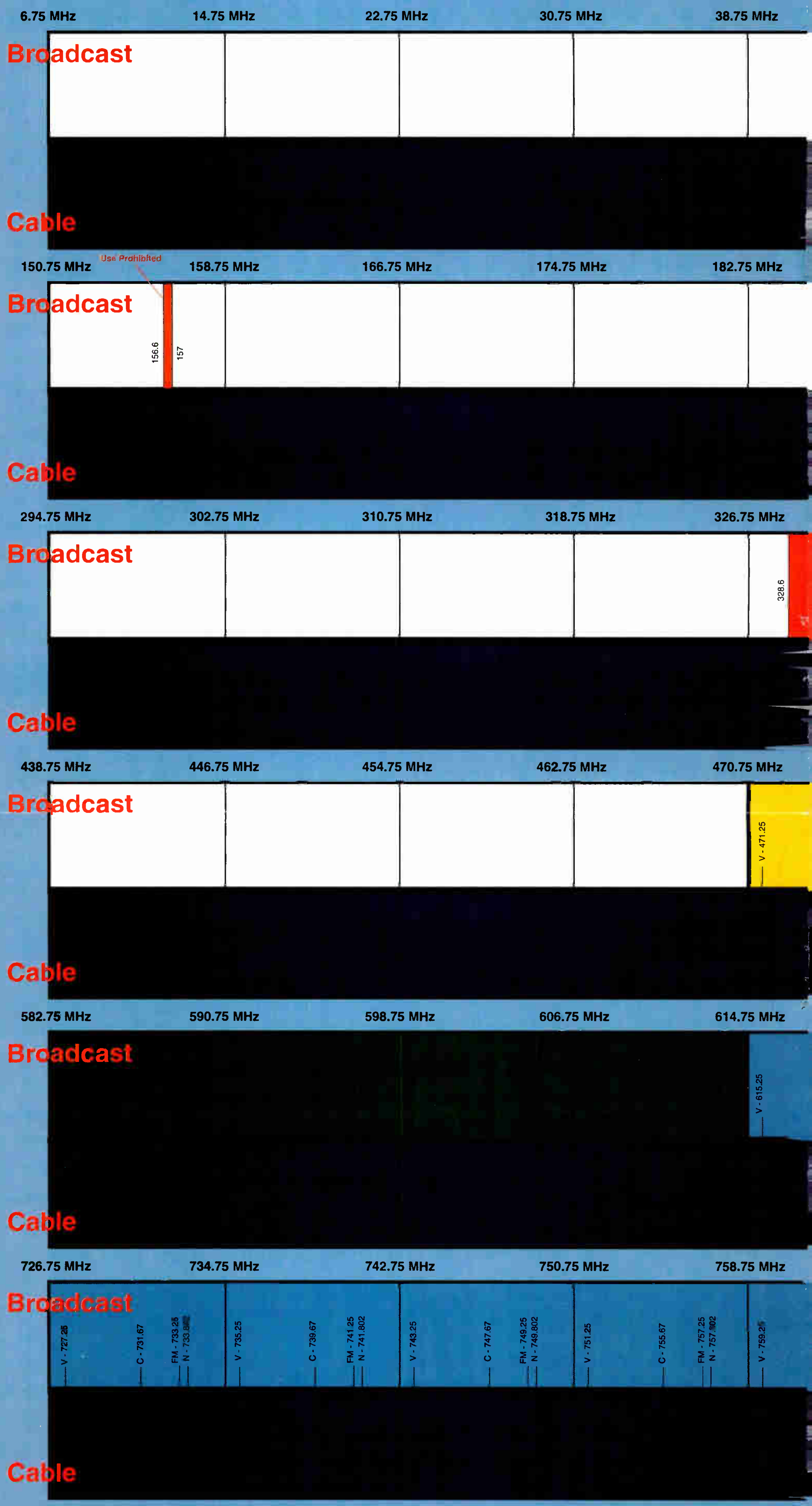
UHF



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UHF Broadcast and
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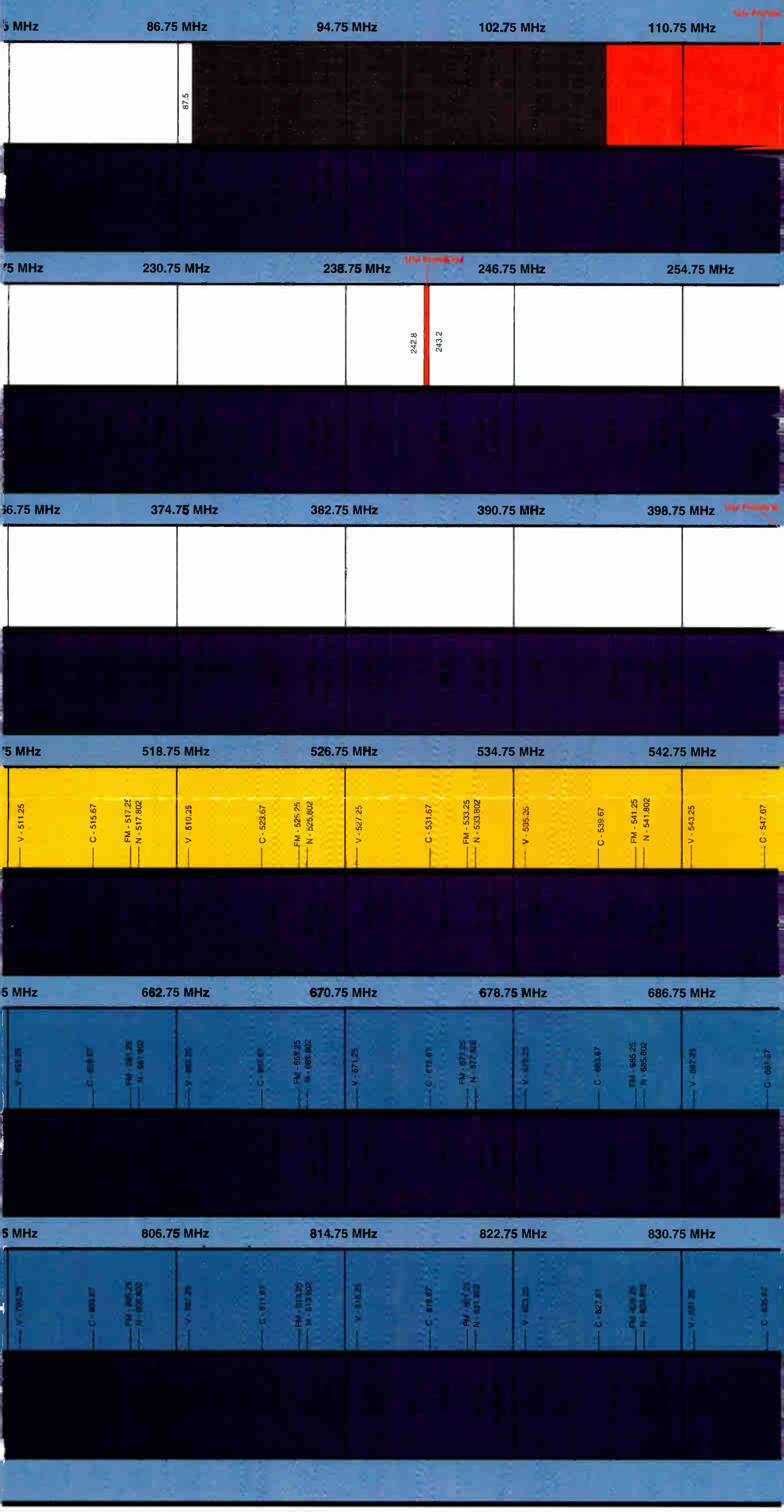

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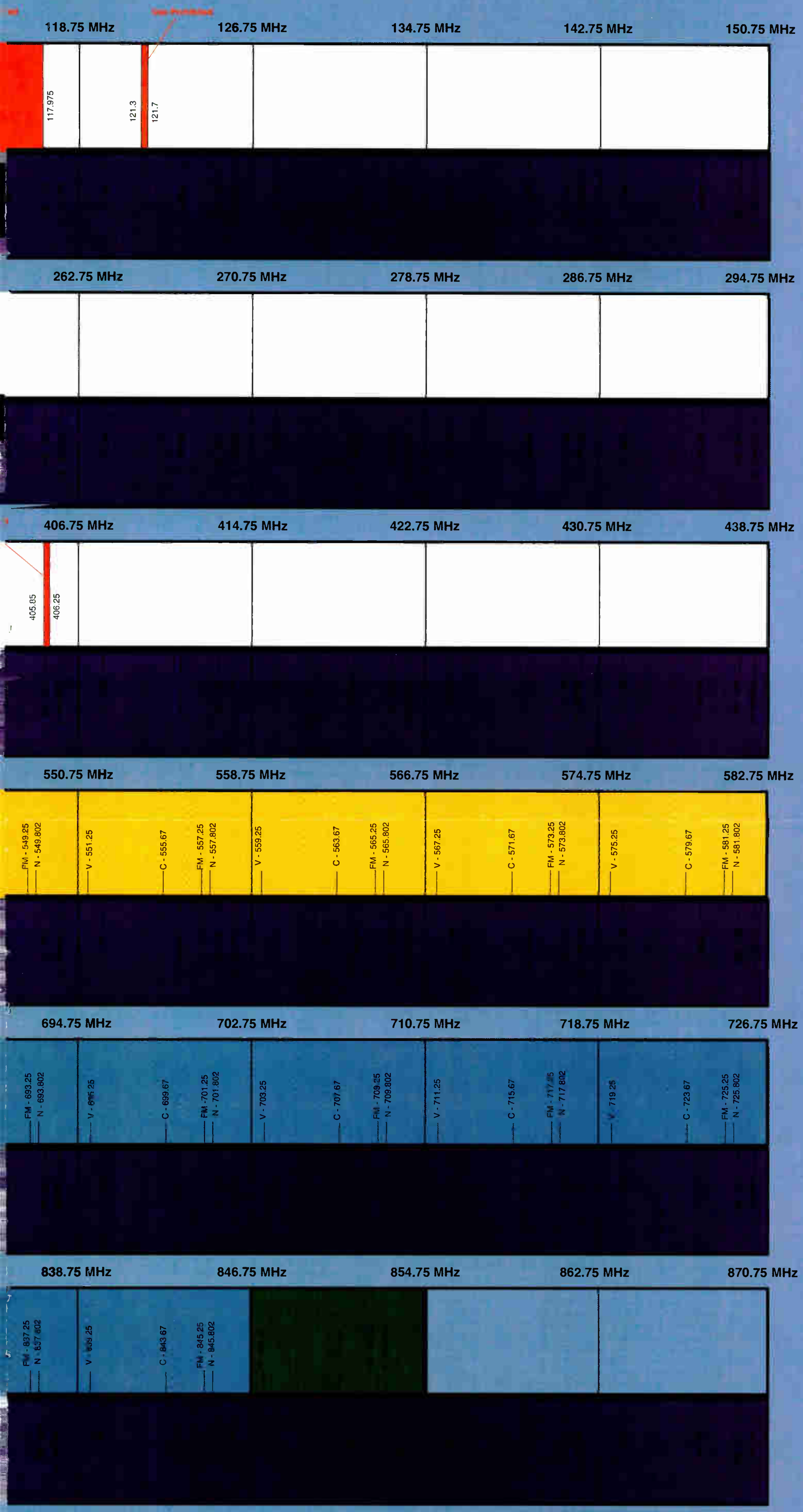

nt.

The use of vision/sound/pilot carriers and color sub-carriers in this frequency range is prohibited. Further, the radiated levels of any sidebands or of any intermodulation products or spurious frequencies on the system falling within this frequency range shall not exceed 21 dB (µV/m). For more information, consult the Department of Trade and Industry (DT) document MPT-1510.

FM broadcast band

V = Video carrier frequency
C = Color carrier frequency
FM = FM sound carrier frequency
N = Nicam sound carrier frequency

Band IV

Note: Channel numbers are not standardized.

CED

Band V

CED Magazine, 600 South Cherry Street, Suite 400, Denver, CO 80222, Phone (303) 393-7449, Fax (303) 393-6654.

Developing a technical training program

During the past several years, many cable system operators have recognized that the need for training in our industry is growing, and will continue to do so. Technologies such as fiber optics, digital signals and compression, PCN/PCS, data communications and video on demand have all placed new requirements for technical understanding on our engineering leaders.

While some of these technical topics are still confined to the conference halls and pages of our industry's trade press, there will be a growing need for our staff level engineers and field technicians to have an understanding of these technologies. Whether it is a formal or informal program, the process by which this information will be passed on to our technical workforce is what constitutes technical training.

As with any other project, the hardest part of implementing a training program is getting started. In this article, I will try to offer some suggestions to aid in that process. While this article is not intended to be a complete guide to training programs, it should be helpful to those who are relatively new to this type of job responsibility.

In order to make the task of getting started a little easier, I've attempted to break the process into several steps. You may be more comfortable completing these in some order other than the one I've listed them in, but each step is essential to the overall success of the program.

Step one: Setting objectives

Without a goal, a training program would be a collection of facts and ideas which would serve no purpose other than to enhance the knowledge level of our personnel. While this is not a destructive result, a more focused set of objectives can help to eliminate unnecessary time spent in classrooms and labs, and increase the effectiveness of the time which is spent learning.

Be very specific when setting the objectives for your training program. It is not enough to state that you wish to "improve the productivity of your field staff" with a training program, even if this is the ultimate goal. A more approximate goal might be to "reduce the number of repeat service calls by 10 percent over the next six months by developing a checklist of preventive measures to be taken on each service call and installation visits to a customer's home."

By Ron Wolfe, Manager, ATC National Training Center, Time-Warner Cable

> As with any other project, the hardest part of implementing a training program is getting started.

Developing a list of *specific* objectives will also allow you to prioritize your training efforts to obtain the greatest possible return on your training investment. In fact, this is the next step you should take in developing your program.

Step two: Prioritize your objectives

If you are just beginning a serious training effort, it is unrealistic to believe that you will be able to address all of your training issues simultaneously. It will be more productive to concentrate your efforts on one or two areas where the most improvement is needed. Your priorities may be driven by cost factors, or they may be dependent on regulatory issues and other factors, and it will be necessary to weigh all of these when making your decisions.

It isn't necessary to have an item by item list of priorities for your programs, so don't get bogged down in an over-analysis of priorities. Instead, try to group your training projects into a few categories of importance. It is better to have made progress on a second or third most important project than to have spent several days agonizing over a decision of where to start.

Step three: Determining relevance

One of the most important questions a trainer must learn to answer *accurately and honestly* is whether or not the problem to be addressed is one which is related to training. For example, let's assume there has been a large increase in repeat service calls over the past year. At first glance it might appear that your technical staff is not doing a good job at correcting all of the problems when visiting a customer's home.

A more careful analysis might uncover that the problem was spawned when your company switched brands of connectors last year, and the new connectors don't perform as needed. All of the training in the world will not make a defective product work, and conversely, even a good product will not work well if it is not properly used.

It is also necessary to determine the cost benefit ratio of your program. Simply stated, is the cost of the problem more or less than the cost of the solution? As an example, if improper connector installation had resulted in only six service calls over the past two years (don't we wish!), it would not be practical or cost effective to design a week-long session for all of your personnel to address this problem.

Step four: Program design

The complete process of designing a training program would consume many more pages than are available in this issue, but the following general suggestions will get you started in the process.

I prefer to start any development of training programs with a list of output products. My list starts with the simple heading: "Upon the completion of this course, the student will be able to..."

This allows you to maintain your focus throughout the development on those items which are truly the objectives of the course. Don't forget to be conscious of the time allowed to complete the class. It may be necessary to break your objectives into two or more sessions if the list is lengthy.

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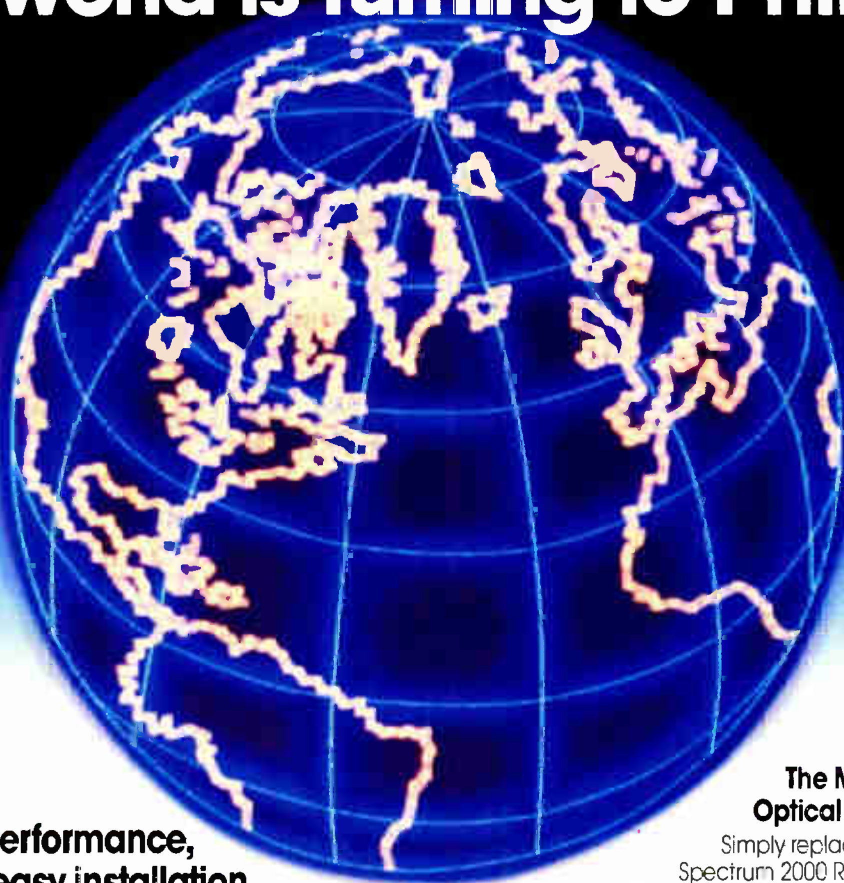

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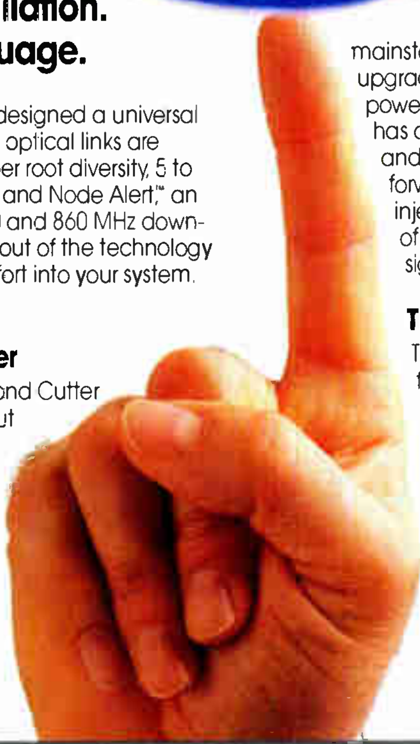

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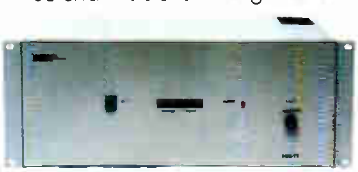

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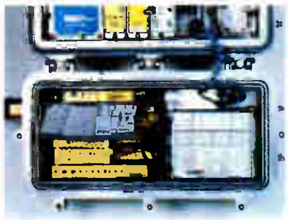

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I've found that with some exceptions, the maximum effective course length is about five days, or one week in the classroom, with successive sessions being scheduled no sooner than three months after. This gives your students an opportunity to practice their new skills and refine them before moving onto more complex topics.

After determining each of the new skills to be learned, I organize them in a fashion which allows each new topic introduced to be built upon concepts learned in previous sessions. As an example, during a design course it would not be effective to discuss determining equalizer values before first discussing the relationships between carrier frequency and cable loss. By following this progressive teaching method, your staff will not only learn faster, but their retention will be greater, because they will understand why an equalizer has a specific value and not just which numbers to plug into which formula.

Step five: Topic research

After you have organized the program, it is time to start gathering reference information about each of the topics. This doesn't always mean spending hours with your nose buried in reference books, but it could be as simple as spending a few minutes discussing a topic with a resident expert.

> Don't be overwhelmed by the fact that you may be developing a program which addresses topics which you have little exposure to.

Don't be overwhelmed by the fact that you may be developing a program which addresses topics which you have little exposure to. It is not always necessary to be an expert on a topic to be able to effectively teach it. I like to use outside experts in many of our courses, especially for the first few sessions of a new seminar. This allows the instructor to develop and administer the program, and to sit through these sessions as a student as well as an instructor. After doing this one or two times, you'll gain the knowledge to teach the program yourself.

Step six: Reinforcement techniques

Many studies of adult learning techniques have demonstrated that there is a significant increase in the effectiveness of training programs and student retention if there are "hands-on" exercises included in the agenda. Retention percentages can be increased from less than 50 percent for standard lectures to 90 percent for lectures followed by lab exercises.

Try to think through each point which you consider to be important to your program and develop some type of active exercise where the students can immediately use the new skills they have learned in a hands-on fashion. These exercises should be mixed in with the lecture materials at regular intervals to reinforce lecture concepts prior to moving on to new topics. This will also serve to break up the monotony of long lecture sessions. As a rule, try not to have your lectures last longer than one hour without some type of break.

Step seven: Verification/certification

In order to determine the effectiveness of a training program, we need to have some means of determining whether the message has gotten through. The most common and traditional method is some form of testing. This is far from the only means available to you and, despite its usefulness in some applications, you should not rely too heavily on written testing.

Taking our previous example of a training program being designed to reduce repeat service calls, it should be obvious that an accurate measure of the effectiveness of the program would be to monitor the percentage of repeat service calls and look for some reduction in that statistic. Continued management support will be determined on the level of success you have in meeting those types of objectives, and not on the test scores of your students.

Step eight: Classroom delivery

Despite the fact that this is the part of the training process that generally causes the most apprehension among trainers, it is really the easiest part of the process, if all the prior steps have been executed. The first few times that anyone is in front of a group, there will be some nervous tension, and I believe this is good. It causes trainers to prepare well.

There are many texts available on effective speaking skills, and to list them here would not be possible. I use a softcover text which is inexpensive, yet it provides some good basic techniques for classroom presentations. The title of the book is "Effective Business and Technical Presentations," by George L. Morrisey and Thomas L. Seshrest. This text covers all of the basic skills you will need to get started in the classroom, including the use of visual presentations and reinforcement techniques.

It is very important to have a good understanding of classroom presentation techniques, as even the most knowledgeable engineer can have problems when trying to convey a complex message. Any one of us who has attended trade shows and conferences can probably remember at least one presentation where we were disappointed by the delivery of the information, and one where we came away feeling not only informed, but entertained as well.

Try to analyze both types of presentations and determine which techniques worked, and which ones didn't. It is quite likely that you learn in a fashion very similar to your own students, and emulating (not copying) successful presenters can help you develop a successful style which is uniquely your own.

Conclusion

I'm sure that at this point, you have many questions remaining to be answered about getting your program started. The most important point is to get started today, and not to let the apparent size of the task prevent you from making any progress. The one most important lesson I've learned during my tenure at the training center is that those projects which are not started are the least likely to be completed. Analyze your training needs, develop a plan which can show measurable progress to meet those needs, gather the material and present it. It's that simple. CED

Managing creative customer service

The single most important thing to remember about any enterprise is that results exist only on the outside. The result of a business is a satisfied customer....

—Peter Drucker[1]

Over the past several years the quality of cable TV's customer service has been the target of discussion, newspaper and magazine articles, political scrutiny and professional evaluation. Cable TV service is generally pretty good. But it sits so squarely in the public eye, whenever there is a problem it gets full attention.

Industry leaders agree that excellent customer service should be the norm rather than the exception. Many cable systems have made great strides to improve their customer service. Others are aware of their service deficiencies and are taking steps to correct them.

As a group, the cable industry has been very responsive. Both the National Cable Television Association and the Community Antenna Television Association have cooperated to create rigorous customer service standards that challenge the industry to achieve measurable performance targets. They cover office and telephone availability, installations, outages and service calls, and communications, bills and refunds. Most cable systems aim to achieve these minimum standards.

Practical methods

Despite this progress, one of the best-kept secrets in the cable TV industry is how to manage technical and customer service personnel to achieve excellent customer service. What practical methods work to motivate all employees to provide outstanding service? There are plenty of well-run departments with important lessons to offer.

However, unlike the "technical" side of the industry, supervisors and managers find they have few channels to learn about successful customer service practices or share their own accomplishments. Even within MSOs, there is often little cross-pollination from one system to another.

By Robert Gordon, President of Orion Business Services Inc.

This situation is beginning to change for the better. For example, SCTE's Chesapeake Chapter organized a seminar in June that featured a full day of discussions including topics on how to interpret the NCTA Customer Service Gold Seal Standards, troubleshooting service calls from a CSR's perspective, and cable technology for non-technical personnel. The meeting attracted more than 50 CSRs, sales representatives, and other non-technical personnel thirsting to learn how successful systems operated and what lessons they had to offer.

Human interaction, the substance of service, cannot be reduced to a cookbook set of instructions.

Managing for excellent service

Recent research into successful customer service has revealed five principles that apply equally well to cable TV's technical and customer-service leaders. They are based on the ideas developed by W. Edwards Deming that helped launch the Japanese economic phenomenon and now contribute to America's growing commitment to quality.[2]

Excellent managers establish an environment for creative customer service. Human interaction, the substance of service, cannot be reduced to a cookbook set of instructions. There are too many variables. Creative customer service occurs when employees are empowered to use their own good judgment to meet customers' needs and improve their workplace performance. As Deming says, "remove barriers that rob people of pride of workmanship."

Creative employees feel personally responsible for the success of their company, understand its values, are delegated the authority to manage their work, and have the tools to achieve results. Here's how excellent managers instill these qualities:

1. Communicate regularly and encourage feedback. Motivated employees want to express their ideas on how to improve their work and see their recommendations put into action. If denied this opportunity, they will become dissatisfied, frustrated and stressed. Good ideas may be lost and productivity will suffer.

Establish an environment in which technicians and CSRs are free to express their views, question decisions, and disagree. Firm control and constant harmony don't result in effective customer service. Encourage staff to discuss controversial issues. Maintain an "open mind" policy along with an open door policy.

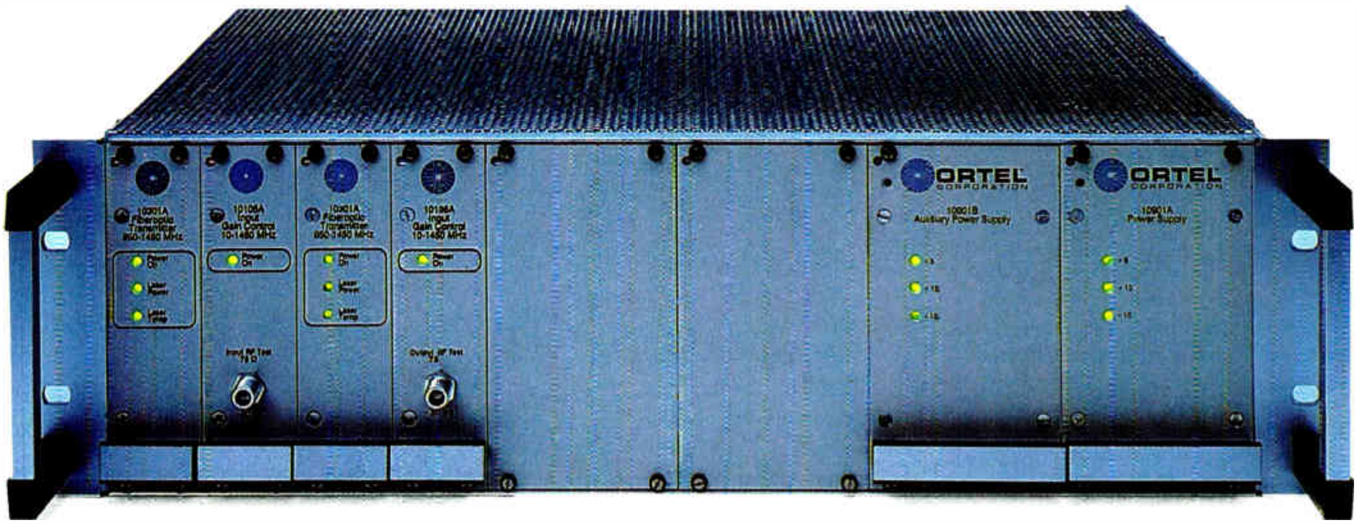
Guarantee frank discussions, without risk, by showing a sincere interest in what the staff thinks. Never get defensive. According to Deming, "Drive out fear, so that everyone may work effectively." Consider each suggestion seriously and provide a clear reply, either positive or negative.

Three excellent approaches to learn what's on staff members' minds and involve them in problem solving include:

Three communication tools

- Keep your antennas out. Wander around, observe performance and chat with your staff regularly. This is particularly revealing during peak work periods when strain reveals cracks in the system. Find out what problems the CSRs and technicians are facing and how they react under pressure. For CSRs, listen to their telephone conversations via service quality observations to find out about your customers' concerns and how they are being handled. Similarly, ride along with technicians to observe their performance solving customers' problems.
- Establish regular staff meetings to air problems or issues. Someone has to mind the store, so invite a few staff members to attend at one time and stag-

Freedom package.



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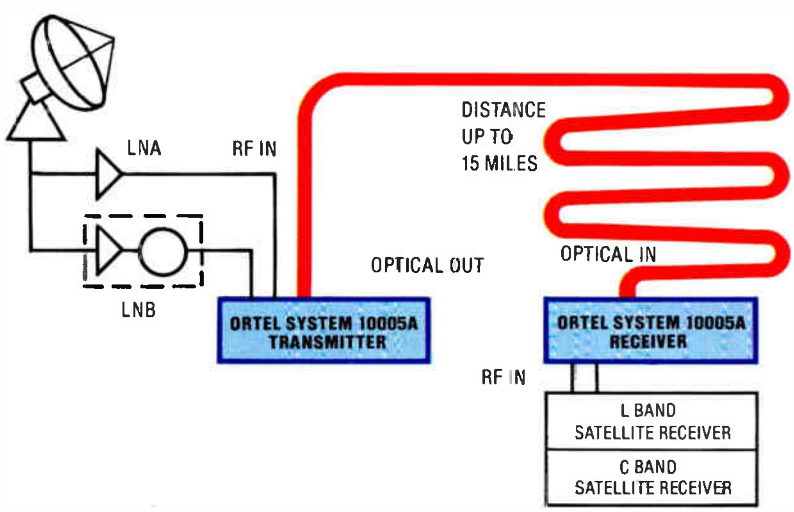

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ger the schedule of meetings so the entire staff may participate. Brown-bag lunches offer a relaxed setting, encouraging greater openness.

Ask a guest speaker from another cable system to talk about their solutions to specific problems. Encourage discussions.

- Create a competition for outstanding suggestions on improving service. Offer prizes, rewards or recognition. Large and expensive incentives are not necessary nor expected. One cable company awards the winner a parking space next to the general manager's for one month. Respond to all suggestions—even unworkable ones.

2. Set goals and measure performance. Prepare clear, dated, measurable and attainable performance objectives and evaluate each employee's performance accordingly. Many different quantitative benchmarks have been used in the cable industry to measure performance: the number of service calls completed; a CSR's telephone availability; the number of calls handled in a day; the amount of "talk time" involved in each call; or the number and dollar of sales.

Numeric goals are often misleading because they diminish the focus on quality. Many systems are getting away from talk-time and other numerical measures of performance. They recognize that it is often better to invest the extra time to solve a problem the first time rather than risk dissatisfying a customer or rolling a truck unnecessarily.

Cable employees, because of the abundance of negative feedback they receive from customers, may need extra recognition to keep them motivated.

Agree on a combination of qualitative and quantitative benchmarks to measure results and use them consistently to evaluate all staff members' performance levels. The results may be used as the basis for corrective action, encouragement, counseling, training and motivation.

Appoint a team

When you plan to establish a new performance policy, appoint a team from various levels of the company to help draft the policy. Get at all sides of the issue. Make sure they prepare unambiguous written goals and guidelines. Include the objective, what must be done, how to do it, and specific deadlines. Invite other staff members to review and question the details of the directive before it is finalized. Modify or improve it if better ideas surface. Monitor staff members to see how well they are complying and provide them with feedback.

3. Provide praise liberally and criticism with sensitivity. Everyone needs feedback on his or her job performance—some people more than others. A good manager is quick to let subordinates know what she thinks—for good or bad. Take the time to recognize the accomplishments of staff members. Your success depends on their cooperation. When you are commended by superiors, share the praise generously with your staff.

Unfortunately, cable employees, like other service providers, receive an abundance of negative feedback from customers. They may need extra recognition to keep them motivated. According to Kenneth Blanchard in the "One Minute Manager,"

"...the most important thing in training somebody to become a winner is to catch them doing something right—in the beginning approximately right and gradually moving them toward the desired behavior. With a winner you don't have to catch them doing things right very often, because good performers catch themselves doing things right and are able to be self-reinforcing."[3]

The opposite is also true. Criticize poor work as soon as it happens. Don't allow substandard work to continue. Be constructive, reminding your employee what the appropriate method should be. Discuss your future expectations. Allow him to express his view and probe for the cause of the problem. Don't beat around the bush—be clear. Your objective is to ensure that your staff member improves his performance. If necessary, offer assistance or training.

Use "no-fault" evaluations that emphasize the positive and employ coaching and counseling to improve your staff's performance. Evaluate everyone quarterly rather than annually to reinforce the notion of continuous improvement.

4. Delegate responsibility and authority. Every supervisor must learn how and when to let go of certain responsibilities and authority. This is often difficult for supervisors who worked their way up the ladder and are most comfortable doing rather than managing. But it is essential to give staff members the chance to solve their own problems—even if they make mistakes.

Nothing impedes an organization's ability to respond to customers' needs more than its failure to delegate. Motorola, the winner of a Malcolm Baldridge National Quality Award, has as one of its operating principles: "Push responsibility down the ranks of the organization."[4]

Prepare broad guidelines on refunds, credits, scheduling and so on. Allow employees a degree of independence and creativity in making decisions to help customers in cases where guidelines are unclear. From time to time, review the policies with your entire staff. Make sure all members understand the limits of their authority and ensure that they are behaving consistently. Have a roundtable to discuss new issues that are arising frequently so that everyone can work together to find solutions and own the outcome of decisions.

According to psychologist Mariquita Mullan, "People report feeling less stressed when they have latitude about how they do their job." A side benefit is that these employees have the highest morale, they are most satisfied with their work, and demonstrate a lower turnover rate.

5. Provide training. Ongoing, systematic training is a necessary component of good customer service. Deming recommends that organizations "encourage education and self-improvement for everyone." Well trained personnel are able to handle customers' needs quickly, effectively, and with a minimum of cost. Cable systems that emphasize training have improved their customer satisfaction leading directly to better community relations, and increased profitability through greater sales, higher subscriber penetration and retention, and reduced service calls.

Train regularly

Systematic training helps to continually improve the quality of performance and enable the company to remain competitive. It keeps the workforce current and motivated and provides for career development and succession planning.

In the best run organizations, creative technicians and CSRs are taught to be personally responsible for the success of their company:

- They learn the company's goals, values and traditional methods of operation so they can contribute to the company's effectiveness and strategic objectives.
- They understand their role in the company and why it is important. They understand the consequences of doing their job well or poorly. They know their responsibilities and how to use their authority within the prescribed limits to complete their tasks.
- They know how to relate to others in their own and other departments. They recognize and respect lines of authority. They understand the formal and informal procedures for getting results.
- They feel empowered to meet customers' needs creatively (even if it means making mistakes occasionally) so they can perform their tasks effectively without needing close supervision.

> In the best run organizations, creative technicians and CSRs are taught to be personally responsible for the success of their company.

A final message from Mr. Deming: "Management must be responsible for change." That means you! CED

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An overview of adaptive equalization

Equalization is key to making digital CATV work

As digital transmission over cable moves from the realm of the theoretical to the practical, the effect of transmission channel impairments on digital signals must be considered. Some impairments which have negligible effect on analog transmission can produce significant bit error rates in digital signals. Microreflections are an example of one such impairment.

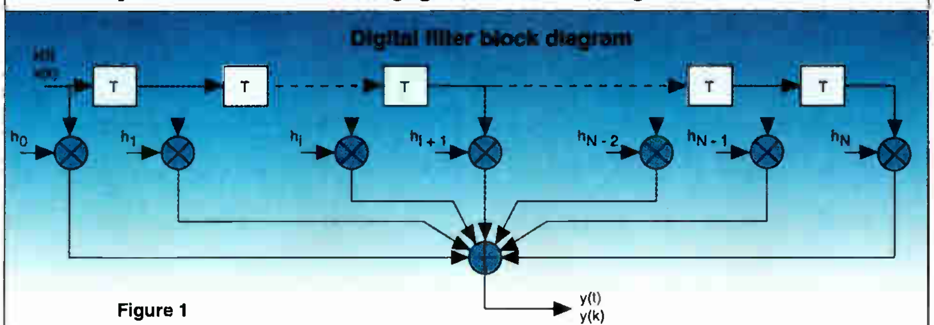


Figure 1

Microreflections

Reflections in a cable system may be produced by any or all of the following sources:

- Return loss of amplifiers and taps on trunk and distribution systems.
- Unterminated or misterminated drops.
- Return loss of subscriber equipment. This includes both active devices (cable ready TV receivers, VCRs and converters) as well as passive devices (splitters, A/B switches, etc.).

It has been shown via laboratory and field tests[1,2] that the major contributor to cable system reflections is the subscriber environment. Since these echoes are relatively short (less than 100 nS), they do not produce a noticeable effect on analog video signals. However, they can cause bit error rates in excess of 10^{-3} in digital transmission. In addition, echoes in the home may exhibit variations in amplitude with time.

Effects of consumer equipment

For example, if a cable ready receiver and the subscriber's digital converter are connected to a splitter which has relatively poor return loss and interport isolation, the effects of receiver input impedance changes attributable to channel switching will be observed as a change in echo amplitude at the converter input. In order to correct for the effects of reflections, it is necessary to incorporate adaptive equalization in the digital converter.

An adaptive equalizer is a special class of digital filter in which the coefficient values may be adjusted to compensate for the effects of echoes in a digital signal.

Prior to discussing the workings of adaptive equalization, however, it is helpful to review the characteristics of digital filters in general.

FIR digital filters

A block diagram of a digital filter is shown in Figure 1. The filter shown here is known as a non-recursive or finite impulse response (FIR) filter. There is another type of digital filter, called a recursive or infinite impulse response (IIR) filter, which is sometimes used. However, because the majority of adaptive equalizers are of the FIR type, we will confine our discussion to this type of filter. More information on both types of digital filters may be found in other reading[3].

The filter shown in Figure 1 consists of a tapped delay line (for example, a shift register) consisting of N+1 taps, with the output data from each tap being multiplied by coefficients $h_0 \ldots h_N$. The multiplier outputs are then summed to produce the filter output.

If each tap produces a delay T, then the filter output y(t) is related to the input x(t) by the equation:

(1) $y(t) = h_0x(t) + h_1x(t-T) + \ldots + h_Nx(t-NT)$

For a sampled signal with sampling period T, the output equation for the kth sample is:

(2) $y(K) = h_0x(k) + h_1x(k-1) + \ldots + h_Nx(k-N)$

or, more concisely

(3) $$y(k) = \sum_{i=0}^{i=N} h_i x(k-i)$$

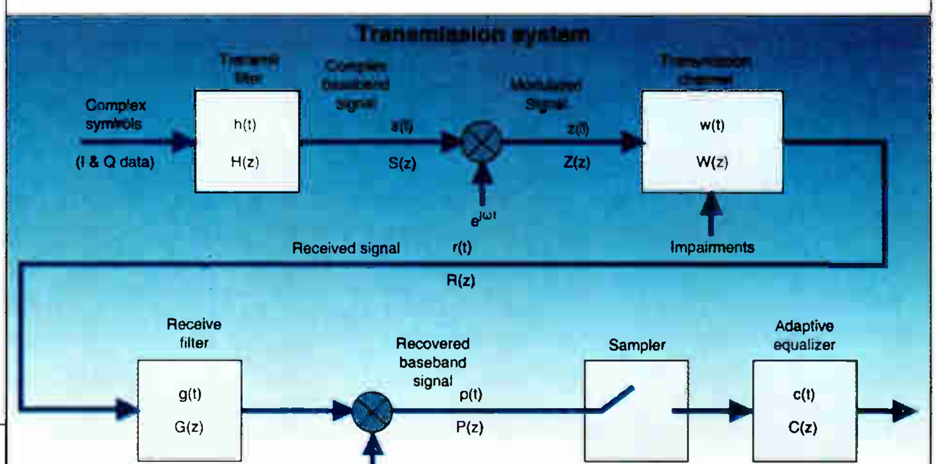
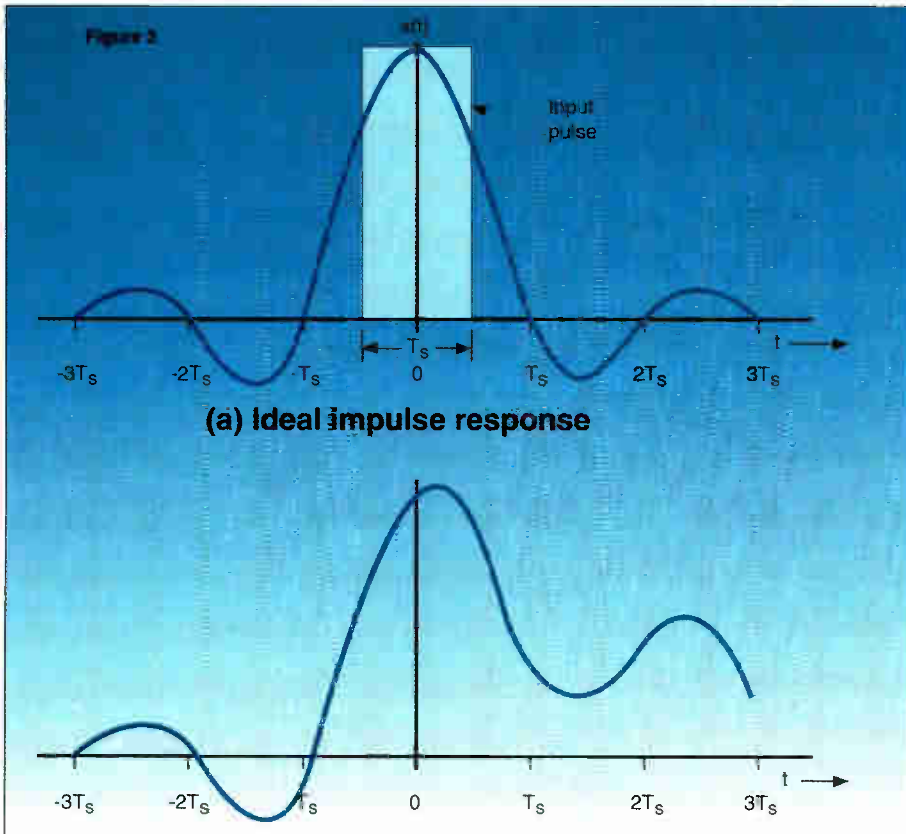


Figure 2

By Joseph B. Waltrich, Manager, ATV Systems, Jerrold Communications


Times Fiber is not your average hole in the wall company.



(a) Ideal impulse response

(b) Distorted impulse response

Equation (3) has the form of a convolution. Because the output of a system is defined as the convolution of the input with the system's impulse response, the values of the coefficients hi determine another important property of the filter: the impulse response. As the name implies, the impulse response of a filter is its output when the input is an impulse. Additional information on convolution and impulse response may be found in other reading 3,4.

The frequency response of a digital filter is given by the equation:

$$(4)\quad H(\omega) = \sum_{i=0}^{i=N} h_i e^{-j\omega i}$$

where ω = $2\pi f$ = frequency in radians/sec.

The quantity $z = e^{jw}$ is often used to define the z transform of a digital filter. That is:

$$(5)\quad H(z) = \sum_{i=0}^{i=N} h_i z^{-i}$$

The term z^{-i} represents a delay of i sampling periods. Therefore, the notation z^{-i} is often used in digital filter diagrams to indicate a delay of one sampling period.

Although the impulse response and the frequency response of a filter are interrelated, the function of an adaptive equalizer is perhaps better understood in terms of impulse response.

Figure 2 shows a simplified block diagram of a transmission channel. The I and Q data streams are filtered prior to transmission using a raised cosine filter. This filter is designed to optimize transmission bandwidth and minimize intersymbol interference. The impulse response of such a filter as a function of time is given by:

$$(6) \quad h(x) = \frac{\sin \pi x}{\pi x}\left[\frac{\cos(\alpha \pi x)}{1-4\alpha^2 x^2}\right]$$

where the input is an impulse whose width is equal to the symbol period Ts and:

$x = t/Ts$
α = filter rolloff

For a brick wall filter, $\alpha = 0$. In practice, the value of α is generally chosen in the neighborhood of 0.15 to 0.25. Figure 3 shows the impulse response of a transmission filter with $\alpha = 0.2$. From Figure 3a, it is seen that the impulse response of the filter is a maximum at t = 0 and is zero at multiples of the symbol period Ts. If this condition is satisfied then all symbols will pass through the same points at integral multiples of the sampling period and, at these points, any symbol will be unaffected by its neighbors. That is, there will be no intersymbol interference.

An eye diagram is formed from overlaid traces of small sections of the filtered signal. The points of maximum vertical opening of the eyes are those points through which all symbols pass.

Figure 4 shows a simple 2-level eye diagram for a signal without intersymbol interference.

Eye diagram - no intersymbol interference

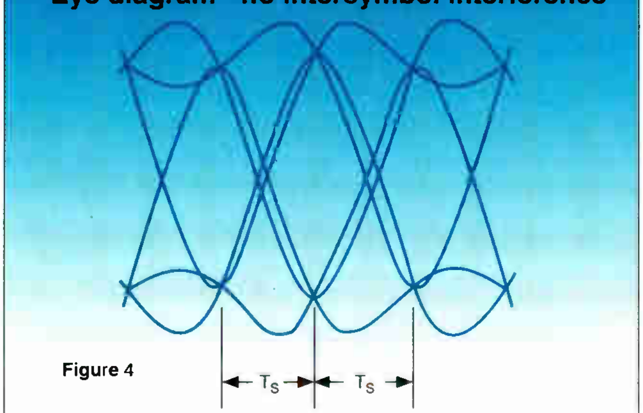


Figure 4

After filtering, the complex baseband signal s(t) is modulated and input to the transmission channel. The received signal r(t) is filtered and demodulated to recover a complex baseband signal p(t) which, in the absence of channel impairments, should be identical to the input signal s(t). If the channel contains impairments which produce amplitude and phase distortion, the impulse response will be distorted as shown in the example of Figure 3b and adjacent pulses will interfere with one another, causing the eye pattern to exhibit some amount of closure.

How it works

Adaptive equalization performs the function of restoring the system's impulse response to something close to the ideal by passing the signal through a filter whose coefficients are adjustable over time so as to accommodate the changing nature of impairments in the channel.

If the structure of the data stream is such that it is possible to send a training signal to the receiver and if the channel characteristics vary slowly with time, then adaptive equalization can be accomplished by a simple zero forcing equalizer. The zero forcing equalizer is a filter whose coefficients are updated only during the training sequence.

As the name implies, the equalizer tries to force the system impulse response to pass through zero at integral multiples of the symbol period Ts. The equalized impulse response is obtained by measuring the received unequalized impulse p(t) and determining the values of the filter coefficients c_i which will cause the impulse response to equal zero at multiples of T_s. For a sampled signal with sampling period T_s:

$$(7) \quad p_{eq}(k) = \sum_{i=0}^{i=N} c_i p(k-i)$$

where $p_{eq}(k)$ is the desired (i.e. equalized) response and p(k-i) is the (k-i)th sample of the received signal. If $p_{eq}(k)$ is set to zero everywhere except $p_{eq}(N/2) = 1$ (assuming N is an even number), then equation (7) yields a series of simultaneous equations from which it is possible to derive the value of the coefficients

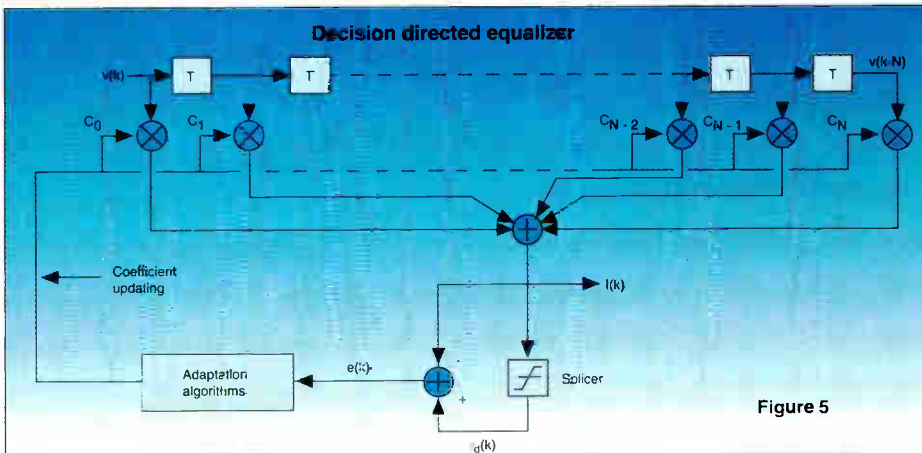


Figure 5

c_i.

For example, for a five-tap (N=4) equalizer, the equations would be:

(8)

$p_{eq}(0) = c_0p(0) + c_1p(-1) + c_2p(-2) + c_3p(-3) + c_4p(-4) = 0$

$p_{eq}(1) = c_0p(1) + c_1p(0) + c_2p(-1) + c_3p(-2) + c_4p(-3) = 0$

$p_{eq}(2) = c_0p(2) + c_1p(1) + c_2p(0) + c_3p(-1) + c_4p(-2) = 1$

$p_{eq}(3) = c_0p(3) + c_1p(2) + c_2p(1) + c_3p(0) + c_4p(01) = 0$

$p_{eq}(4) = c_0p(4) + c_1p(3) + c_2p(2) + c_3p(1) + c_4p(0) = 0$

Note that for a five-tap equalizer, nine input samples are required to calculate the coefficients. For an N tap equalizer, 2N+1 input samples would be required. Feher5 and Lee and Messerschmitt6 provide additional information on zero forcing equalizers.

The zero forcing equalizer works well in situations where the channel characteristics vary slowly with time and transmission of information can be interrupted in order to send a training signal and compute the equalizer coefficients. Unfortunately, a cable system does not lend itself well to this type of equalization.

The subscriber's home must be considered as part of the transmission channel and the characteristics of this portion of the channel can change rapidly with time due to channel switching, etc. Furthermore, it is not practical to interrupt transmission of digital video in order to send a training signal.

Therefore, a different adaptive equalization technique, known as decision directed equalization, must be used.

Decision directed equalization

A block diagram of a decision directed equalizer is shown in Figure 5. The filter is an FIR filter whose coefficients are updated, based on decisions made regarding the desired value of the output. The coefficient update process is as follows:

1. The actual filter output, I(k) is calculated based on some initial value of the coefficients.

2. The desired output, $I_d(k)$ is determined from the actual output. This may

be done by passing the filter output I(k) through a data comparator (shown in Figure 5 as a slicer) to generate the desired value $I_d(k)$. This operation constitutes the decision process.

3. The error e(k) between the desired and actual value is computed.

4. The error, in conjunction with other parameters, is used to calculate updated values of the coefficients.

5. The process is repeated until a minimum error is obtained.

Coefficient updating may be performed using any one of the following equations:

(9.1)
$c_i(k+1) = c_i(k) + \mu e(k)v^*(k-1)$

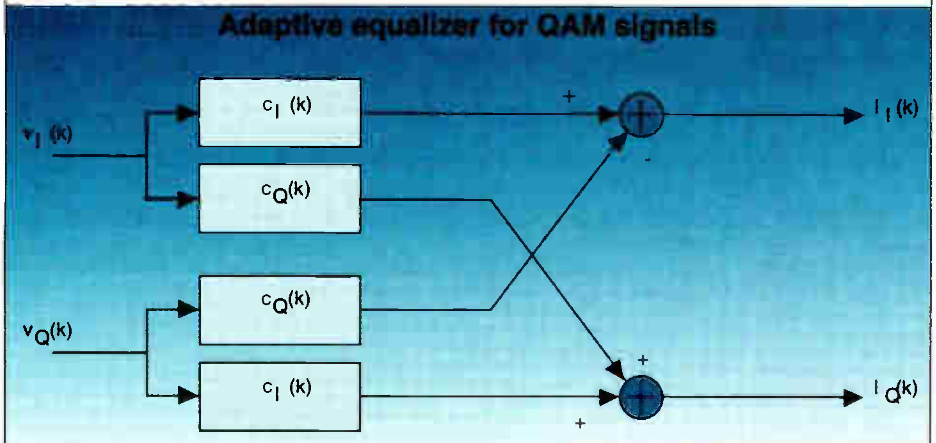


Figure 6

$I(k) = \Sigma(c_I(k) + jc_Q(k))(v_I(k) + jv_Q(k))$
$= \Sigma[(c_I(k)v_I(k) - c_Q(k)v_Q(k) + j(c_I(k)v_Q(k) + c_Q(k)v_I(k))]$

(9.2)
$c_i(k+1) = c_i(k) + \mu(e(k)v^*(k-1)$

(9.3)
$c_i(k+1) = c_i(k) + \mu e(k)\mathrm{sgn}(v^*(k-1))$

(9.4)
$c_i(k+1) = c_i(k) + \mu\,\mathrm{sgn}(e(k))\mathrm{sgn}(v^*(k-1))$

where $c_i(k+1)$ = updated value of ith filter coefficient

$c_i(k)$ = coefficient value for current sample

$I(k) = \Sigma c_i v(k-i)$ = actual filter output

$I_d(k)$ = desired filter output (estimated from actual value)

e(k) = Id(k) - I(k) = error between desired and actual filter output

$v^*(k-i)$ = complex conjugate of input v, at ith tap

μ = a constant, known as the step size.

Derivation of equations (9.1) through (9.4) may be found in Proakis7.

The use of $v^*(k-i)$ requires some explanation. In a QAM signal, the input v(k) may be expressed as a complex number, $v_I(k) + jv_Q(k)$ where $v_I(k)$ and $v_Q(k)$ are the in-phase and quadrature components of the input signal. In this case, the complex conjugate of v(k) is, of course, $v_I(k) - jv_Q(k)$. This results in complex values for the error and the coefficients. Table 1 presents an example of the coefficient updating process for a five-tap equalizer applied to a QPSK (4QAM) signal. In this case the desired inputs are 1+j, 1-j, -1+j and -1-j.

Table 1 presents an example of the first two iterations of the equalizing process. The equalizer is initialized by setting all but one of its coefficients equal to zero. The non-zero coefficient is set equal to one. In this example, the non-zero coefficient is chosen to be the center tap c_2, although this is not mandatory.

At the time of initialization, the equalizer's shift register contains the data shown in column 3 of the table. Since only c_2 is used for the first computation, the filter output I(k) is equal to the data value stored in the second delay of the filter's shift register (i.e.- v(k-2)). This rounds off to a desired value of $I_d(k) = -1 + j$.

The error e(k) and the data values from column 3 are then used in equation (9.1) to calculate the updated coefficients shown in column 4. The process is repeated using the new data input to the equalizer plus the previous data which has now been shifted by one delay interval.

Note that the absolute value of the error | e(k) | has decreased after the second iteration. This process is repeated until the error converges to a minimum value.

Because both the filter coefficients and the input are complex numbers, four multiplications are required in order to compute the filter output I(k). This means that four filter sections will be required to implement the adaptive equalizer as shown in Figure 6.

The example shown in Table 1 uses equation (9.1) for coefficient updating. Computation may be simplified by using signs rather than actual values for e(k) and/or v*(k-i). However, this may exact a penalty in terms of the time required for error convergence.

Table 1

Coefficient update example

		μ = .1		
k=		k		k+1
i	c_i	v (k-i)	c_i	v (k-i)
0	0	-.958 - j.758	.03 + j.002	-1.2 - j1.4
1	-	1.25 = j.973	-.007 - j.038	-.958 - j.758
2	1	-.82 + j1.166	.995 + j.035	1.25 = j.937
3	0	-.924 + j1.034	-.001 + j.034	-.82 + j1.166
4	0	-1 + j1.226	-.002 + j.039	-.924 + j1.034
I (k)		-.82 + j1.166		1.146 - j.959
I_d (k)		-1 + j		1 - j
e(k)		-.18 - j.166		-.146 - j.041
|e|		.245		.151

Step size

The equalizer convergence is also dependent on the step size. Too large a value of μ will result in an increase in the error with time. Too small a value will lengthen the convergence time of the filter. In practice, μ is usually chosen to be much smaller than in the example of Table 1. In some cases a so-called "Gear Shift Algorithm" is used. That is, a large value of μ is used for the initial computations, followed by a reduction in the step size after sufficient time for convergence has elapsed.

The length of the equalizer is dependent on the delay of the longest echo to be corrected. In general, the equalizer should be made somewhat longer than this value. It is not uncommon to design an adaptive equalizer to be two or three times the length of the longest echo. Additional information regarding equalizer hardware implementations may be found in Treichler, et al8

Hardware implementation of adaptive equalizers has recently been facilitated by the introduction of a number of digital filter ICs. Some examples of these chips are the Harris HSP43168, Genum GF9101, LSI Logic L642645 and the Thomson IMSA100. These devices contain from eight to 32 taps and provide up to 16-bit accuracy at data rates up to 45 MHz. Chips may be cascaded for applications requiring longer filters. The Thomson IMSA100 also performs other functions such as correlation, convolution and DFT operations.

To date, all digital TV systems developed in the U.S. have incorporated some form of adaptive equalization. This article has attempted to provide an overview of the subject. Considerably more information may be found in the reference material and other publications. **CED**

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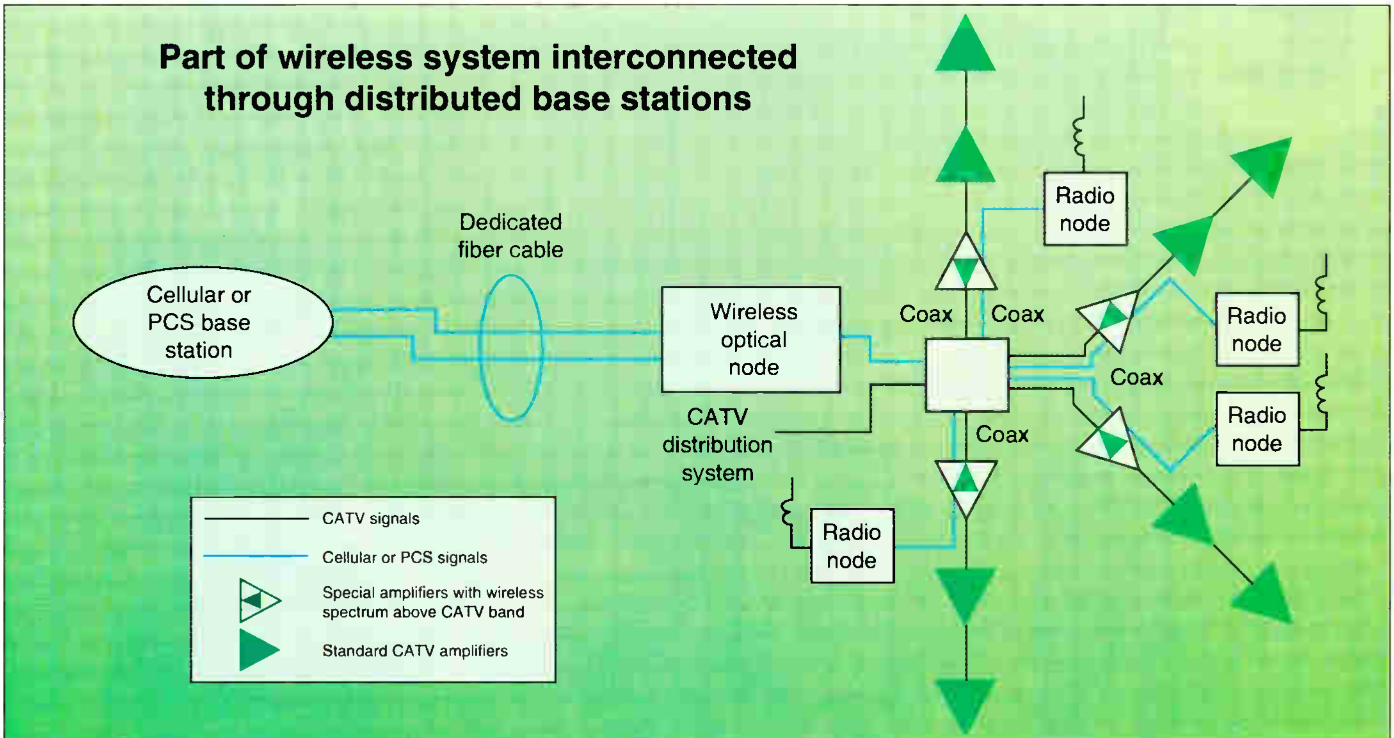

Detail of Comcast's PCN trial.

from aggregated noise," Huff explains.

• **Limited coverage from CATV strand-mounted antennas.** Currently, strand-mounted antennas sit about 18 to 20 feet above the ground. That may not be high enough, Huff says. "In many cases, it makes a lot of difference to be up twice as high, or at 36 feet above the ground," Huff says. "We've seen cases where doubling the antenna height triples coverage. That's an economic trade-off that a PCS or cellular operator has to go through." The remedy, Huff says, is to obtain access for higher antennas on nearby poles or structures, where applicable.

In summary, Huff explained that the key to success will be establishing a contiguous coverage area for future PCS users. "People won't want islands of service," Huff says.

Compression

Continuing the discussion on emerging technologies was Jerrold Director of Advanced Television Joseph Glaab, who updated the audience on the progress of HDTV testing process going on in Alexandria, Va.

"HDTV is a very hot topic now that the FCC is trying to adopt a standard that will likely be adopted globally," Glaab said at the meeting. Generally, the FCC has defined an HDTV transmission method as a signal that fits into a 6 MHz channel, provides immunity to adjacent and co-channel interference, with high picture and sound quality.

At the time of the meeting, Glaab updated attendees on the current testing status of the six proponents:

• Narrow Muse, NHK/Japan Broadcasting Corp.—testing complete.
• DigiCipher, General Instrument (digital)—testing complete.
• DSC-HDTV, Zenith Electronics Corp./AT&T—testing complete.
• ADTV, Advanced Television Research Consortium—being tested (*testing since completed*).
• ATVA Progressive System, Massachusetts Institute of Technology/ATVA—on the docks, waiting to be tested (*presently under test*).

One of the problems encountered during testing, Glaab explains, was the fair and equal testing among different submissions. "It took about six months before they could find an effective scan convertor," Glaab recalls. "And that's only how you scan it; there are lots of other factors to test."

Competition

Wrapping up the meeting was the dynamic Stanley Greene, now a regional vice president of Suburban Cable but interestingly, a former Bell of Pennsylvania employee. Speaking on the cable's technological future, Greene warned attendees to pay close heed to local legislative happenings.

"The telcos are winning over the legislators—that's clearly not good," Greene said. "They're putting out the perception that fiber optics is synonymous with telephone. The average person believes this."

As an example of how effective telcos are at wooing legislators, Greene showed the audience a newspaper clipping touting a seminar titled "The Infrastructure of the Future: Can Pennsylvania Keep pace?" Notably, the seminar was hosted by Bell of Pennsylvania and a state legislator. "Talk about having legislators in your back pocket!" Greene commented.

To that end, Greene is active on the Pennsylvania Cable Television Association's task force to combat "the kinds of (political) things telcos are doing."

"The race isn't cable getting into cable telephone, or vice-versa," Greene explains. "The race is who will put together this comprehensive communications system first?"

That's why, Greene advises, cable's technical employees should start envisioning themselves as *communications* engineers, not cable engineers. "We have to realize, sooner than later, that we're in the communications business, not the cable business," Greene says.

In closing, Greene offered this advice to those attendees active in fiber optic deployment: "If fiber is the great equalizer, then we need to deploy it as quickly as possible, so we can do more things with it. That way, we're better positioned for the future." **CED**

By Leslie Ellis

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Maintaining video playback systems

If laser disc players aren't in the budget, following these guidelines can extend the life of videotape machines

System reliability and picture quality are two major concerns with any playback system. The weakest link in a system are the video players. Being mechanical in nature, they have the highest susceptibility to failure and need to be constantly maintained to ensure their performance and reliability. The system operator must first develop, then carefully follow a preventive maintenance program for the players (based on manufacturers' recommendation). It is also helpful to have at least a basic understanding of the equipment's operational aspects.

Tape players

A video tape is composed of tiny magnetic particles bound adhesively to a polyester or plastic backed material. The density and quality of the magnetic material determines the quality of the tape. As the tape is thread throughout the player, it passes through and makes contact with pinch rollers, capstans, cylinders and heads.

When tape passes over the upper cylinder, the playback heads read the polarity of the magnetic particles on the tape, translating them into video and audio signals. The point of this simplified explanation of tape playback is that the extensive amount of contact between tape and machine parts has a direct impact on machine performance over time.

As a tape is played over and over, magnetic particles fall off and attach themselves to various parts of the internal assemblies. A buildup of these particles over time will affect machine performance as well as tape quality. Therefore, a conscientious program of preventive maintenance is imperative for the reliability of any playback system.

By Quintin Williams, Senior Systems Engineer, Pioneer Communications of America Inc.

As a tape is played over and over, magnetic particles fall off and attach themselves to various parts of the internal assemblies.

Maintenance guidelines

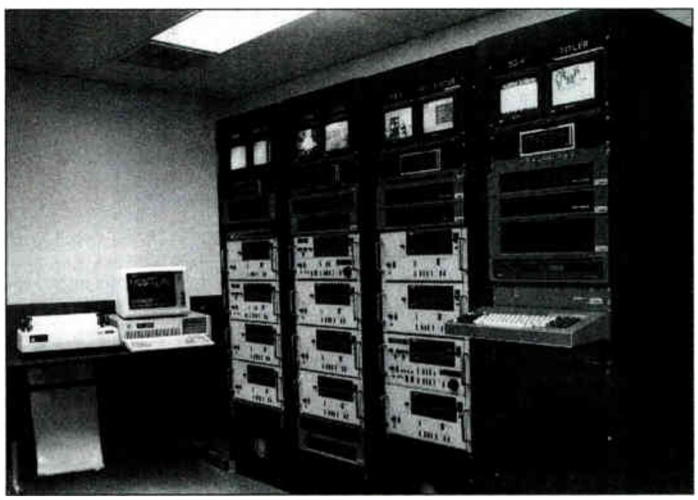
Here are a few helpful recommended guidelines in conducting preventive machine maintenance:

1. Perform a visual inspection of belts, pinch rollers, heads and tape guides on a weekly basis.
2. Clean all audio heads, control heads, playback heads, pinch rollers, capstans, tape transporters, and the drum on a daily or weekly basis (as required).
3. Check tension and sensor adjustments every three to five weeks to ensure that proper tension is applied to the tape.
4. Replace brake assemblies every three months, or as required.
5. Replace belts, pinch rollers and solenoid assemblies every six to eight weeks or as required.
6. Replace the head assembly per manufacturer's recommendations.

The cost of replacement parts varies depending on the manufacturer and model number. Therefore, it is difficult to determine an average repair cost of a tape player. However, before purchasing a tape player, contact the manufacturer and request a maintenance chart on your particular player. The information provided will contain the recommended maintenance schedule required to prolong the life of the machine.

Video disc players

The most recent opponent to enter the playback arena as a source of video and audio delivery is the video disc player. An understanding of the operation and maintenance requirements of a video disc player is essential in determining the advantages of using video disc technology as a reliable source for playback.



VTR machines generally receive the most wear and tear in commercial insertion applications.

All video and audio information on a video disc is read via laser beam, similar to the method used in compact disc technology. Degradation of the recorded medium over time or mechanical deterioration of the optic system will not occur primarily because there is no direct contact between the optic receiver and video disc.

A routine preventive maintenance program for maintaining and cleaning video disc players is not essential nor is it recommended by the manufacturer. Video disc players do not contain belts, rollers or heads which periodically need to be lubricated, cleaned, aligned, degaussed or replaced as do tape machines.

Most manufacturers *do* recommend that the devices be operated in a temperature controlled, dust-free environment to achieve long-term optimum performance. Periodic cleaning of the optic lens is not recommended by the manufacturer as long as favorable environmental conditions exist in the headend.

Some high-end industrial grade video disc players are designed and built to run continually, 24-hours a day. According to maintenance schedules based on mean time to failures (MTTF), four assemblies on this device may need to be replaced over a period of time (this may vary by manufacturer.) Replacement times for these assemblies are approximately one hour each. The assemblies are as follow:

> A routine preventive maintenance program for maintaining and cleaning video disc players is not essential.

1. The optical pickup assembly, otherwise known as the laser assembly, has a MTTF of 13,500 hours (equal to 18 months of continuous operation). It is the costliest assembly to replace, at a retail price of $135.
2. The spindle motor assembly, responsible for rotating the video disc at a continuous 1,800 RPM has a MTTF of 20,000 hours (equal to 27 months of continuous operation).
3. The tilt motor assembly, responsible for ensuring that the optical pickup assembly tracks parallel to the video disc, also has a MTTF of 20,000 hours.
4. The loading motor assembly, which operates the loading tray, has a MTTF rated at 20,000 hours.

The average yearly cost of maintaining this particular video disc player is estimated at 10 percent of the original cost of the player itself.

Studies comparing the annual maintenance cost of tape and video disc players reveal that the percentage of repair cost to equipment cost on video disc players is much lower. Add to that the exceptional video and audio quality delivered by a video disc player and the benefits of video disc technology become even more evident.

However, if traditional video tape machines are a part of your system's current program, it is advisable to maintain them as directed on a regular basis. The end result will be fewer machine breakdowns and, consequently, better performance. CED

Safety in the workplace: fact or fantasy?

In 1990, American industry set a record for the number of occupational illnesses and injuries in the workplace. During the same period, cable television had more cases, lost workday cases, non-fatal cases without lost workdays, and lost workdays per 100 full-time employees than the telephone and electric industries. Before someone declares this information to be false, incorrect, or tainted for use as a scare tactic, the source of this information should be disclosed.

OSHAct

Each year, businesses with more than 10 employees report all occupational accidents and injuries to the Department of Labor in order to comply with 29 CFR 1904.1 of the OSHAct. This information is recorded by standard industrial codes (SIC), thereby making it easy to report, compile and evaluate the data. SIC 48 is for all communications combined, 481 is for telephone communications, 484 is for cable and pay television services, and electric is found under SIC 491.

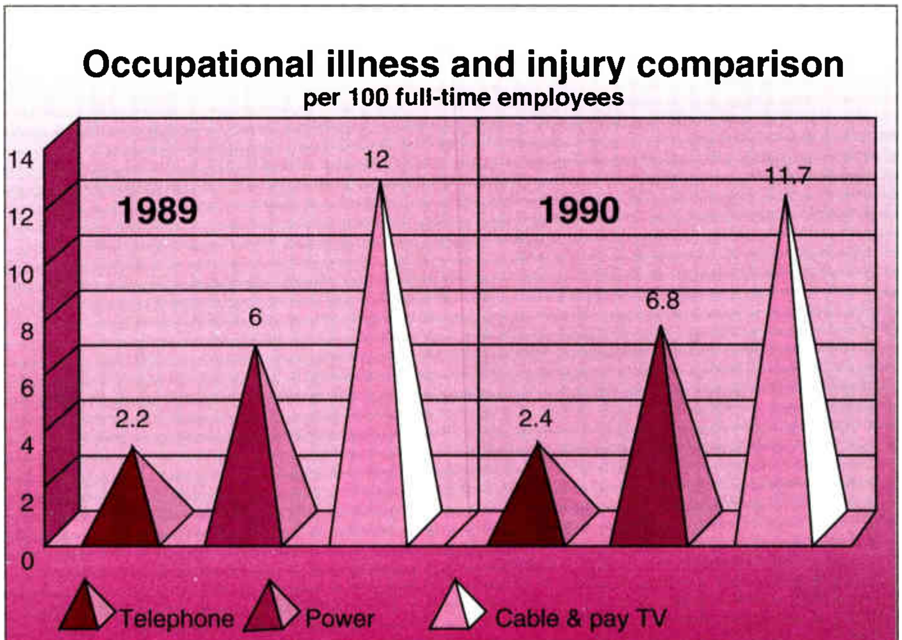


Figure 1

Support from the top

The questions have been asked, "How do you get management to understand the importance of safety in the workplace?" and "How do you get management to support safety in the workplace?" Some may think these are absurd questions because management *always* professes that safety is very important. The National Safety Council recently published several articles concerning the reasons for the failure of otherwise sound safety programs.

The reason cited most often for safety program failure was lack of top management support.

Lip service

If any executive or manager is asked if they support safety in the workplace, the answer will most likely be: "Nothing is more important than the safety of the worker," or a similar comment. In the real world, safety gets more lip service than real attention.

Managers are concerned with meeting budgets while supervisors are concerned with pleasing managers, and in turn, field personnel are concerned with getting the job done and keeping the supervisor happy. For some mysterious reason, few managers appear to understand proactive safety practices vs. reactive safety or the fact that fewer injuries in the workplace directly affect the bottom line. Restated in simple terms, less injuries improve productivity and morale while reducing insurance costs and lost time.

Safety is one of those issues that most businesses profess to support without reservation; unfortunately however, they tend to deal with safety *after* the fact, causing them to be reactive and often looking for someone on whom to place the blame rather than focusing on the real cause of the accident or injury. This most often occurs when an employee is seriously injured, the company is severely fined for violating safe working standards or, even worse, someone is killed or disabled.

Set a good example

There are other reasons safety programs often fail and they all tend to point to a lack of support by management. A very simple example of this is when the system manager decides to "get in touch with what is happening in the field." He or she goes to a job site where hard hats are required, walks around asking questions, providing that pat on the back and the "good job, keep it up" support. He/she does this without giving the slightest thought to wearing a hard hat.

The message sent is clear—safety applies to the worker in the field—not to managers, and therefore safety is not an important issue. OSHA also contributes to poor safety practices by not consistently applying safety standards when conducting inspections. State inspectors tend to inspect more and fine less while offering advice to correct problems in the workplace. On the other hand, federal inspectors inspect less frequently, write more citations and assess larger fines.

Of the 23 state-operated OSHA programs, all but one is under review for failure to comply with minimum federal health and safety standards. Some states would prefer to continue the state-operated OSHA programs while others

By George F. Taylor, Principle, Taylor Morris Associates

would happily dump the problem back in the federal government's lap. Manpower, time and money restrict both state and federal agencies from conducting more inspections and enforcing the standards.

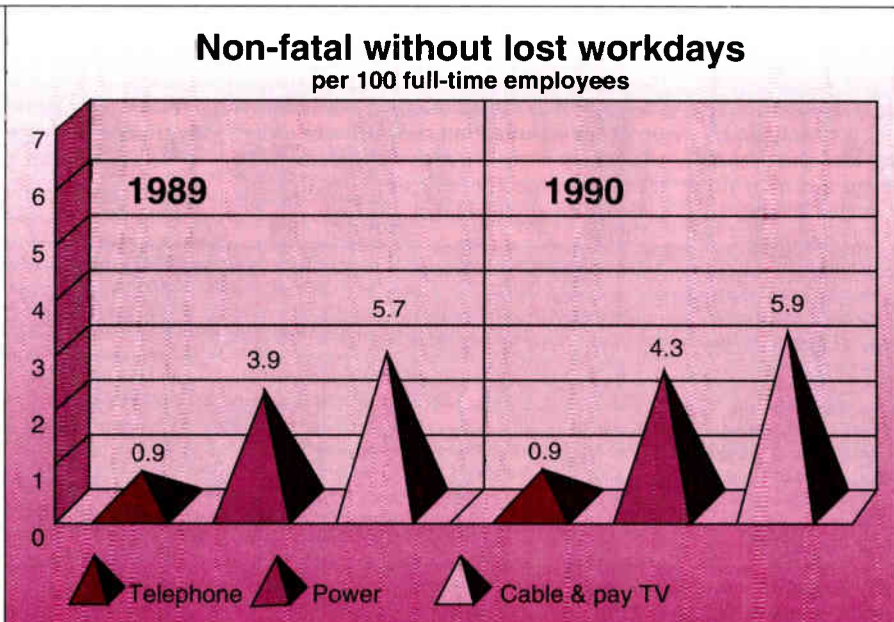


Figure 2

Blissful ignorance?

Because it is impossible for state and federal OSHA inspectors to inspect *every* business, many managers hold to the theory that because they have never been inspected and the odds of being inspected are very low, they don't have to worry. Therefore, they do little or nothing with regard to safety. Equipment that should be replaced continues to be used, required training is never provided, and safety programs that should be updated and enforced are disregarded.

In the meantime, workers' compensation claims continue to be filed for injuries that could have easily been prevented—all because safety issues are not taken seriously.

When businesses *do* concern themselves with safety, they tend to focus on the safety of field, warehouse or laboratory personnel with little, if any, concern for the office worker. Obviously, office safety issues are different from those relating to field and warehouse workers; however, the issues are real and are as pertinent as those associated with other work areas.

Consider what safety issues exist for the customer service representative who sits in front of a computer all day, or the secretary who replaces the toner in the copy machine, or the convertor repair person who is exposed to some type of chemical eight or more hours a day while cleaning convertor housings? These are only a few of the safety issues that are often overlooked.

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A little competition never hurts

Editor's note:
Recently, KBLCOM and its systems in Minneapolis, Minn; Portland, Ore., Garden Grove, Calif., Torrence, Calif., San Antonio, Texas and Laredo, Texas held a detailed technical competition. The goal was to enhance signal quality via friendly competition between the systems.

Rick Clevenger, KBLCOM vice president of engineering, devised the competition, scoring method and points to be tested. Allen Anderson, director of technical services, tabulated the points and administered the competition.

In the outcome, Minneapolis won the overall competition for total points, while Portland captured the Master Control area and Minneapolis the headend area. San Antonio claimed the field portion of the contest.

The competition presented some creative ideas on how to perform and present objective testing of picture quality. We thought it was a novel approach, so we asked Paragon's Rich Henkemeyer and Matt Haviland, of the Minneapolis system, to describe what happened during the competition:

We rented a motorhome for comfort and convenience during the plant portion of the contest. In it, we loaded a Tektronix VM-700, a precision demod, a dot matrix printer, a Tektronix spectrum analyzer, a 13-inch television and the necessary cameras, film and supplies. Once all that was packed, we barely had enough room for each member of the team to gather 'round and witness the results.

Although we got some very strange looks from some of the citizens, once they saw the magnetic Paragon Cable System Testing signs, they wanted a job like ours!

Each city invited a visiting witness from another system to choose any two test points from a possible 12, located at the deepest portions of the system. The "home team" chose the next four from the same list, totaling six locations to be tested and scored.

Everyone agreed that the VM-700 with a precision demod in front of it would be a good source for reading the signal-to-noise ratio. Because we had already used it for testing in the headend and master control, we felt comfortable with the readings.

Besides signal-to-noise, we also tested for cascade linearity using a Tektronix spectrum analyzer and a polaroid camera; 24-hour level variance using a SAM-1000; and subjective picture quality with a 13-inch Toshiba television and a Zenith Z-View convertor.

Each test location could score a maximum of 250 points, as follows:

Test	Points	Spec
S/N	90	+3dB/-2dB
24-hour level	80	
Cascade Lin.	80	N/10 + 3dB

Plus, an additional six bonus points for subjective picture quality (to be counted only in case of a tie).

Headend

The "headend" signal quality audit was performed on all modulators in the headends. Performance criteria was predetermined, and a point system awarded for each specification weighted to importance of overall picture quality. A total of 250 points could be accumulated for each modulator.

A pass/fail for each of 16 criteria was awarded, with a "pass" receiving all criteria points and a "fail" receiving zero points. The tests were performed using the Tektronix 1910 digital generator inserting VITS to program the video at the first insertion point of baseband video. The tests on each modulator were performed at the headend system combined output using a Rhode & Schwartz precision demodulator in conjunction with the video analyzer to perform the VITS analysis for each video specification.

A hardcopy of each modulator was printed from the data compiled. All modulators were tested during a six hour period in all headends.

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VM700A Video Measurement Set
Channel C Paragon Audit

Paragon Audit			*Violated Limits* Lower	Upper	
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2T Pulse k-Factor	1.3	% Kf			
S/N Unif Lum-Wghtd	56.9	dB			RMS
Chroma-Lum Delay	60.5	ns			
Chroma-Lum Gain	101.0	%			
Differential Gain	1.55	%			At 37 % APL
Differential Phase	1.76	Deg			At 37 % APL
Lum Non-Linearity	1.28	%			At 37 % APL
FCC Multiburst Flag	99.4	% Bar			
FCC MB Packet #1	58.7	% Flag			
FCC MB Packet #2	61.9	% Flag			
FCC MB Packet #3	63.1	% Flag			
FCC MB Packet #4	62.4	% Flag			
FCC MB Packet #5	61.1	% Flag			
NTC7 20 IRE Chroma	20.1	IRE			(Ref 40 IRE Chr)
NTC7 80 IRE Chroma	79.9	IRE			(Ref 40 IRE Chr)
NTC7 Chr NL Phase	0.3	Deg			
NTC7 Chr-Lum Intmd	-0.0	IRE			(Ref Lum Pedestal)

Figure 1

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Partnership for a Drug-Free America

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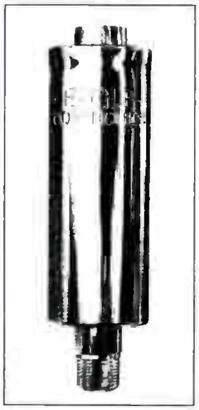

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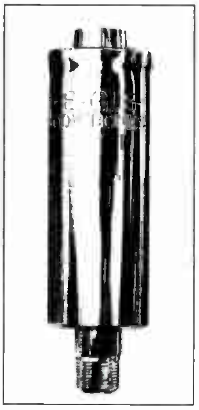

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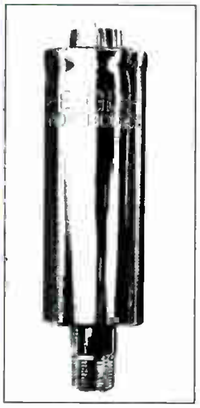

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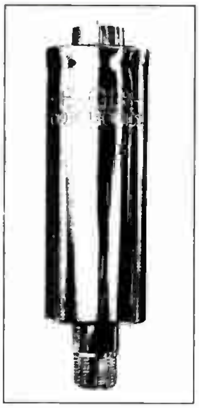

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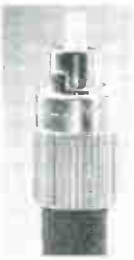

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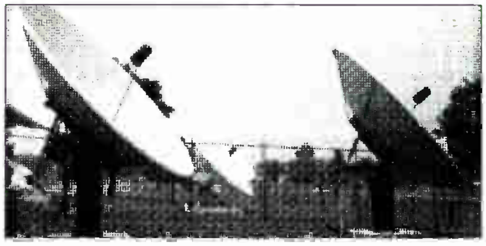

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CABLE EQUIPMENT

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Wired or wireless?

There is a notion abroad in the land that wireless telecommunications systems could actually displace wire-based systems, whether copper pairs, coaxial cable or optical fiber.

The trend toward tetherless telephones and wireless LANs and PBXs is accelerating toward a new era in personal communication. Fleet communications are exploding in a crescendo of specialized mobile radio systems. Geosynchronous satellites are being jammed together with only 2 degree longitude separation, a mere 950 miles while speeding through space at 7000 miles an hour. Soon we will be using low-earth orbiting satellites for a kind of global cellular communications. Lifeline communications for utilities are still provided by fixed point-to-point microwave. We even have "wireless cable," an oxymoron if ever there was one.

Wireless communication

In the century since Guglielmo Marconi (1873-1937) invented wireless communication, we have learned a great deal about its enormous capability. Even the imaginative and creative Marconi would have been astonished at the uses to which we have put this phenomenon. Yet, we have also learned about its limitations. Because of the myriad unquantifiable vagaries to which it is subject, radio propagation is usually expressed in statistical terms involving averages, probabilities and deviations.

Between fixed points, radio linkage can be engineered to provide communication at least as dependable as wire based linkage, if not actually better. But radio links serving mobile stations, or broadcast transmissions to all locations within an area cannot be engineered to provide equally dependable performance at all times and locations.

Wire based transmission paths will generally subsist wherever the importance of dependability outweighs the need or desire for mobility. Under pressure for scarce spectrum, wire lines could even replace existing fixed point-to-point radio links where mobility is not an issue. There appears to be a growing demand for freedom to communicate without the umbilical cord. But there is also an intrinsic tradeoff between mobility and dependability. Will cordless telephone users, for example, simply learn to accept the existence of dead zones, fading, and perhaps even interference?

> Wire based transmission paths will subsist wherever the importance of dependability outweighs the need or desire for mobility.

The traditional policy, not always practiced, has been to preserve the radio spectrum for necessarily mobile communications. Considerations of cost and convenience, however, have led to substantial spectrum allotments for non-mobile point-to-point microwave and entertainment broadcasting.

For example, point-to-point microwave is surely a more convenient and less costly way to communicate across the desert, penetrate rugged mountains, or traverse the Big Cypress Swamp than placing copper or fiber cables. But not all fixed microwave relay paths are geographically so difficult.

Television services, currently using the largest block of radio spectrum, are now available on broadband coaxial and fiber cables to more than 95% of all households in the United States. Radio broadcasting, both AM and FM, are now serving a largely mobile audience. But although portable television sets are used at the beach, in mobile homes and recreational boats, television is still predominantly a fixed service.

The unlimited spectrum

The electromagnetic spectrum is not really a scarce natural resource. What is scarce is the portion of the spectrum we know how to use effectively, and profitably. In 1920, nothing shorter than 100 meter wavelength (above 3 MHz) was considered useable. Let the amateurs have it: it's worthless. In 1940, 75 MHz was considered "ultra-high frequency."

The crunch is not a shortage of spectrum; but rather, not knowing how best to use the micrometric wavelengths, profitably. This will change. But meanwhile, a bitter struggle will continue for control of the presently most useful VHF/UHF spectrum, 30-3000 MHz. The outcome will be strongly influenced by political power, which is not entirely divorced from the "public interest."

Already, FCC has indicated that the improved information transfer efficiency of HDTV will free up the 72 MHz allotted to television in the 54-88 MHz and 174-216 MHz VHF bands. The 673 VHF stations, presently operating on NTSC standards, would move to the UHF band 470-806 MHz, with HDTV standards.

Are consumers more likely to settle for over-the-air HDTV broadcast at UHF, or wire-based HDTV distributed by cable TV, or even by telco BISDN? The political power of land-mobile radio has fought relentlessly, and with considerable success, for the release of unused UHF television channels. On the other hand, users of fixed point-to-point microwave are lobbying vigorously to protect the 2 GHz band from the PCS marauders.

Cable TV is comfortably independent of radio spectrum allotments, except for satellite relay facilities that are staunchly defended by powerful allies. Broadcasters are trapped between the inexorable march toward new television standards, the daunting prospects of wired HDTV distribution, and the vision of land mobile wolves salivating over the release of the VHF TV bands in 15 years.

Wired or wireless? Stay tuned. CED

By Archer S. Taylor, Director and Senior Engineering Consultant, Malarkey-Taylor Associates, Inc.

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