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Inside: Orbital Arc Chart

CED

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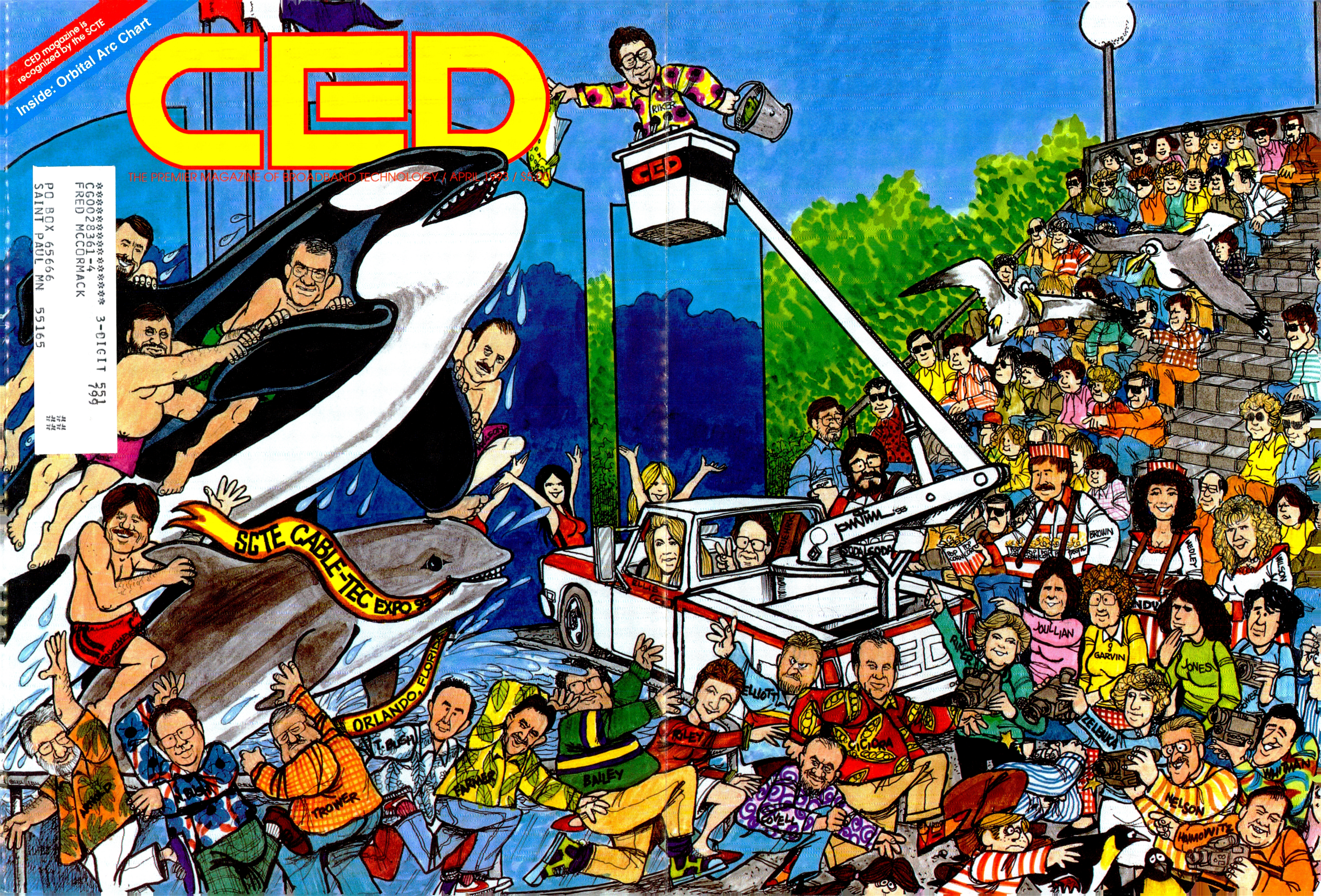

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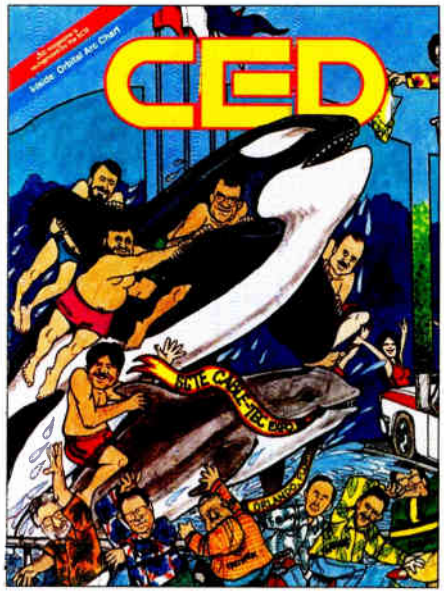

About the Cover:
The SCTE staff and board members find fun in Orlando. Illustration by Rob Pudim.

DEPARTMENTS

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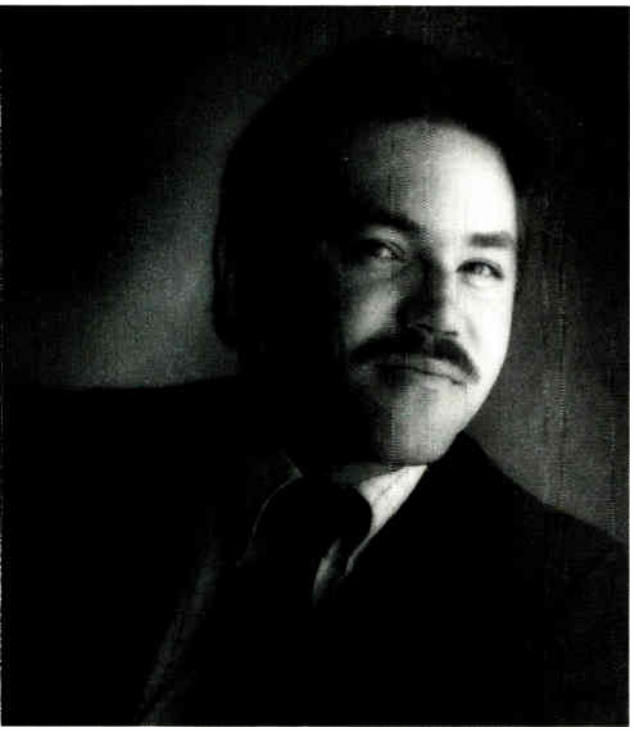

Jerry Neal
Senior Software Engineer
Pioneer Communications of America
Cable Systems Division

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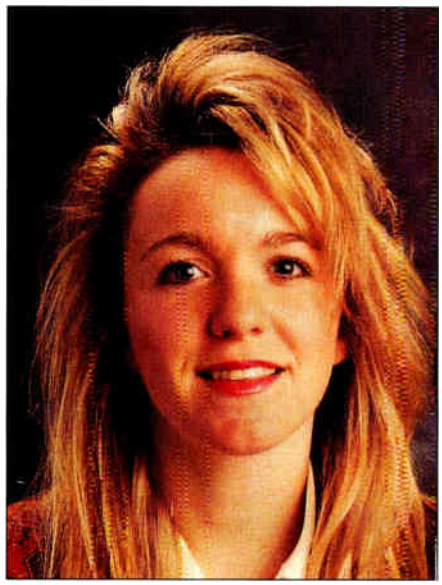
Involvement isn't torture

Recently, the SCTE's Emergency Broadcast System subcommittee penned a document to the FCC regarding cable's involvement in this potentially costly—and potentially mandatory—endeavor.

The SCTE's Interface Practices Subcommittee, meanwhile, has been working for some years to define standards and test procedures that will assist and/or affect virtually everyone within the technical community. It has single-handedly put together a weighty binder that summarizes the industry's testing and standardization procedures.

And, the SCTE's Design and Construction Committee has segmented itself into four subcommittees to design tools for engineers and techs.



This is just a sampling of the volunteer effort going on in the halls and hotel meeting rooms of most cable trade shows. So what's wrong with the picture?

It's the same group of volunteers, time and time again.

Year after year, gathering after gathering, the same mix of people—mostly vendors and a handful of dedicated operators—don a smile and wearily raise a hand when the inevitable question arises: "Are there any volunteers?"

As a journalist who has covered these efforts for nearly three years—stalking convention halls and finding the same core groups of people nipping away at solutions to benefit the industry—I find the level of volunteer effort embarrassing.

There seems to be several misconceptions here. First is the notion that volunteering is "too much work"—that getting involved will put an end to personal activities because there won't be enough time in a day to do it all. Sure, expending a little extra effort can take a few hours per month away from other activities. But it's also an opportunity to contribute something worthwhile to an industry that, ultimately, puts the meat next to your potatoes at night.

Second is the idea that committee work must happen by appointment. Anyone who has attended a committee meeting knows this is clearly not the case; simply showing up an actived brain is sufficient and welcomed.

Frankly, I'm tired of having to constantly encourage MSO-involvement in volunteer groups. So—at this year's Expo, please make it a priority to *get active* in SCTE doings. A complete listing of meeting schedules can be found on page 124. Getting involved really isn't painful—and you just might be surprised at what you learn.

Leslie Ellis
Managing Editor

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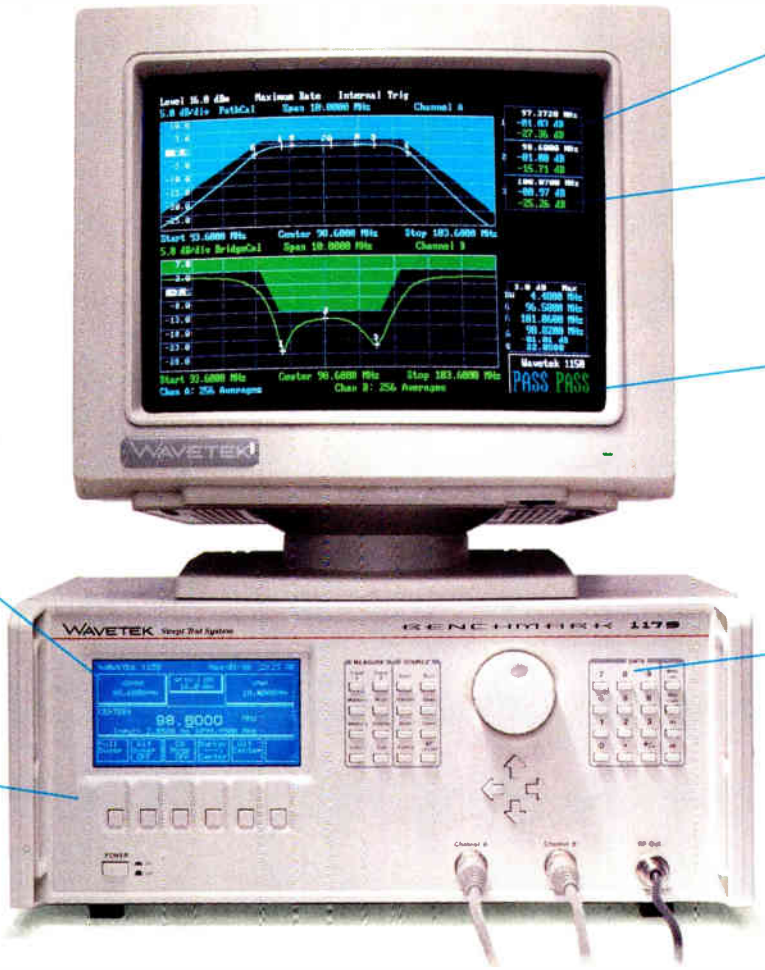

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Cablevision maps strategy to build advanced network

Cablevision Systems Corp. announced last month it has committed to deploying an advanced fiber optic network utilizing 750-MHz distribution equipment throughout its flagship metropolitan New York and Long Island systems. The sprawling system represents the largest deployment of 750-MHz technology to date and represents yet another version of the "information superhighway" being built by cable MSOs to support a wide range of video, voice and data services.

The company plans to offer subscribers 77 channels of standard analog video while keeping 200 MHz in reserve for digitally compressed programming as well as other potential services. According to Wilt Hildenbrand, Cablevision's vice president of technology, the system will use the traditional 5 MHz to 30 MHz return band to facilitate two-way communications with end users. He said the 25 MHz located there will be more than needed to handle transmissions from the 500-home nodes being served by fiber.

However, should it be needed, Hildenbrand said additional return spectrum could be carved out about 750 MHz by installing diplex filters, thereby avoiding the need to upgrade amplifiers to handle higher frequencies.

Cablevision has been upgrading its metro New York and Long Island plants with fiber for some time now. It is unique because the MSO has embraced fiber gear that operates at 1550 nm instead of 1310 nm to take advantage of fiber's attenuation characteristics and to deploy optical amplifiers at distribution hub sites (see "Rethinking traditional CATV architectures," *CED* Sept. 1990, p.50).

Cablevision has just completed the first phase of its Long Island rebuild by interconnecting its systems with fiber supertrunks and extending fiber into neighborhoods. Next up is completion of the Long Island rebuild and Yonkers. Officials said that the company's Connecticut systems, which have experienced a shortage of bandwidth, will also be upgraded to 750 MHz.

Cablevision brought out its most senior executives to make the announcement. According to a press report in *Multichannel News*, Chairman Charles Dolan said, "This isn't a test or a demonstration of advanced network technology for 4,000 households." That was a clear reference to Time Warner's much publicized Orlando, Fla. project, which promises to deliver a wide range of services via fast-packet switching. Instead, Dolan said this system will serve 1.1 million subs in New York, Connecticut and New Jersey.

Beyond standard video, Cablevision plans to connect State University of New York at Stony Brook with Cold Spring Harbor Laboratory and Brookhaven National Laboratory so that those facilities can share computers and transfer medical images electronically. Cablevision plans to make its plant available for institutional networks to facilities located throughout the area. Cablevision also demonstrated telecommuting, video conferencing, video on demand and personal communications services—all of which can be sent over its fiber plant.

Any commitment to digital compression was noticeably absent from the Cablevision announcement. Instead, Hildenbrand said Cablevision is concentrating on building the network that will support such services while the technical issues surrounding MPEG compatibility are clarified. He said the introduction of compression into Cablevision's systems is "at least a year away."

Adelphia plans passive system

In contrast to Cablevision's strategy, Adelphia Communications Corp. announced it is deploying a passive system that utilizes fiber to nodes serving as few as 200 homes in a rebuild of its Syracuse, N.Y. system. The system reportedly will deliver 1 GHz of bandwidth to subscribers for the same cost as 750 MHz equipment, according to Adelphia executives.

Vendors have not yet been selected for the Syracuse rebuild, which consists of 320 miles of plant passing 66,000 homes. The $5 million rebuild is scheduled to be completed by 1995.

The Adelphia "Passive Cable Network Architecture" consists of home-run fibers from the headend to several hub sites, which in turn feed several AM nodes that service an area about one mile in radius. From the node, coaxial cable feeds the subscribers.

The system is also interactive. But in order to reduce costs, Adelphia will place the reverse transmitter at the hub site, which will service five nodes in the reverse direction. Furthermore, coaxial cable, not fiber, will be used to transmit return signals from the nodes to the hub sites. Adelphia also plans to use lasers powerful enough to feed several links fully loaded with 77 channels of video to help reduce capital expenditures.

Dan Liberatore, vice president of engineering at Adelphia, said further cost reduction should come as a result of the elimination of more than 1,000 RF amplifier stations.

Adelphia officials admit the system works economically in Syracuse, where housing density is fairly high. Studies are being done to determine if the topology is economical in less urban environments and in upgrade scenarios.

The topology represents the first reported deployment of a passive hybrid fiber/coaxial network, a project which CableLabs has been investigating.

MSOs commit to Jerrold decoders

Jerrold Communications continued its domination of the addressable set-top world by announcing that several more MSOs have selected General Instrument to supply DigiCable digital decompression terminals for their systems.

Of course, Tele-Communications Inc. set the pace and made headlines everywhere during last year's Western Cable Show in December when it announced its plan to purchase 1 million Jerrold digital set-tops over the next couple of years. TCI will use the devices to deliver as many as 500 channels of video to its cable subscribers, beginning in about a year.

Since then, Comcast, Sammons, Newhouse and Cablevision Industries have also committed to test and purchase a total of 600,000 more Jerrold terminals, giving that company the *de facto* industry standard—at least in the early going. At roughly $200 per box, Jerrold has already sold about $320 million of digital boxes, not counting the headend equipment that must also be installed.

• Comcast announced in mid-February that it plans to purchase about 150,000 DigiCable terminals and headend equipment for satellite reception of

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digital signals. Comcast said it will roll out digital devices in 1994.

• Sammons followed in early March by announcing its selection of Jerrold for approximately 70,000 units which it plans to test in early 1994 and roll out to cable customers in the middle of the year. Sammons will test how consumers react to a much larger number of channel choices and then will study ways to implement electronic program guides that give subscribers more programming information and help them make choices.

• Newhouse Broadcasting announced it has chosen GI to deliver 250,000 set-tops for its NewChannels, MetroVision and Vision cable systems. The equipment will be rolled out beginning in 1994.

• Cablevision Industries announced plans to purchase more than 125,000 DigiCable convertors and will also roll them out in 1994. Cablevision currently has about 1.8 million subscribers in 18 states.

In addition to the set-tops, General Instrument's VideoCipher Division has already closed a deal with distributor Antec Communication Services to market commercial DigiCipher digital compression receiver/descramblers for the U.S. The IRDs will be used in cable headends to receive satellite programming encrypted with DigiCipher technology. Antec will initially stock 10,000 units, according to Marty Ingram, Antec president.

CableLabs, Rogers issue PCS RFP

CableLabs and Rogers Cablesystems have issued a request for proposal to develop equipment that make it possible for cable operators to deploy personal communications services.

According to a CableLabs spokesman, the RFP is intended to advance the availability of equipment for CableLabs member companies as well as other CATV companies. Rogers will assist CableLabs in evaluating all proposals submitted and prepare a list of respondents for cable operators, who will each make their own individual equipment purchasing decisions.

The request calls for the development of equipment that uses the Remote Antenna Driver (RAD) technology, which is proprietary to CableLabs and Rogers Communications. This technology is based on distributed antennas all transmitting on similar frequencies served by a single radio base station. The approach results in a lower capital cost.

This type of technology has been used by several cable operators during PCS field trials that use low-power wireless terminals. Commercial installation of RADs may begin in Canada as early as this year.

RFP responses are due by 5 p.m. April 16 at Rogers Engineering offices, 1 Valleybrook Drive, Don Mills, Ontario, Canada M3B 2S7.

LSI Logic debuts decoder chip

Semi-conductor manufacturer LSI Logic will announce this month the development and availability of an MPEG video decoder designed to receive compressed digital video signals over cable systems and other broadcast applications. The highly integrated decoder is supported by a single chip that provides studio quality component video signals.

U.S. digital TV decoder forecast

	1993	1994	1995	1996
Cable headends	15	60	60	45
Cable set-tops	10	250	1,500	4,000
Consumer TVRO	25	400	250	100
Wireless cable	–	100	200	250
DBS set-tops	–	500	1,000	1,000
Business TV/ Distance learning	25	30	40	50
Total	75	1,340	3,050	5,445

Note: All figures are in thousands of units
Source: LSI Logic

LSI officials include as possible users of the decoder cable TV set-top manufacturers, headend equipment, DBS set-tops, telephone company video-on-demand systems, business and educational TV systems as well as consumer video applications like digital video discs, digital VCRs, interactive CDs and PC multimedia cards.

NCTA slates tech sessions

For those who are already planning to attend the 1993 National Cable Show June 6-9 in San Francisco, a full slate of 12 technical sessions has been set by the NCTA Science and Technology department. The schedule covers topics as diverse as cable plant construction and interactive/multimedia services. The tentative schedule is as follows:

System architecture: moderated by Chris Bowick of Jones Intercable, Monday, June 7, 1:30 p.m. to 3 p.m.

Consumer interface: Vito Brugliera of Zenith, Monday, June 7, 1:30 p.m. to 3 p.m.

Plant construction/operations, Dave Large of InterMedia Partners, Monday, June 7, 3:15 p.m. to 4:45 p.m.

Consumer electronics debate, William Bresnan (tentative), Monday, June 7, 3:15 p.m. to 4:45 p.m.

New technology, Dan Pike of Prime Cable, Tuesday, June 8, 10:30 a.m. to 11:45 a.m.

Interactive/multimedia, Paul Resch of The Disney Channel, Tuesday, June 8, 10:30 a.m. to 11:45 a.m.

Digital technology, Tom Elliot of Tele-Communications Inc., Tuesday, June 8, 2 p.m. to 3:30 p.m.

Conditional access, Alex Best of Cox Cable, Tuesday, June 8, 2 p.m. to 3:30 p.m.

Headend, Joe Van Loan of Cablevision Industries, Tuesday, June 8, 3:45 p.m. to 5:15 p.m.

Cable regulations, Wendell Bailey of NCTA, Tuesday, June 8, 3:45 p.m. to 5:15 p.m.

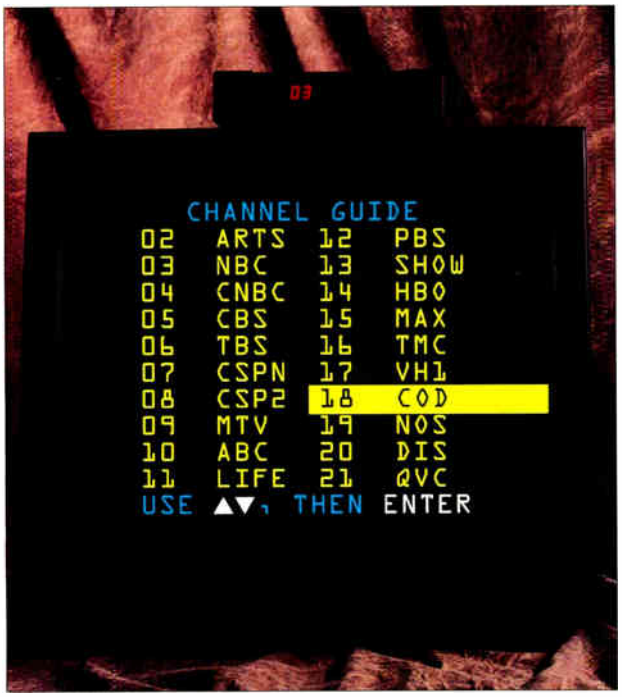
Fiber optics, David Fellows of Continental Cable, Wednesday, June 9, 9 a.m. to 10:30 a.m.

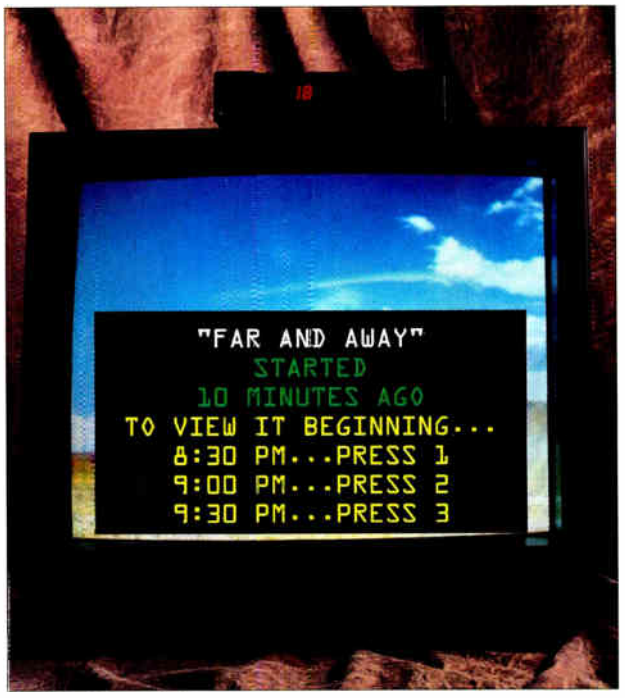
Compression, Geoff Roman of Jerrold Communications, Wednesday, June 9, 9 a.m. to 10:30 a.m.

Jottings

It's easy to understand why cable operators are announcing plans to build interactive "electronic superhighways:" competition is coming fast and furious. United States Satellite Broadcasting, the DBS provider that plans to be up and running early next year, signed with Viacom and Time Warner to offer Showtime, The Movie Channel, MTV, Nickelodeon, Flix, HBO and Cinemax to customers . . . a little while later, regional Bell operating company Ameritch proposed loudly that it would relinquish its sole hold on telco services within the local loop in exchange for access to others services and markets . . . Samsung's R&D arm has reportedly developed a digital laser disc recording system that can both record and play more than 100 minutes of MPEG2 compressed video. The system uses a "green" laser, which operates at a shorter wavelength to write information more densely than "red" lasers.

Compiled by Roger Brown





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Ralph Haimowitz

Haimowitz: SCTE's training bulldog

It's an interesting mental image. Picture the giant-sized Ralph Haimowitz crouched over his North Carolina garden, pulling up cucumbers and peas which he'll later par-boil, season and pour into Mason jars with the help of his new bride, Brenda.

Most people know Ralph as the guy who travels across the nation, putting on his series of SCTE training seminars for technicians and installers–with more than a little passion. As director of training for the Society, Haimowitz is a seasoned and die-hard technical trainer who does more than just teach. Indeed, the man eats, lives and breathes technical training (when he's not eating the riches from his garden)—and pity the person who dares to profess any negative thoughts about technical training to Haimowitz. It's not likely to be a pretty sight.

That's because although technical training is obviously Haimowitz's mission in life, it's also his pet peeve. "There's an unfortunate attitude about technical training, and that is that the technical forces *cost* money instead of *making* money," Haimowitz says.

Indeed, Haimowitz's friendly demeanor and ready smile subdue slightly when he talks about the need for technical training. "It's my biggest challenge in life—convincing management that it needs to budget for and include technical and safety training into its operations," he says, his voice raising to almost a bellow.

Haimowitz's favorite ammunition when selling MSO management on technical training goes something like this: Put all marketing and sales personnel on a 90-day vacation, and see what happens. Chances are, at the end of the 90 days, the system would not have made any more money, and the customer base wouldn't have changed more than one or two percent.

Then, for the next 90 days, bring the marketing and sales folks back in, but put the technical forces on a 90-day vacation, and watch the chaos kick in. "The point of the story is, management must stop looking at us (the technical community) as though we don't make them any money. Because we sure as hell keep them from losing money," Haimowitz emphasizes.

Second career

Haimowitz, at 58, cites cable as his second full career. He spent more than 20 years in the Air Force, where he worked on a broadband system that linked Cape Canaveral with Patrick Air Force Base. The Air Force is also where Haimowitz picked up his engineering education.

He entered the cable business in 1972 as a system engineer for then-Indian River Cablevision, a small independent system located in Sebastian, Fla. The move has since turned into a second career of 20-some years. "I took the job for peanuts, and read literally everything I could get my hands on," Haimowitz says of his first cable job.

Within two years, Haimowitz was selected by the system's board as general manager of the system. When potential buyers started sniffing out the system, Haimowitz stuck an exorbitant price tag on it. "We didn't really want to sell it," he now laughs, "so we put a ridiculous price on it and said, `this is our rock-bottom price.' "

Soon after, the system sold, and Haimowitz went to the Community Antenna Television Association (CATA) as its technical trainer. "I had been on the CATA board for five years," Haimowitz explains, "and the association was looking for someone to do technical training, write publications and answer technical questions. That's how I got into the training side of things."

In 1984, Haimowitz left CATA to assist in a rebuild/upgrade of then-American Cablesystem's Pompano, Fla. plant. When the upgrade reached completion, Haimowitz was named director of technical training for the systems. "I put together a massive training program for the installers," Haimowitz says.

That all ended in March 1988, when SCTE President Bill Riker gave Haimowitz a call, citing a need for someone who could do technical training and chapter development for the organization. Haimowitz gladly accepted.

As director of technical training for the SCTE, Haimowitz spends about half of his time on the road. He teaches four courses: Technology for Technicians, Technology for Technicians II, a five-day Train the Trainer program and a one-day OSHA seminar.

In Haimowitz's opinion, technical training is desperately needed. "I go into these training sessions and spend the first half of the day teaching these guys math and basic algebra," Haimowitz laments. "They're so hungry for training—they're like starving children, and I'm throwing candy at them."

Further, Haimowitz says, as the industry progresses toward digital networks and other emerging technological advances, the need for training will increase 10-fold. "We don't even splice connectors properly yet," Haimowitz says. "One of the first tests I give is a drop cable preparation and F-fitting installation. No kidding: 80 percent of the guys I train don't put fittings on right. What's going to happen when these emerging technologies get to the implementation stage? It's downright scary."

Biggest SCTE proponent

Haimowitz has been an active SCTE member since 1978; in 1979 he was selected as the organization's Member of the Year. He says he has little time for other industry affiliations: "The SCTE is a full-time endeavor for me."

Haimowitz says the town of Boon, N.C.—located in the northwest corner of the state, less than seven miles from the Tennessee border—has been good to him. It's where he met his second wife, Brenda, after all. "There's something about these country women," Haimowitz marvels of his new bride.

Not surprisingly, it's Brenda who taught Ralph about the business of preserving fresh vegetables. "All of our hobbies have to do with making things. We make salsa, pickles, and can just about every vegetable imaginable," Haimowitz says. "We even do a thing called 'dilly-carrots.' "

Dillycarrots?

"It's like a dillypickle, but with carrots," Haimowitz laughs. CED

By Leslie Ellis

The Great "Hey, what's this battery for anyway?" Contest

Can You Find the Battery that's Right for Cable?

Test your cable battery knowledge. Here are four typical batteries now being used for standby powering purposes in the cable industry. Only one battery meets the demanding needs of cable. Can you find the cable battery—and match up the others with their intended uses? If you can (and we promise, it's not hard) you could be the lucky winner of a Macintosh® PowerBook™ 145 or an NEC® Ultra Lite™ SL-20 laptop computer (contest details below).

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A

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B

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C

MK Battery™—A sealed gelled electrolyte battery designed for deep-cycle applications such as marine cranking. Low maintenance. Phosphoric acid used as additive in gel to aid in deep cycle performance, but at the price of reduced service life on float charge.

D

your answers

☐	A	
☐	B	
☐	C	
☐	D	

Cable—Long 'idle times'; float charging typical; not a cycling application. Long periods between performance checks by maintenence personnel. Requires four to five years of service for reasonable payback on upfront battery costs.

UPS—Long 'idle times'; normally room-temperature operation in computer rooms, headends or offices. Lower-cost batteries which are not suited for extreme environments may be used.

Marine—Typical deep-cycle requirement; discharge to "flat" levels frequently; requires phosphoric acid to resist internal stresses. Cranking service common. Low cost, consumer product.

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Building the HDTV elephant

After years of debate on improved television it was assumed by many that a historic moment would take place on February 24, 1993. At that time, the FCC Advisory Committee on Advanced Television Service was to receive the recommendations of a special panel which was tasked with examining all of the data from the five proponent systems and determine which system was the best.

Well, the old saying that the best laid plans of mice and men oft go astray proved to be true.

The special panel met Feb. 8-12. If nothing else, the meeting was a beneficial lesson in committee organizational structure and activities. The committee was comprised of 25 voting members representing "the leadership of the Advisory Committee and expert qualifications." Also included were representatives of each proponent and related parties (Canada and Mexico), as well as ex-officio members who came from important positions within the deliberative process. The meetings were all chaired by Dr. Robert Hopkins, executive director of the Advanced Television Systems Committee and co-chaired by Lex Felker from Time Warner.

The first day was taken up by organizational matters and an introductory analysis of the collected data. Attendees were also organized into teams of viewers, who would visit the ATTC to view a series of training or calibration tapes. The last group went home just before midnight.

The next morning, there was a discussion about the effort put forth by all five proponents. But the process revealed a significant difference between "perfect images" (studio reference) and "less than perfect" images (resulting from the compression algorithms). The difference was significant enough for me to determine that none of the five proponents was commercially viable.

This did not trouble me as much as one might imagine. I was aware that each proponent learned a great deal about handling the diversity of material that will likely need processing in a day-to-day TV environment. Each had announced hardware and technique improvements at one time or another to improve different aspects of the system. With that in mind, it seemed all discussions would center around re-testing the proponents' new and improved systems.

Alas, however, the Committee demanded the process be completed in the manner in which it had begun. So, for the next several days, we debated many things, not the least of which were quarters of a decibel and parts-per-million on equipment that no longer existed.

The silver lining

Nevertheless, many good things came out of this meeting. It was made clear, for example, that the efforts by some proponents to introduce a transmission technique that allowed for graceful degradation of a digital signal were simply not worth the effort and might be harmful to image quality. A strong message was sent that this was not an appropriate use of the limited resources of the digital signal.

There was also debate over the general issue of weighting each of the attributes. As the committee deliberated on parameters and performance by each system, a large amount of time and many words were used to debate the performance of a single proponent on a certain parameter when quiet reflection would have led one to see that the particular parameter was, overall, not terribly important.

If a scheme were used to pick a winner by counting up pips, with no regard to the relative importance of each of the parameters, then a system with mediocre (or worse) image quality could have won by gathering more accolades than someone who had superior or near-perfect image quality. This certainly should not be the case, and hopefully the committee will rectify this situation in the end.

I don't want this to sound worse than it is. It is striking that several of the systems ranked within 0.3 CCIR grades of the studio reference image—a high-quality image by anyone's standards. This particular level of performance on the CCIR grades led me to a troubling thought: If this group could find systems which came close to studio reference standards needed improvement, we must have a rating system that was designed to be applied to analog systems and is therefore inappropriate for digital systems.

I have a strong sense that had any analog system come within 0.3 grading points on the CCIR scale to the studio reference standard, one and all would have found that system more than adequate for the rigors of the commercial world. And yet, when these digitally-compressed HDTV systems performed to that level, several people found them to be insufficiently developed for commercial service at this time.

This means either that a new scale must be developed or we must recalibrate the last half of the last grade in the CCIR scale in order to more closely examine digital images in the future—sort of a vernier scale for the last 0.5.

In the end, the special panel wrote an executive report for the Advisory Committee and we all went home. Some, I suspect, were feeling (as I did) that something had been left undone.

At the Advisory Committee meeting, our report was delivered. It said, in the nicest possible terms, that the Special Panel had decided that digital systems were the appropriate technology for the American public, that NHK had withdrawn its analog proposal in the face of this decision, that each of the four remaining digital systems had proven their ability to make suitable images; that all were very close to being deemed capable of producing images suitable for commercial deployment in the U.S., and that the Special Panel recommends they all make improvements and bring their systems back for a new series of special tests.

However, the chairman called for the four proponents to get together in what is being called a "grand alliance" and come back to the Test Center with only one system made up of the best parts of each of the four remaining proponents. Whether this grand alliance is possible or not remains to be seen. But, even as I write this article, there are rumors the parties are meeting to see what is possible. CED

By Wendell Bailey, VP of Science and Technology, NCTA

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Asynchronous Transfer Mode

Asynchronous Transfer Mode, or ATM, is an international standard approved by the Consultative Committee for International Telegraph and Telephone. ATM created headlines in the cable industry when Time Warner announced its plan to develop a "Full Service Network" in Orlando, Fla. with ATM as the data transfer mode of choice.

Historical perspective

It is generally believed that most future multimedia networks, in both the public and the private sectors, will be based on ATM and other "cell relay" technologies—as opposed to the traditional time-division-multiplexed (TDM) approaches that we know today, such as the North American hierarchy of DS-0, DS-1, and DS-3 (64 kB/s, 1.544 Mb/s, and 44.736 Mb/s respectively) for voice networks. This is being driven by the fact that "bandwidth on demand" will certainly be a requirement of any information-highway of the future.

Historically, the use of a DS-x digital hierarchy for the transport of voice information was certainly adequate[1]. With 64 kB/s as the base transport data rate for voice information, one could easily build 24 of these voice circuits into a DS-1 level of service, and 672 of them into a DS-3 level of service.

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

Standard traffic engineering, using the Law of Large Numbers, could also predict how many such circuits would be needed during any given part of the day. Generally speaking, one could predict that in a given central office, serving about 10,000 local loop subscribers, only about 5 percent of the lines would be active during a normal business hour. In addition, once a line becomes active with voice transmission, the CO expects to receive a well-defined TDM stream of digital information at 64 kB/s to appropriately route to its destination. These types of predictions are useful in determining local loop and inter-office equipment switching requirements.

Note, however, that needs within this multimedia information society are changing. In a multimedia environment, providers must have the capability of dynamically changing the bi-directional data rate for information exchange. Our future will include variations on many of the following applications:

Downloading or uploading massive data files—perhaps with bit-mapped graphics; downloading or uploading very small data files; video-on-demand; CD-quality audio on demand; desk-top video teleconferencing—perhaps at various N x 64 kB/s data rates; education-on-demand; home shopping; home banking; medical imaging; and facsimile.

One major factor each of these applications has in common is that not one of them will require the same data rate for transport. Each application will require enormous differences in the rate of transfer of information through the network, and the rates required may not suitably fit within the DS-x hierarchy.

ATM's real advantage

It is in this dynamic allocation of data rate (or bandwidth) that ATM shines. ATM is a high bandwidth switching and multiplexing technology. It consists of a series of cells or packets, each containing 53 bytes of data. These 53 bytes consist of 5 bytes of header information and 48 bytes of actual "payload."

Each of these cells or packets is identified and switched or routed through the network by means of a set of address labels located in the header. The header contains a virtual path identifier (VPI) and a virtual channel identifier (VCI) for each cell, as well as an error detection field. The VPI and the VCI are both used to create a virtual connection between two points in the network, or among several different points in the network for multipoint-to-multipoint communication purposes.

Note that because each packet in this high data-rate serial data stream is individually addressed, it can be dynamically routed anywhere in the network, based upon user demand. This allows for ATM to dynamically support virtual channels at a bit rate allocation anywhere from just a few kB/s up to the total payload capacity of the network.

In addition, these virtual channel bit rate allocations can be asymmetrical, meaning that the two or more users in communication with each other may communicate at their own data rate based on their own individual needs.

Note, however, that ATM is not a random access technique in which there is no guarantee of the length of time it will take to transmit the data. Instead, with ATM, upon connecting to the network, each user's interface equipment negotiates with the network for a particular "Quality of Service" and the network guarantees delivery of the cells.

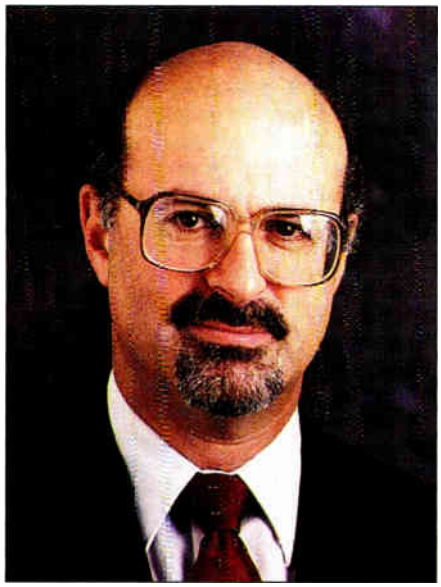
A misnomer?

ATM is not really an "asynchronous" transmission technique at all. The cells, in fact, are clocked synchronously throughout the network. However, ATM is asynchronous in that the information or cells being transmitted from a given source or received by a given location do not appear in the data multiplex at predetermined time intervals, as is the case with a traditional TDM signal. Instead, because each cell is individually addressed, it can appear at anytime in the multiplex and will still be received by the intended user. The information contained in the cell is therefore received "asynchronously" or "randomly" as opposed to at a predetermined time or location in the multiplex.

ATM seems like an excellent data transport mechanism to lay the foundation for cable TV multimedia networks of the future. One issue facing the industry at this point in its development is the cost of the technology—especially the cost of the terminal device(s) that may be required. When you consider the fact, however, that only a few years ago, fiber optics for CATV networks was considered too costly to be practical, I think you'll agree that with a similar call to arms for ATM, there is a chance that ATM may too be practical. CED

Reference

1. Minoli, Daniel, "ATM and Cell Relay Concepts, DATAPRO Communications Series on Broadband Networking," McGraw-Hill, 1992.



The telephone biz: Who's in charge?

So, you want to enter the telephone business? Well, it's a service business, just like Federal Express, so arrange your funding, install your network, and start up your business. What's that you say? Government approval? You need government approval to offer telephone service? Which government?

Jurisdiction

The law that created the Federal Communications Commission is called the Communications Act of 1934. It lays out the areas where the FCC has jurisdiction, and it also specifies where the FCC does not have jurisdiction.

For example, Section 2(b) of the Communications Act says that (with a few exceptions) the FCC does not have jurisdiction over communications services that are entirely within a single state. And Section 221(b) says that the FCC does not have jurisdiction over telephone exchange service, even if the service crosses state lines, providing such service is being regulated by a state regulatory commission or local government authority. (Telephone exchange service is the law's name for public switched telephone service.)

Section 214 of the Communications Act says that a telephone carrier must first get FCC permission before it constructs a network. And Sections 201 and 202 say that telephone carriers must charge rates that are reasonable and non-discriminatory. These are the two basic elements of government regulation of telephone service: entry regulation and rate regulation.

For interstate long distance telephone service, entry and rate regulation is done by the FCC. The FCC's entry regulation is very liberal, because it favors competition.

But for intrastate long distance service and private line service, the FCC is prohibited by Section 2(b) from regulating. And for local exchange telephone service, Section 221(b) prohibits FCC regulation.

In these two instances, it is the state regulatory commission (called the Public Service Commission or the Public Utilities Commission or perhaps the State Corporation Commission) that regulates entry and rates. And most of the state commissions do not favor competition, so entry is very difficult.

The FCC has jurisdiction over all aspects of interstate calls. Therefore, it regulates competitive access carriers, whose local transmission facilities are used to originate and terminate interstate calls.

Jointly-used plant

Much of the public switched telephone network carries a combination of local exchange calls, intrastate calls and interstate calls. For example, the local central office switching machine handles all types of calls. Long ago, the FCC and the state regulatory commissions agreed on allocation methods to allocate the costs of jointly used plant investment to the interstate and intrastate jurisdictions.

This allocation is needed for rate regulation. Telephone rates must be "just and reasonable." Over the years, this has been interpreted to mean rates that cover expenses and also earn a fair return on plant investment. Determination of plant investment, called the "rate base," is the most important element of telephone rate regulation.

This allocation process is usually called "jurisdictional separations" or just "separations." And for most types of plant investment, the allocation ratio is based on "minutes of use"—minutes of interstate use vs. minutes of intrastate use. One allocation is done to separate investment between interstate and intrastate, and another allocation separates investment between local exchange service and intrastate toll (long distance) service.

Radio communications services

There are local communications services that use radio. Cellular is the best example. Here, the law gives the FCC authority over the radio licenses, but gives the states the authority to regulate rates. So the jurisdiction is split. The FCC controls entry, but not rates. The FCC also gives out radio licenses for other forms of local communications, including paging, microwave delivery of video (MMDS) and digital microwave links used by competitive local access carriers such as LOCATE. The states are not permitted to interfere with interstate communications policies, nor to make decisions that are inconsistent with FCC policies. There have often been disputes between the FCC and various state commissions over policies that govern radio-based communications services, and when the case goes to court, the FCC always wins.

Today, the FCC allows virtually anyone to enter the interstate communications business. This includes companies like Metropolitan Fiber and Teleport, who install local communications networks that are used to connect with interstate carriers like AT&T, MCI and Sprint. Cable companies can enter this business also, if they think they can compete with the telephone company and the handful of competitive access carriers that now exist in major cities.

But cable companies cannot enter the intrastate and local communications business quite so easily. As Manhattan Cable learned years ago when it began offering local leased lines, the permission of the state regulatory commission is necessary.

For entry into local exchange telephone service, this permission is likely to be difficult to obtain. It will take years of hearings in every state before entry policies are changed to be as liberal as the FCC's entry policies.

One of the major virtues of radio-based PCS is that licensing and entry will be controlled by the FCC, not the state commissions. Some feel that PCS has the potential to be economically competitive with wireline local exchange telephone service. If so, the FCC will be able to do an end run around the entry barriers of the state regulatory commissions.

So who's really in charge? It all depends which piece of the telephone business you're in. But for local public switched telephone service, the states are still firmly in charge. CED

By Jeffrey Krauss, independent telecommunications policy consultant and President of Telecommunications and Technology Policy, Rockville, Md.

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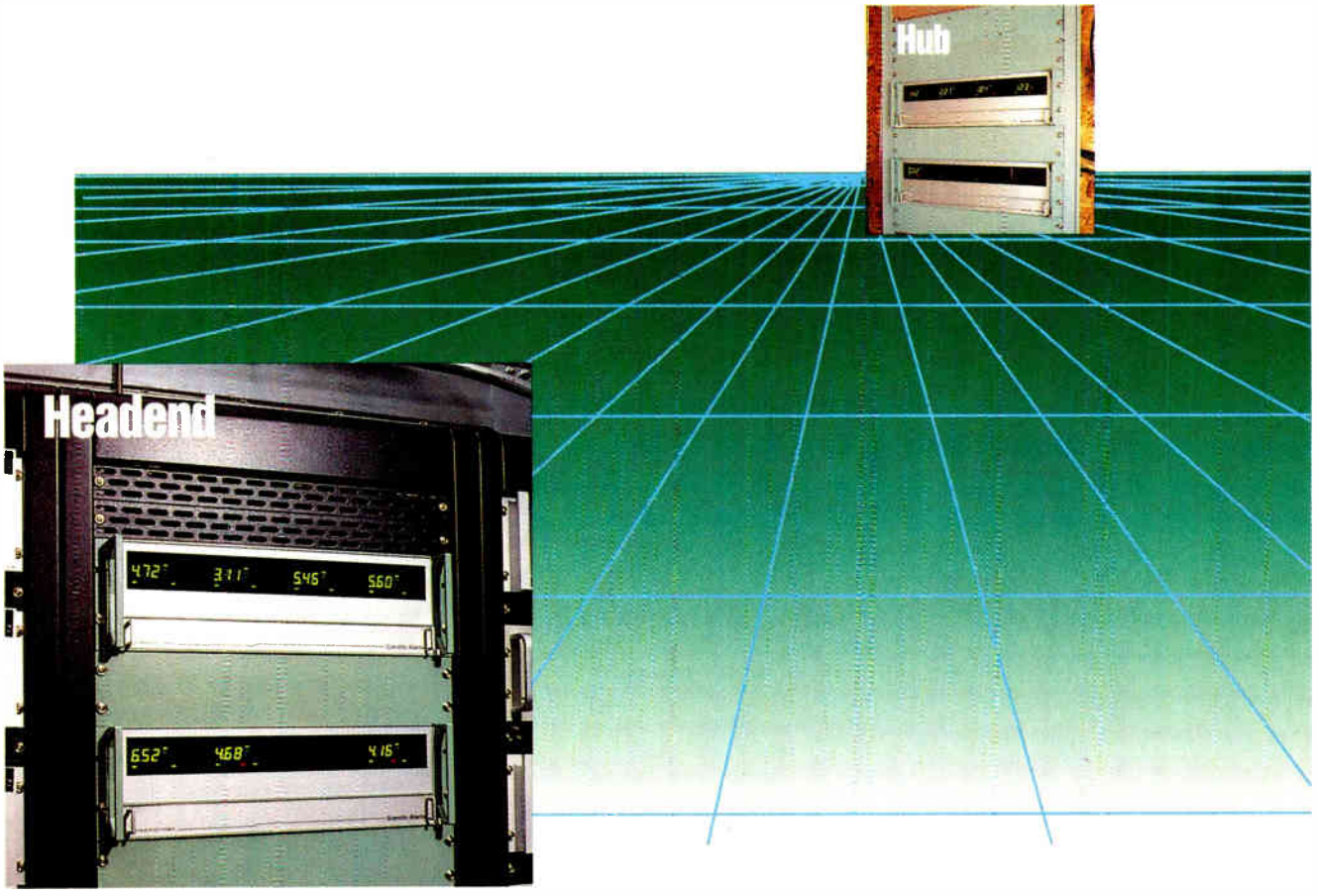

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Clearing the air

I write concerning an article that was printed in the February 1993 issue of *CED* magazine. The article was written by Harmonic Lightwaves about a CableLabs project ("The path to passive optical networks," *CED*, February 1993, p.63.) It could lead to misunderstanding, based upon its primary focus on the passive optical network (PON) approach to cable architecture.

CableLabs is pursuing a regional hub concept for cable network architecture. That was mentioned in the article and has been widely noted. CableLabs has discussed many variations that may be implemented of that regional hub concept, sometimes referring to research into the potential for a passive coaxial network.

But the passive optical network is not one that CableLabs has mentioned.

In addition to the emphasis which the article places on this PON approach, the piece is accompanied by a regional hub drawing which is incorrectly described as "The passive optical network as outlined by Cable Television Laboratories."

With this much emphasis on PON, a reader could draw the conclusion that the PON approach is the way to go, and that CableLabs is singularly pursuing that approach. That would be unfortunate.

Thank you for your continuing coverage.

Mike Schwartz
VP Communications
CableLabs

CED *apologizes to CableLabs and anyone else who may have misunderstood the intent of the Harmonic Lightwaves article. It was never intended to imply that CableLabs endorses the Passive Optical Network (PON) architecture developed by the telephony industry (note that the Harmonic story never used the PON acronym). Perhaps the phrase "passive optical network" was just a poor choice of words. We also apologize for incorrectly identifying the illustration used in the article.*

The purpose of the article is to inform readers that one method of realizing an advanced network topology, such as the one envisioned by CableLabs, is through passive optical technology. The article describes the factors that such technology must address to meet the needs of a cable operator.

It is unfortunate that this misunderstanding occurred.—Editor.

Old invention?

I was surprised to read in the November 1992 issue, page 10, a report of the "invention" by David Goodman of Inline Connection Corp. of a system that allows the distribution of video in conjunction with voice signals over twisted-pair telephone wiring, and that he has been issued a patent for this idea.

A patent is normally issued only when it is clear that the idea proposed is novel and has not been developed before. However, I did in fact develop such a system specifically for solving an internal video distribution problem in 1949 in London, England. This system allowed the transmission of video signals at 45 MHz over 4-pair relay cables carrying radio programs at audio frequencies up to about 12 kHz using high- and low-pass filters to separate the bands and prevent mutual interference. The relay cables consisted of balanced pairs with characteristics similar to those of telephone pairs, and the technique was later applied on a much larger scale to external distribution over extensive radio relay systems in England as an alternative to duplicating the existing cables with coaxial for simultaneous video distribution.

This development was described in some detail in a book I wrote and published in 1980, entitled "Thirty years in cable TV: Reminiscences of a pioneer."

K.J. Easton, P.E.
President
Cable Consulting Services Ltd.

Credit due

In the December 1992 issue of *CED*, an article authored by Emmanuel Vella of Harmonic Lightwaves entitled, "External modulation: New flexibility in CATV network architectures," was published. The article closed with several references. Reference number 4 indicated the article, "Extending the advantages of fiber optics," from *CED*, May 1992, authored by Mike Sparkman.

This article was co-authored by Dale F. Lutz, president of ETG, along with Mike Sparkman. I apologize for this oversight.

Paul Schaller
VP sales and marketing
Harmonic Lightwaves

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Circle Reader Service No. 14

Cable industry leads fiber optic market

Study shows cable as market leader in fiber optic deployment, up over 100 percent in '92

Cable television is the fastest-growing market segment within the North American fiber optic market, growing by more than 100 percent in 1992, according to figures released by Corning Inc. during the Optical Fiber Conference in late February.

The overall fiber optic market itself grew by a whopping 30 percent in 1992 and is now approaching 5 million kilometers per year, according to Clark Kinlin, director of fiber sales and marketing at Corning. Cable TV purchases now account for nearly 9 percent of the total North American market for cabled optical fiber. He estimated that about 10 million cable subscribers now get video via systems that have deployed fiber.

There is some indication that CATV has taken the fiber market by surprise. Just two years ago, Corning executives estimated that cable television would probably top out at about 10 percent of the total market. However, operators have clearly accelerated the pace of fiber implementation over the past 24 months. But just how long can the industry sustain the pace? No one is certain.

Kinlin said he expects cable industry growth to be strong, but he doubted the industry could continue to grow at the pace it set last year. He conservatively forecast growth to be about 50 percent in 1993, led by operators like Tele-Communications Inc., Time Warner Cable and NewChannels. These cable operators are "truly technology entrepreneurs" who latch on to new, cost-effective technology with great vigor, Kinlin said.

Privately, Kinlin admitted that breaking the fiber market out by segment is becoming more difficult to do because traditional industry boundaries are being washed away through joint ventures and efforts by one industry to get into another industry. It is especially difficult to forecast the cable-TV market because it can be affected heavily by just two or three MSOs, he added.

In contrast, the local telephone market for fiber cable grew just 30 percent, although that market segment still dom-

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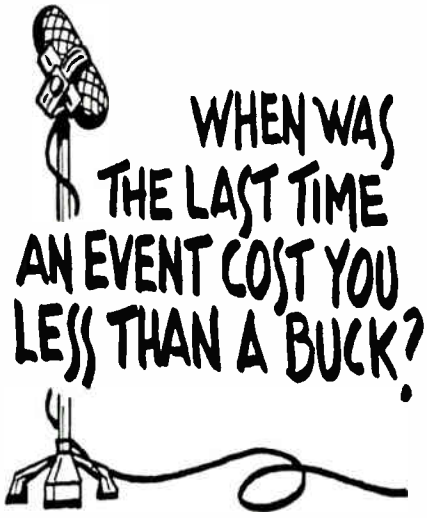

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inates the overall market pie.

Corning's OFC press briefing this year was decidedly focused on legislative and regulatory change. Tim Regan, Corning vice president and director of public policy, provided an overview of pending legislation that might effect direct cable/telco competition, something Corning as a company advocates.

Regan touched on a number of planned and pending bills before Congress, but became most animated when he discussed a document prepared by President Bill Clinton, titled "Technology for America's Economic Growth, A New Direction to Build Economic Strength." That paper outlines new programs that would lead toward the creation of national "information superhighways" to serve financial institutions, educators, the medical profession and manufacturers, among others.

Regan termed the issuance of that document a "very significant event" because it should serve to reduce the gridlock surrounding a national telecommunications policy and advance the discussions related to cable/telco crossownership and video provision by telcos.

Cable is leader

Separately, in comments filed with the Federal Communications Commission regarding the 1992 Cable Act, Corning espouses cable-TV's role as a provider of a fiber-based, high speed network capable of delivering video, data and voice to the nation's people and businesses.

The comments, submitted by Jan Suwinski, executive vice president of Corning's Opto-Electronics Group and Fiber Optics Division chairman of the Telecommunications Industry Association, cites cable's rapid pace of deploying fiber optics; it's increase in capital spending to upgrade cable plant; and makes note of the fact that 10 million cable subscribers now view video delivered by fiber.

Throughout the conference, more attention than ever was paid to cable television and/or broadband video delivery. A special symposium, titled "What is the correct technology choice(s) for the next generation telecommunication and CATV systems?" was offered during the conference.

During that symposium, a researcher from British Telecom reviewed the need for an optical amplifier that operates in the 1310 nanometer wavelength and predicted that such a device is "practical in the future."

Because the vast majority of fiber optic electronics used to transport video is 1310 nm equipment, an amplifier designed for that wavelength would be able to exploit the network that is already in place or is being deployed today, said David Smith of BT. Most researchers are pinning their hopes on fluoride fiber doped with the rare earth element praseodymium (Pr).

The big obstacle, according to Smith, with making Pr-doped devices practical is efficiency. Presently, lab experiments are achieving 15 dB fiber gains from 130 mW pump lasers, which represents the type of efficiency that will lead to the development of a commercial product. In fact, a postdeadline paper delivered at OFC by a research team from NTT reported a 28.3 dB gain from a 280 mW pump.[1]

Furthermore, Smith says the 1310 nm amplifier is on the same progress curve as the successful erbium-doped amplifier was on just a few years ago. For example, Smith says the idea of a 1310 amp was first proposed in 1989. It

was then demonstrated in 1991 and a diode pumped device was announced in 1992. Smith says availability of a commercial product will now depend on market demand more than anything else.

Also on the dais was Ed Callahan of Antec, who detailed the Star-Star-Bus architecture and the improved reliability and picture quality fiber optics is bringing to cable plant around the country. He explained to the audience that two-way broadband networks are being planned by Time Warner in Florida and how an integrated voice/video system is being deployed by TeleWest in the United Kingdom.

Reference

1. Shimizu, Makoto, et al, NTT Optoelectronics Laboratories, "28.3 dB Gain Pr-Doped Fluoride Fiber Amplifier Module Pumped by 1.017 μm InGaAs-LDs," OFC/IOOC '93 Postdeadline Papers, p.52.

Technology not the key issue

Editor's note: *What follows is a distillation of a presentation made by Gary Kim for* CED *magazine at the Optical Fiber Conference in San Jose, Calif. in February.*

Though optical fiber, new network topologies, feeder plant redesign and dramatically-lower microprocessor costs have radically altered cable's physical platform, compared to the early-1980s, the key question for proponents of cable-delivered multimedia services aimed at residential customers remains the issue of demand. Then, as now, providers of interactive, digital-based services must ascertain whether customers will pay money for any of the new services. Among those possible services are home shopping, home banking, database access, video games, interactive educational software and electronic newspapers.

Not that cable is neophyte in that regard. In 1981, for example, Times-Mirror teamed with Bank of America to trial interactive videotex for 350 customers in the upscale Palos Verdes and Mission Viejo, Calif. communities. The "Gateway" service, developed as the result of Times-Mirror's trials, rolled out in Orange County in October 1984 featuring a database of about 50,000 pages of information for $30 a month.

The in-home terminal, called "Sceptre," was supplied by AT&T and used the telephone network for upstream signaling as well as screen downloads. Among other information providers who signed up for a fling was American Airlines and the Automobile Club of Southern California. The airline provided flight schedules, travel tips, and information on frequent-flyer programs, for example. The auto club supplied auto insurance quotes and travel quizzes.

Cox Cable developed at about the same time its "Indax" system. Indax offered a range of services including home banking—bill paying, account reconciliation and brokerage services from Chase Manhattan Bank, for example. It also offered home shopping and a range of news and information services. A joint venture between General Instrument Corp. and Mattel Corp., known as Playcable, also sought to create a programming service based on video game technology in the early 1980s. The NABU Network also attempted, in the early 1980s, to create an interactive programming service using interactive terminals and computer-based graphics.

Earlier, in 1977, Warner Cable had begun experimenting with an interactive technology it christened "Qube," in Columbus, Ohio. By 1981, Warner Amex began rolling out Qube in Cincinnati and Houston. A year later, Qube came to Dallas, Pittsburgh and St. Louis.

Kids join in the fun

Qube for Kids allowed area youngsters to call in questions while Qube Sports let viewers register opinions on what sporting events should be aired on upcoming shows. The "Sight on Sound" program let viewers vote on what music videos they wanted to view. Qube produced the nation's first infomercial, aired on Dec. 1, 1977. The first interactive game show, "Flippo's Magic Circus," aired in December 1977. The first pay-per-view championship boxing match also was offered in June 1980. Perhaps more important, a number of highly-successful programming genres are descended from Qube, including MTV, Nickelodeon (originally known as "Pinwheel") and The Movie Channel (all owned today by Viacom International Inc.). Though commercially a lost cause, Qube did represent, at the time, one of the largest operating commercial data communications and interactive networks, used by consumers, in the United States.

None of those efforts proved commercially viable. Customer appetite proved to be the most-significant showstopper. But underpowered, high-priced technology also contributed. In some cases, equipment costing as much as $2,400 had to be installed in a customer's home. Corded remotes, limited ability to use the cable return path, rudimentary screen displays and relative customer familiarity with remote controls or VCR programming may also have been issues. VCR penetration stood at less than 2 percent in 1980, though it was over 60 percent in 1990.

The impact today

In that regard, Time Warner Cable Group's 4,000-home test of the "Full Service Network" in Orlando, Fla., will prove an intriguing test of whether consumer electronics technology advances, a revamped network and more-seasoned programming approaches will succeed where numerous earlier attempts failed. The "Main Street" roll-out by Daniels Cablevision in Carlsbad, Calif., an interactive service provided by GTE Corp., and the example of the Videoway interactive service provided by Le Group Videotron, also will bear watching. Prime Ticket Network also will test an interactive "Press Box" sports news show, using technology supplied by ACTV.

One shouldn't underestimate the considerable advances in technological underpinnings, led by the advent of optical fiber, but including microprocessor prices an order of magnitude lower, as key elements of a new multimedia platform. We forget that, in 1980, an eight-bit microprocessor with four megabytes of random access memory cost $800. The display and disk storage were extra. We forget that MCI, Sprint and the Bell Operating Companies didn't exist. We forget that most businesses had no facsimile machines in 1980. Where today the cost of outfitting a fiber-to-feeder network for two-way operation runs as low as $6 a subscriber, the cost was prohibitive in 1980.

Still, technology isn't the key issue. Customer willingness to pay money for interactive access to digital information services remains the unknown. CED

By Gary Kim

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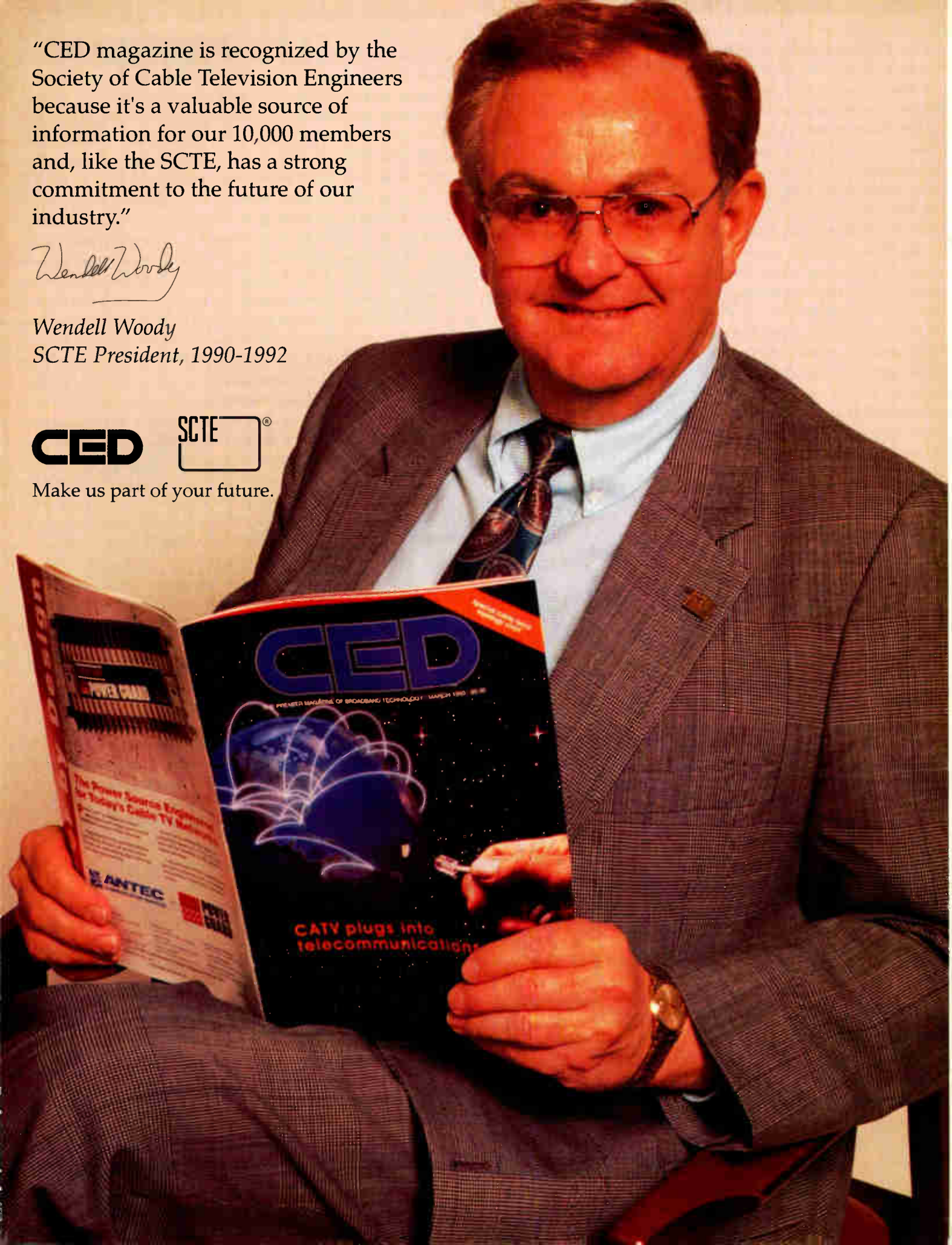

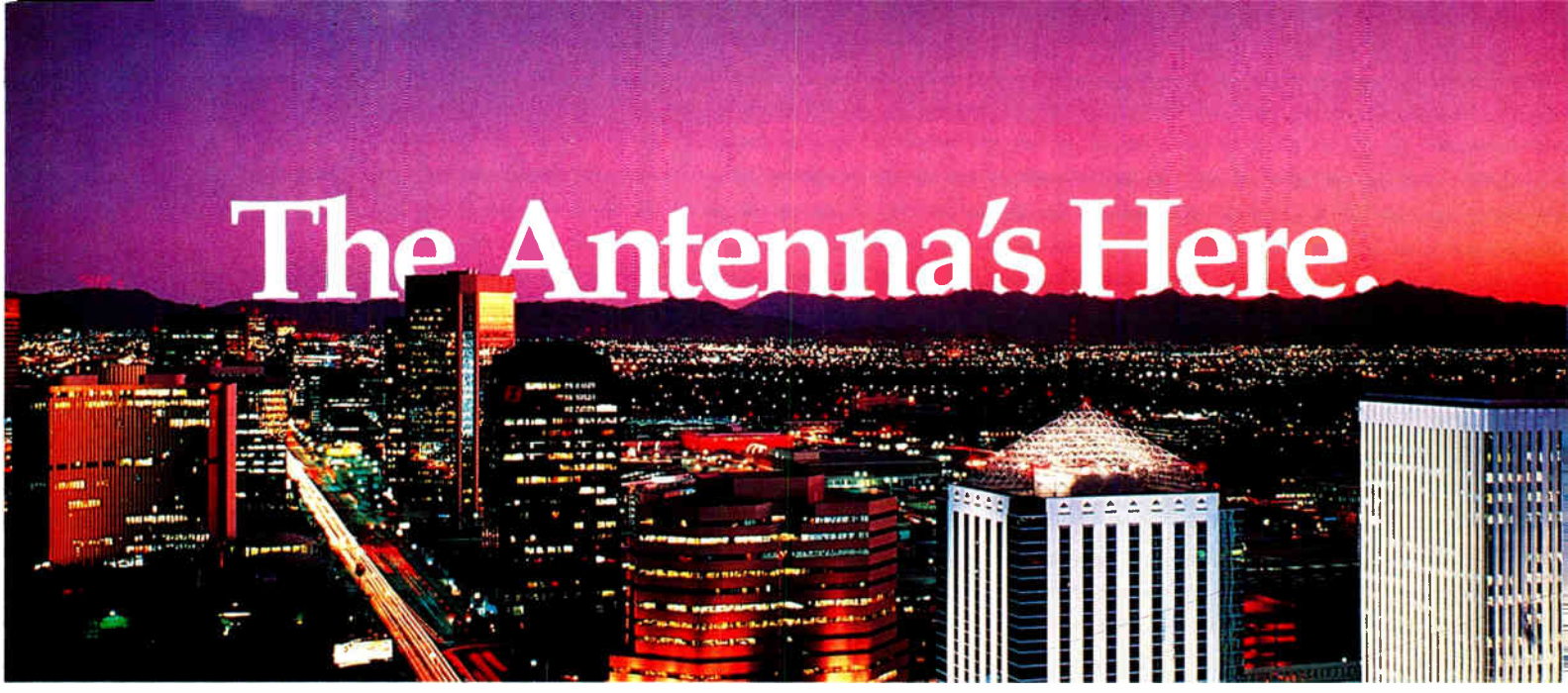

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the FCC says must be within ±2 dB from 0.75 MHz to 5 MHz above the lower channel boundary limit. It is also measured at the subscriber terminal. What makes the test tricky is the fact that the in-band flatness of the selected test channels is tested not only after the convertor, but after the effects of everything else in the signal path (see Table 1).

Ted Hartson, VP of engineering for Post-Newsweek Cable and one of the engineers who filed reconsideration comments to the FCC about the technical standards, has this to say about in-band flatness: "In our (reconsideration) comments, we noted that response deviation of 6 dB to 7 dB is common in over-the-air signals. So, I feel the rule is excessive. From the headend through the plant to the convertor, the convertor could feasibly consume the entire deviation all by itself."

In-band flatness is tested by using a demodulator and a waveform monitor, says Large. "But unless you have a VITS generator, you have to use the VITS supplied by the programmer. It's a lot of work without a waveform monitor and a demod. It's not nearly as clean as just measuring levels."

Still others feel that convertors simply weren't designed for the kinds of testing mandated by the FCC rules. "Set-tops were never designed to be perfect," says Harrigan. "We're not putting the VCRs and other home terminal equipment through the same rigorous testing as we're trying to put to a $60 or $100 box."

How long is a day, anyway?

Another test snag frequently cited by engineers is the 24-hour signal level variation tests. Depending on the demographics of a cable system, it's entirely possible that the designated 24 hours can expire before the required test rounds are completed—particularly if the testing is done manually.

A case in point is Time-Warner's 1 GHz Brooklyn/Queens, N.Y. system. According to Johnson, a total of 13 channels were subject to testing in Brooklyn/Queens, at some 25 to 30 test points. Although Johnson isn't certain how long it would have actually taken Time Warner staffers to make the 24-hour test loop without automated test equipment, it's safe to say that, given the size of the metropolitan area, it would have been something close to a nightmare.

However, Rogers submits that the 24-hour test he performed on his system in Virginia proved the most rewarding. "I wrote myself a note two years ago saying I should test the extremities of my system at least once a month," Rogers says. "Sure, the 24-hour tests are time-consuming. It took me 2.5 hours to make just one loop. But I realized that my system isn't the same at 9 a.m. Sunday as it is at 9 p.m. I was able to find and correct a problem I didn't even know I had."

The good news

The good news is, test results are meant to be carefully filed on-site, and not sent to Washington, D.C. on a semi-annual basis. Because of that, however, many engineers have decided to use the gray area known as "good engineering practices" to resolve sticky issues.

"As long as I can show a prospective FCC investigator that the tests were performed in good faith, using sound engineering practices, I think the actual test methodologies are debatable," says one engineer who prefers to remain unnamed. "The worst they can do is to ask me to make the tests again, right?"

Maybe. But the gray area currently embodied within the FCC technical standards will become significantly whiter within the next few months, when the NCTA Engineering Committee puts the finishing revisions on its "blue book" titled *Recommended Practices for Measurements*, which describes good engineering practices for performing the proof-of-performance tests.

Going forward

Most engineers say that going forward, the testing shouldn't be too difficult, except for the 43 dB CNR spec slated for implementation in 1995. That could be a tough nut to crack in systems with long amplifier cascades, says Hartson. "Making 43 dB could be a working job. We have time, of course, but it might require some architectural considerations, such as cascade reduction and the addition of fiber (into the system)."

In fact, many cable systems across the U.S. seem to be somewhat ahead of the game, as far as actually *passing* the required specifications. "We never stopped doing proof tests here," says Dick Beard, a regional engineering manager for Continental Cablevision. "So other than trying to run the tests through the convertor, we didn't have any problems meeting specs."

Sammons Communications was also prepared to meet the specifications, according to its Field Service Engineer Leslie Read. "We've had testing going on since the mid-1980s, so we were not at all blindsided by these tests," Read says. And, over at InterMedia Partners, Large primed his systems by performing what he calls a "wake-up call" of the required proof tests. "We did preliminary tests before the actual set of proof tests was due to be made," Large explains.

The biggest area of refinement going forward will likely be data assimilation and reporting, simply because it's a huge task. "It's unbelievable," says Rogers. "By the time you're finished collecting the data, you're left with a stack of maybe 300 or more pieces of paper."

Which raises the question: if the proof tests have run the gamut from panic to perplexity to a pain-in-the-neck, what's the final analogy? Proof of paperwork? CED

By Leslie Ellis

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Incoming microwave	Equalizers
Satellite receivers	Amplifiers
Processors	Fiber paths
Modulators	Reprocessing
Bandpass filters	Microwave (single channel)
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Encoders	FM supertrunks
Satellite decoders	Diplex filters
Cable	Routing switches
Passives	Ad insertion equipment
Taps	House amplifiers
Set-tops	Channel substitution

Note: Not all items listed above are required by the FCC to be tested. These are the items, however, that can affect end-of-line convertor measurements.

Table 1

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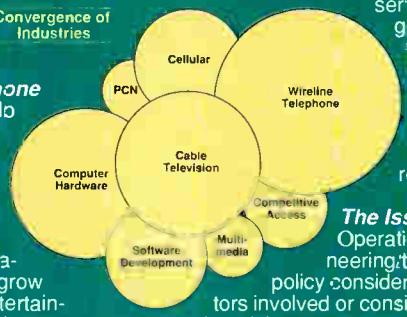

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The headend of the future

Cable television headends are currently going through a period of radical transition. The changes are made possible by technology, driven by economics, and are bringing in their wake, simultaneously, a wealth of new services that promise to transform the nature of the cable industry.

The traditional headend has been a collection point for multiple audio and video signals, received from over the airwaves, microwaves or satellite. These signals are combined together and sent out over common distribution cables, to be ultimately viewed in the home. The main modification to this traditional concept is the advent of fiber optics, the power and flexibility of which will allow the increasing use of digital compression.

The most important ramification of this technological advance, according to Stephen Dukes, vice president of advanced network development at CableLabs, is the regional hub concept. "The intent of (the regional hub concept) is to centralize as much advanced functionality as possible. Instead of placing the functionality in the headend, it will be placed in the regional hub that will use a ring facility to connect to the various headends," Dukes submits.

The benefits of this consolidation, explains Dukes, include a shared investment which reduces the number of components that have to be placed at each headend. For instance, instead of placing video or digital storage devices at each headend, there will be mass storage at the regional hub. This, in turn, "will lead to a more efficient utilization of human resources," says Dukes. "Instead of having an expert on mass storage at every headend, you'll have just one at the central point."

Will the "typical" headend shown above exist as we know it in 10 years–or even five years? Photo by Don Riley.

A central office in the future?

What will the new headend look like? Andy Paff, president of Optical Networks International, says it will resemble a telephone central office in function. Furthermore, traditional headend locations may undergo a radical change: "A typical remote headend in many cases may be underground, without the need for people to be there 24 hours a day—or even one hour a day," Paff says.

Because the headend is going through a period of such rapid alteration, there's little consensus as to what the physical dimension of a headend will be, or even just what is or is not a headend. For instance, some say the local hub location is really not a headend—that a headend has more functionality than that. Others argue just the opposite. In the former case, the headend will be growing larger and more complex; and in the latter case, it becomes smaller and more compact. Then there are those who say the hub unit is not a headend, but a "super headend."

Still another change, in terms of both function and appearance, will result from increased digital capacity. Warren Davis, manager of product and technical operations at Standard Communications, points out that unlike analog technology, digital devices will make every service the same. "Soon, everything will look like computers—and be computers; boxes with video coming out of them."

Another anomaly is that, given the premise that consolidation is the driving force in the industry, it would appear that the number of headends would dramatically decrease in favor of what we will call the "super headend." Conversely, however, the opposite seems to

By Michael J. Major

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be occurring. The number of conventional headends had often been quoted to be about 9,000; but according to a 1992 NCTA report, the number of headends had grown to 11,340 by the time the report was published.

A splintering effect

Paradoxically, the consolidation of larger headends also means the spawning of smaller ones. David Fellows, senior vice president of engineering and technology at Continental Cablevision (but who was interviewed for this story in his former capacity as president of transmission systems at Scientific-Atlanta), offers the analogy of Eastern Europe.

"At the same time you're seeing Eastern Europe consolidating with and trying to become one with Western Europe, you're also seeing a splintering effect, as in Czechoslovakia and Yugoslavia. The same thing is happening with headends. While you're seeing more people aggregating and consolidating headends for the purposes of ad insertion and monitoring and maintaining the larger headends, you're also seeing people targeting smaller and smaller sections of a franchise, such as Joe's Bar and Grill advertising in Joe's neighborhood."

Furthermore, points out Scott Bachman, CableLabs' vice president of operations technologies projects, a completely different evolution is taking place for very small, widely dispersed rural headends, which cannot justify the costs of fiber optics, or even microwave technology.

"One member came to us explaining that he covered about half a dozen states with about 10,000 subscribers on about 450 headends—the average one serving only 200 to 300 people," says Bachman. "He's so small and dispersed that he can't add channels or use interconnect technology."

The solution here, Bachman suggests, is using digitally compressed audio and video services from satellites which pass through an inexpensive transcoder into subscribers' homes, which will be equipped with digital decompression boxes. Thus, small headends will stay in place and, in fact, increase in number in remote areas to provide local services. Meanwhile, the subscribers will be outfitted with digital decompression boxes and have access to a greater range of services. Under this scenario, the cost to the operator is minimized.

In view of the fact that the consolidation of traditional headends into super headends in some areas will spawn an increased number of conventional headends in other areas, one might think equipment manufacturers might view the future as a period of diminishing sales. Just the opposite is true, however. Furthermore, according to Fellows, the super headend will require an increased level of quality, plus redundancy backup equipment and new monitoring devices which will automatically signal anything that's gone wrong.

Economics is also a motivating factor encouraging MSOs to embrace the new technology. But this, in turn, raises the question as to just how culturally compatible competitors might be in interconnecting with each other. Historically, headends have been separated by franchises that have not necessarily been formed to provide optimum efficiency within any particular geographic area.

Paff says: "Operators will start out interconnecting their own headends, and then they will see how wider relationships will work. There may be some problems, but it's now 10 years after the franchise wars have ended. So the competitive forces are not as great as they were then, and there has been a successful number of clusterings."

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Cooperation has already been going on for a number of years in the form of ad interconnects, the structure of which allows a national advertiser to negotiate with one party for an entire geographical area, instead of dealing with several different operators within that locale. Consolidation should enhance this process, for there's economic motivation for increased cooperation.

As Bachman points out: "National spot TV advertising is a $9 billion a year business, but of that cable gets only $150 million to $170 million. Since cable has 25 percent of the viewers, our share should be between $3 billion and $4 billion. The new technology should make the situation more cost effective for ad interconnect agencies."

Better quality

Michael Smith, director of engineering in Adelphia Cable Communications' Virginia region, says that operational efficiency is the primary driving force for new technology, and that is bringing in its wake not only economic benefits but also improved picture quality and services.

Paff explains that as modules evolve that can remotely monitor and control remote units, specifications have to improve over what had been acceptable for headends designed in the mid 1970s. This means pictures will be cleaner and better, with reduced distortions—and bandwidth will increase, too.

The greater bandwidth will significantly increase the number of entertainment offerings. The super headends will provide an increased capacity to store those offerings. But, even here, this will not necessarily mean a dimunition of conventional headends. As explains Dukes, "As demands increase, you may find some migration into conventional headends. For example, you may have 40 to 200 movies stored at the regional hub in such a fashion that you can play one every 15 minutes. But as demand increases and traffic congestion builds, it may warrant the migration of the top 10 movies to the conventional headends."

Dukes adds that "as time goes on, you will have both the analog and digital components distributed over separate fiber facilities in the same sheath with some kind of combining facilities in the hub through which the programs will be transmitted to the homes."

New services will multiply. For instance, Paff says that near video-on-demand, a derivative of compression technology that allows a person at home to access a number of movies transmitted in windows of 1 to 10 minutes in length, during which time the viewer determines what he wants to watch, should be available in 1994.

Some time after that should come video-on-demand, a more complicated technology through which a customer can select from a wider range of offerings and instantly get what he wants. Also on the way are services such as telephony, alternative access and data communications, in which the cable plant is used to transmit non-entertainment information. Multimedia, interactive shopping and other programs are other possibilities on the horizon.

So, while some see a future with fewer headends woven together by fiber, there will clearly be a need for local signal control, too. Until someone figures out how to miniaturize devices to where they could be mounted in a pedestal or hung on a strand, headends will continue to exist—all the while becoming more complex. CED

Mr. Major is a freelance writer living in Port Townsend, Wash.

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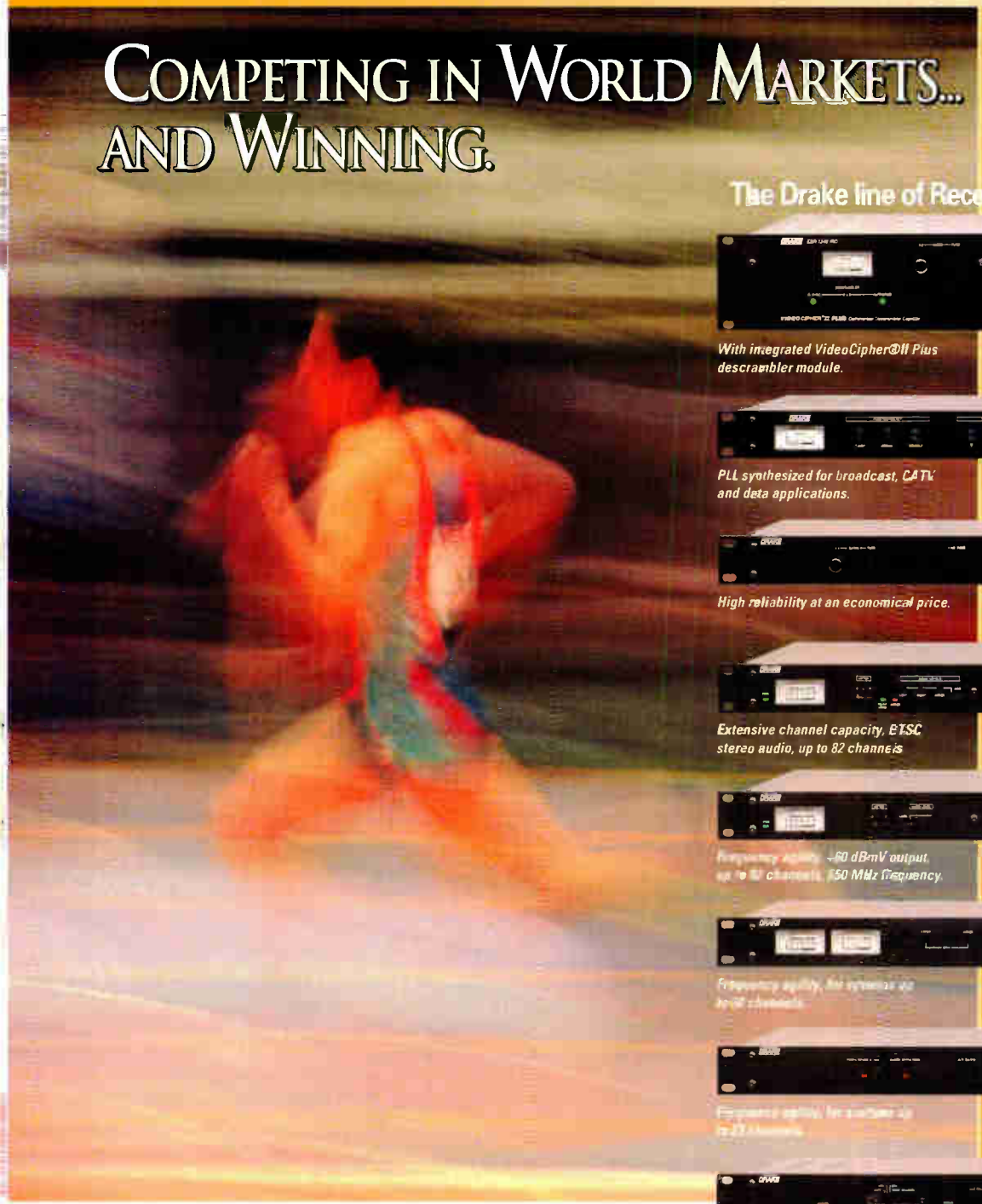

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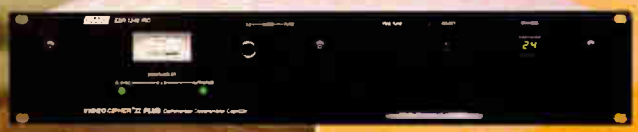

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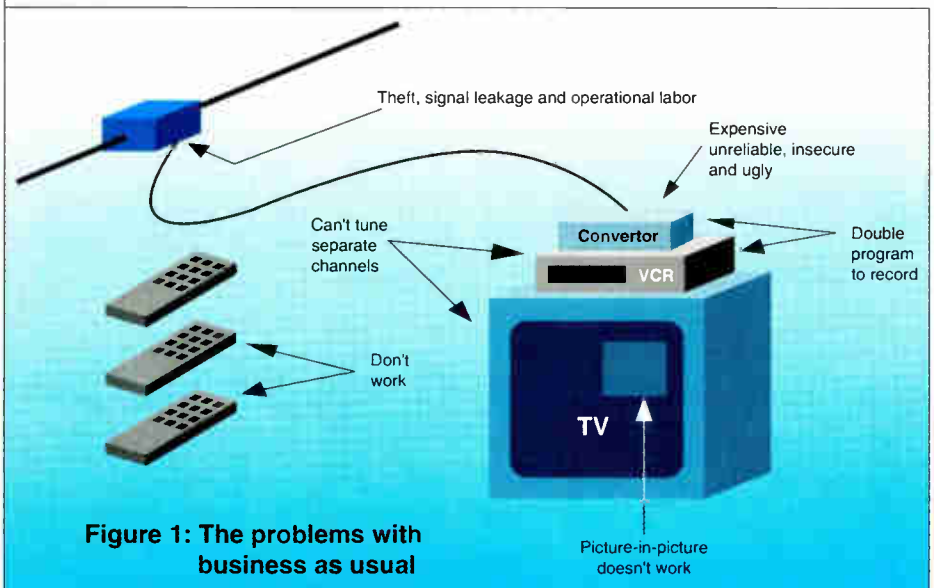

Figure 1: The problems with business as usual

The Federal Communications Commission has issued a Notice of Inquiry[1] to gather information on the available options for delivery of cable signals to customers in ways that do not mess up the features of TV sets and VCRs. This will be followed up by a Notice of Proposed Rulemaking that will result in mandatory rules for operators to follow. The final rules will be issued by April 1994. In other words, the Commission will attempt to solve, by mandate, the same sticky incompatibility problems that the industry has been trying to solve for more than 10 years!

This article is presented as a tutorial for cable operators covering the rulemakings in progress and the available technologies for solving the core issues. The views expressed are purely those of the author.

The law

The FCC didn't ask for this problem. It was mandated by the Cable Act of 1992.[2] That comprehensive piece of legislation actually contains several provisions that will effect this rulemaking. The key provision is as follows:

"Within 1 year after the date of enactment of this section, the Commission, in consultation with representatives of the cable industry and the consumer electronics industry, shall report to Congress on means of assuring compatibility between televisions and video cassette recorders and cable systems, consistent with the need to prevent theft of cable service, so that cable subscribers will be able to enjoy the full benefit of both the programming available on cable systems and the functions available on their televisions and video cassette recorders. Within 180 days after the date of submission of the report required by this subsection, the Commission shall issue such regulations as are necessary to assure such compatibility."

So that there is no doubt of what is intended, the law goes on to list common complaints of cable subscribers:

- The inability to watch one channel while simultaneously recording another.
- The inability to perform a timed recording of programs on different channels.
- The inability to use "advanced television picture generation and display features" (read that picture-in-picture, or PIP) of television sets.

To its credit, Congress gave the Commission some critical latitude in dealing with the issue. In particular:

"The regulations prescribed by the Commission under this section shall include such regulations as are necessary. . . to specify the technical requirements with which a television receiver or video cassette recorder must comply in order to be sold as "cable compatible" or "cable ready". . . ."

Thus, the FCC is allowed to consider solutions that might involve some modification to the characteristics of consumer equipment that is specifically designed (by the nature of its tuning range) to be connected to cable systems. At the very least, the Commission can deal with the existing problems (such as direct pickup of strong off-air channels, signal handling ability and excessive VCR signal loss) that plague operators and their customers today. Equally important, it can consider solutions such as mandatory implementation of the ANSI/EIA Decoder Interface Connector, which has been slow to develop because of the lack of voluntary compliance.

The Commission's task is made more complicated by a number of other provisions in the new law which directly affect the interface problem:[3]

"Basic tier" service. The law establishes a basic tier of service which includes all broadcast stations[4] plus PEG channels. Except where effective competition exists, this service will be rate-regulated, primarily by local authorities.[5]

Channel position requirements. Assuming for the moment that the must-carry provisions withstand legal challenge, each local station demanding carriage will be able to choose a channel position from among:

- Its over-air channel number,
- Its position on the system on July 19, 1985, or
- Its position on the system on January 1, 1992.[6]

Thus, unless the station agrees on a position that best works for the cable operator, the basic tier service may include several non-contiguous channels in the spectrum. Delivering this level of service while protecting other tiers of programming presents a further technical challenge, particularly in light of the consumer-friendliness provisions and the need to hold down the cost of the service. The situation is complicated even more by the potential need to continually modify the channel lineup of the basic tier as stations exercise their right (every three years) to choose between must-carry status and retransmission

By David J. Large, Director of Engineering, InterMedia Partners

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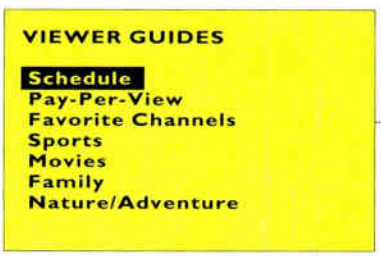

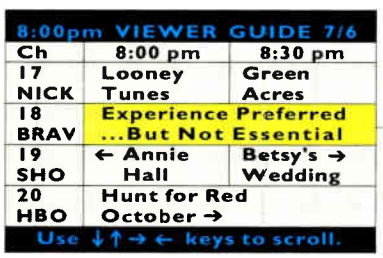

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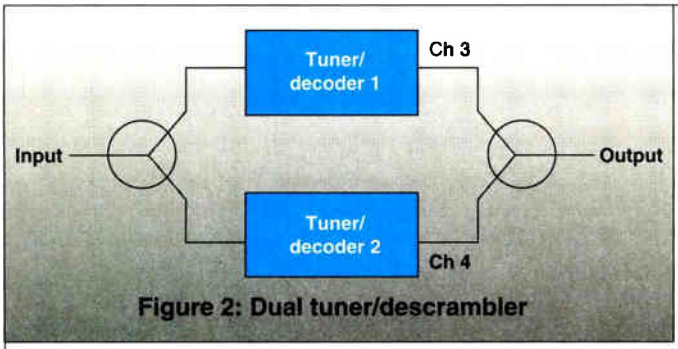

Figure 2: Dual tuner/descrambler

consent.

Anti-buy-through requirements. As a further protection for subscribers to the basic tier service, operators are forbidden from requiring subscription to any higher tier of service as a pre-condition to buying a premium channel or pay-per-view event.[7] Thus, the operator is faced with the technical problem of selectively opening up access to premium and PPV channels without also giving away other tiered channels.

The option of scrambling everything except for the basic tier flies in the face of the consumer-friendly delivery of cable services. Under the law's provisions, the FCC is allowed to limit cable operators' use of scrambling if there are other methods available to control program access which are both technically and economically feasible.

Future extensions to HDTV. The Commission is specifically directed to modify the must-carry rules as required to assure that cable operators carry local advanced television (HDTV) broadcast stations.[8] Thus, proposed solutions should take into account this pending development.

Should the FCC allow local broadcasters to transmit multi-program digitally compressed signals (as some broadcasters have suggested), the stations would probably also argue that this provision should also apply to those signals.

Other requirements

Aside from the Cable Act of 1992, operators need solutions that will meet their business and competitive requirements in the long run. Not only must they accommodate today's need to satisfy customer's expectations, but they must capitalize on the advantages of cable television's delivery system as compared with MMDS, DBS and potential telephone company systems. They must be compatible with HDTV, extended bandwidth delivery, and the delivery of digitally compressed signals and must work in a market that may be dominated by per-event or per-channel marketing.

Exploiting cable's advantages. Were it not for the need to selectively control program access, cable would have an inherent advantage over such systems as DBS in being able to deliver all of its programming simultaneously, while the DBS receiver can only receive a single channel at a time. Thus, second sets and VCRs will require a second receiver or a more expensive dual receiver of some sort. Solutions which allow cable to exploit this difference while selectively controlling program access need to be carefully considered.

Extending to digitally compressed channels. It now appears cable operators will be delivering digitally compressed channels by late 1993 or early 1994. As the industry moves aggressively to capture some of the revenue stream that now goes to the video cassette rental business, it may well

find that the virtual channel capacity afforded by this technology is the most cost-effective approach.

Significantly, none of the existing methods of controlling program access is capable of controlling individual digitally compressed services. In order to realize the benefits of this new technology, operators will need to supplement or replace existing control technology. In order to minimize the cost, it may be most practical to move all per-channel and per-event services to this new technology.

Extending to HDTV. Aside from the Congressionally-mandated future carriage of broadcast HDTV stations, it can be expected that cable programming services will simulcast, then migrate to, this new format. In fact, those programmers whose services are primarily based on film product can be expected to lead, not follow, the broadcasters in this change. The reason is simply that it will be less expensive to deliver film product (which is already HDTV quality and format) via an HDTV transmitter, than it is to convert all of the studio, production and post production equipment in a station, and to build an entirely new transmitter and antenna system.

As with digital compression, existing scrambling systems were designed specifically to control NTSC analog signals and will need to be supplemented or replaced to control HDTV signals.

Extended bandwidth. Cable systems are now being built with 750 MHz to 1000 MHz operational bandwidth. This is beyond the tuning capability of existing convertors and consumer equipment. Solutions are necessary to deal with the expected uses of this expanded channel space.

How did we get here?

While many would argue that the Cable Act of 1992 is not as well written as it could have been, there is no arguing with the frustrations that led to the consumer interface provisions. In the early days of cable, operators protected services with traps, both positive and negative. Traps are very consumer-friendly, in that they deliver all subscribed services in parallel and avoid the problems of convertors. For many operators, especially smaller operators, they are still the method of choice.

On the other hand, the security (especially with positive traps) is very limited and the effect on picture quality is noticeable. They also require a lot of labor every time service levels are changed and, for that reason, almost totally preclude PPV sales. Finally, because of the lack of total RF shielding in many television sets, convertors are sometimes required anyway, just to overcome direct pickup problems.

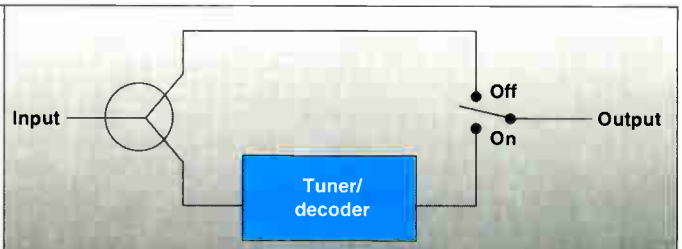

Figure 3: Convertor with bypass switch

Most cable operators in larger systems have selected the addressable convertor as the only option that provides adequate security against premium service theft while allowing simple upgrades and downgrades for customers and sales of PPV events.

In addressable systems, the cable convertor is typically installed ahead of the VCR and television. In that position, it delivers only a single channel to TV and VCR, thereby causing all of the ills listed above.

Moving the convertor to a position between the VCR and TV allows independent tuning, but denies the VCR access to the premium services and complicates the playback process.

The cable industry has long been aware of the awkward problems created by convertors. In 1986, the Consumer Interconnect Subcommittee of the NCTA Engineering Committee issued a report that detailed all of the existing and some proposed solutions to these problems.[9] Few of these solutions were implemented because all solved some part of the problem at the expense of added complexity of equipment and none offered a complete solution.

In the same period, the Electronic Industries Association (EIA) and NCTA formed the Joint Engineering Committee (JEC) to deal with all of the interface issues. The group worked in three specific areas related to consumer interface issues:

• **A uniform channelization standard: IS-6**. To eliminate confusion among several numbering schemes, this standard spelled out a unique relationship between channel number and frequency. This standard was adopted and is in effect, though efforts are underway to update it to accommodate channels above 99.

• **A post-tuner port in consumer equipment for descrambler attachment: ANSI/EIA 563**. Because most of the interface problems arose from placing the convertor's tuner ahead of that in TVs and VCRs, adding a port to consumer equipment *after* the tuner would allow a lower-cost "black-box" descrambler to be placed on the back of the set.

While the standard was adopted, it has not been widely implemented because of a "chicken-and-egg" problem that requires a significant concentration of both consumer equipment and convertors that conform to the standard to make it useful. This option will be discussed in detail. Meanwhile, the standard itself is under discussion to see what modifications will be necessary to accommodate digital transmission.

• **A definition of the desirable characteristics of reception equipment to be connected to cable: IS-23**. The third effort was to acquaint each industry's engineers with the technical requirements and limitations of the other. The resultant document, "CATV RF Interface Specification for Television Receiving Devices," contains information on delivered signal levels and their variation, tuning range, shielding required, local oscillator leakage and other parameters needed to assure a trouble-free connection to a cable system. This document is under active negotiation (and has been since before 1985) and, when finished, will contain much of a functional definition of a "cable-ready" device.

The problem with many of these earlier efforts, of course, is that they predate Picture-in-Picture (PIP), HDTV, digital compression, interdiction, broadband descrambling and other technological problems and proposed solutions.

The available solutions

There are many technical approaches to the simultaneous problems presented by the Cable Act of 1992, the needs of the EIA and NCTA member companies, and the extensions required to accommodate new technologies. Each will be examined for its ability to meet all these needs. The available solutions for the industry fall into three general groups:

• **Modifications to current set-top technology**. These solutions represent various incremental improvements on current set-top descramblers to overcome some of the problems.

• **Broadband solutions installed external to, or at the point of entry of, the residence**. All of these solutions have as their goal the delivery of

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most or all programming simultaneously in descrambled form, so that no convertor is required on the TV set.

• **Solutions based on the Descrambler Interface Connector.** These solutions assume that such a connector becomes a mandated feature on cable-ready receivers, thus overcoming the start-up problems that have plagued this approach in the past.

Set-top solutions

Set-top solutions involve modifications of the technology currently used in tuner-descramblers. All have the advantage that advanced features such as smart on-screen program guides, subject search menus and recording assistance can be accommodated. They also have the advantage that all can be provided on a compatible and incremental basis to all types of existing scrambling systems.

Existing set-top options have gotten a bit of a bad rap. Of the three consumer electronics compatibility problems mentioned in the Cable Act, the second is solved by all brands of set-tops currently available (using built-in timer options, in conjunction with VCR timers). Switchers are available to allow simultaneous access to any non-scrambled channel and any selected scrambled channel. Use of two descramblers will grant simultaneous access to two scrambled channels and, in many cases, will allow even PIP displays to work. While some of these solutions are not as convenient as one might like, they do provide the functionality described in the Act.

Unfortunately, any system based on current scrambling technology will require replacement or augmentation to control of HDTV and/or digitally compressed programming. Also, no convertor-based system offers effective control over access to the lowest level of service, so that manual connection and disconnection of drops will still be required.

In general, it has been assumed for this analysis that the requirement to offer a basic tier service which contains non-contiguous channels will require the scrambling of all tier channels. While this places additional challenges on offering service in a consumer-friendly way, it also offers an additional level of security because a person who steals basic service will not have access to any optional programming.

Some of the more interesting proposed or available modifications to standard descramblers are as follows:

Dual descramblers (see Figure 2).

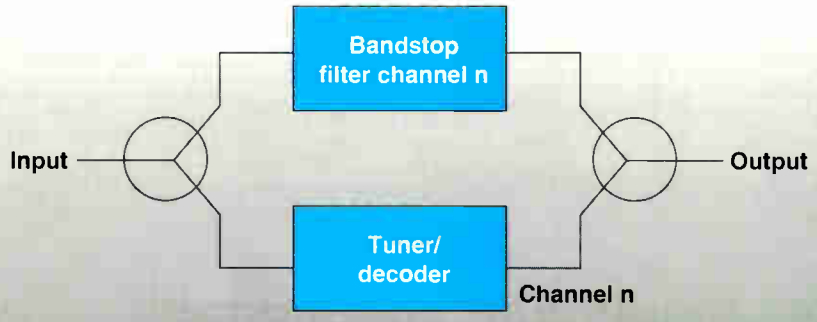

Figure 4: Convertor with bypass filter

Normal addressable convertor-descramblers could be modified to include two tuners and decoders, with outputs on different channels combined on single output cable. A slightly modified remote control could control both tuners' input channel selection. Because a common case, addressable data receiver and power supply would be used, the cost should be somewhat less than two independent units.

The advantage that this device offers is simultaneous access to two channels, rather than a single channel. The two channels can be any combination of basic, tier or premium services.

The limitations are that it doesn't get rid of the redundant remote control, or restore the tuning capabilities of the TV or VCR. Also, it doesn't permit access to *more* than two channels.

Bypass switches (see Figure 3). One currently available, low-cost, option from several manufacturers is a switch that completely bypasses the box when it is turned off. That permits all non-scrambled signals to be delivered simultaneously to VCR and TV, but not at the same time as any scrambled signal.

Unfortunately, if cable operators choose to scramble tier signals because of the anti-buy-through and must-carry provisions of the Cable Act, then only the basic tier channels will be available in the bypass position. Also, it means that the customer must use the convertor's remote when tuning scrambled channels and the TV or VCR remote when the convertor is off, adding to confusion.

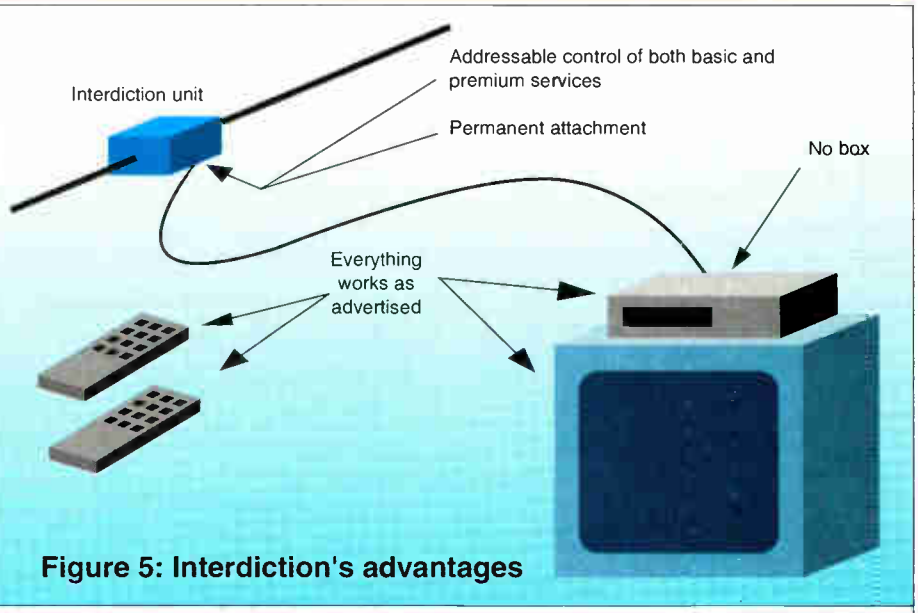

Figure 5: Interdiction's advantages

Bypass filters (see Figure 4). A basic bypass convertor splits the input signal. One leg feeds a conventional tuner/descrambler whose output is on a fixed channel. The other leg passes through a band-stop filter which removes all signals from the convertor output channel, but passes the rest of the spectrum. The two legs are combined into a single output which includes nearly all the input channels, plus the convertor-selected channel, which may be any channel, whether

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scrambled or not. This product is currently available from one convertor manufacturer and is a moderate-cost option.

If operators need to scramble tier channels, customers will be limited to simultaneous access to the basic tier channels plus any one other selected channel.

Basic bypass convertor with trapped basic tier service. If, as some expect, the percentage of subscribers who take only basic tier service is low, then it might be practical to block access to tiered services in such homes using traps, (despite their being possibly on non-adjacent channels). If that were done, then the tiered services would not have to be scrambled and the basic bypass convertor solution would allow simultaneous access to all non-scrambled services plus the selected scrambled service. With future upgrades to convertors, the scrambled service could be HDTV or a digitally compressed service, as well as an NTSC channel.

Broadband solutions

Traps. These are the original signal control technology and are still in widespread use, particularly in rural and smaller systems. There are two types: negative and positive. Negative traps work by notching out the visual carrier of the signal to be denied, while positive traps work by notching out an interfering carrier intentionally inserted at the headend.

The advantages of the trapped solution are that it meets all the consumer interface tests in the Cable Act for all levels of service (including additional outlets) and has the lowest initial capital cost of any option.

Against its advantages must be considered a host of problems with the trap solution:

• *Poor solution for tier protection.* Controlling access to tiered services separately from the basic tier is very difficult with non-contiguous channels using traps because of the number and awkward configuration required.

• *Security.* While a properly installed and functioning negative trap offers a reasonable degree of security, traps that drift or are tampered with fail to block their designed channels without offering physical evidence of malfunction. Positive traps are worse: the basic scrambling is easily defeated and stolen traps can be installed inside the house where they are difficult to audit.

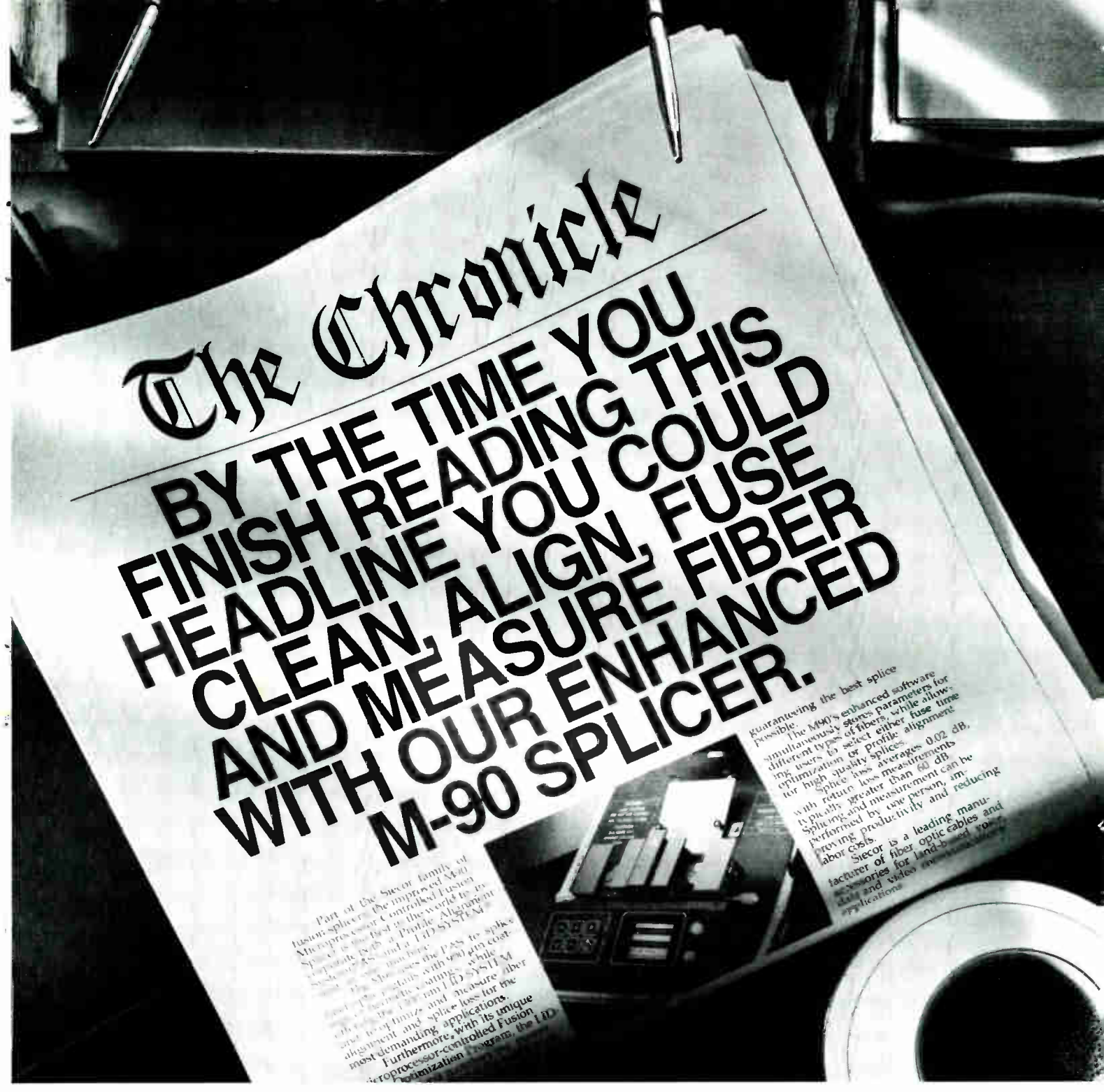
• *Loss of signal strength.* Each trap inserted in a drop adds to the total loss: greatest in adjacent channels, but also across the entire spectrum. The degree of this effect increases as the protected channel increases in frequency so that traps are typically not usable at the higher cable channels.[10]

• *Lack of transactional capability.* Because traps are manually inserted and removed, it is impractical to offer transactional services such as PPV on a regular basis.

• *Picture quality.* Conventional positive traps, in the process of removing the interfering scrambling carrier, also remove a portion of the picture information, resulting in pictures which are noticeably "soft" compared with non-scrambled signals. As with negative traps, this effect increases with frequency, limiting the channels over which the technology is useful. The newer technology shaped bandpass traps suffer less from this problem.

• *Lack of adaptability to new technologies.* Traps are not expected to have the ability to control digital transmissions used for both HDTV and digitally compressed signals.

Interdiction (see Figure 5). Interdiction works by selectively interfering with non-subscribed services in each



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drop line. Physically, units can be used to replace conventional taps. Existing units can control the connect/disconnect function as well as individual channels and operate under full addressable control. Because the scrambling takes place in the drop, signals in the trunk and feeder system are all transported in the clear.

This is a developed technology with several medium-sized installations under way or complete, two active vendors, and two others who have demonstrated prototypes. The inherent advantages of this technology are many:

• *Fully compliant with Cable Act requirements for NTSC and HDTV.* The use of interdiction fully satisfies the specific consumer issues raised by the Cable Act for both NTSC and HDTV signals as all subscribed services are delivered simultaneously and in the clear to all outlets.

• *Full addressable control.* Basic cable service, tiered channels, premium services and transactional services are all addressable. Thus, offering non-contiguous tiers is not a problem. Connect/disconnect control provides major savings in installation labor.

• *High signal quality.* Because the interdiction system operates by interfering with non-subscribed services, all subscribed services are delivered in clear format from the headend to the subscriber.

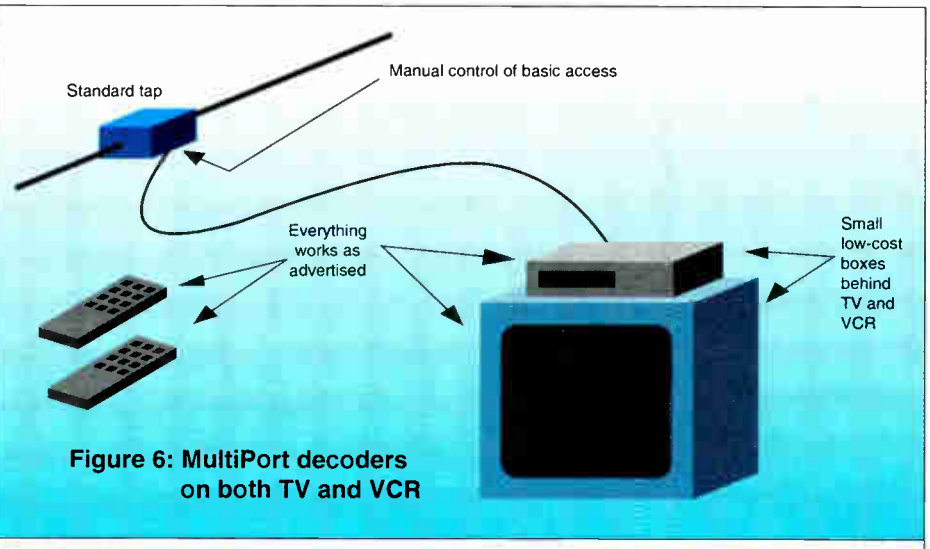

Figure 6: MultiPort decoders on both TV and VCR

• *Better cable plant integrity.* When basic service is controlled by physically connecting and disconnecting the drop cable at the tap, that connection must be made so as to be easily changed. The effect has been that a disproportionate number of system problems and signal leakage defects occur at the tap/drop interface. Use of interdiction allows that connection to be made permanently, and therefore of much higher quality.

• *Security.* Unlike positive trap or set-top convertor scrambling schemes which are designed to be descrambled using low-cost hardware, interdicted signals are designed to be unrecoverable. Thus, a higher degree of scrambling security is possible.

Against these advantages must be considered some disadvantages:

• *Higher initial cost.* Unlike addressable set-top descramblers, which are normally installed only the homes of subscribers who take premium service levels, interdiction units (which cost about as much per port as set-top descramblers) are generally installed at every tap location where there are one or more active customers. Because they are not compatible with existing scrambling systems, incremental installation is awkward.

• *Reduced trunk/distribution security.* Against higher drop security must be balanced the risk of transporting premium channels in the clear in the trunk and distribution networks, particularly a problem in multiple-unit dwellings.

• *Power requirements.* Unlike passive taps, the units must be powered, adding to operational costs.

• *Digital compression limitations.* The broadband technology used in interdiction has no way to control digitally compressed signals, so future implementation of that technology will require independent control hardware.

Note: a system equipped with interdiction could be extended to control digitally compressed signals through means of a set-top digital decoder built into a convertor box with a basic bypass filter, as described above. This would allow the subscriber simultaneous access to one selected digital service, plus all

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other basic, tier, premium and HDTV services subscribed. Thus, unlike set-top solutions to the short-term interface problems, the investment in broadband technology continues to provide full benefits.

Broadband descrambling. Broadband descrambling is a proposed system that utilizes digital signal processing technology to allow simultaneous descrambling of conventionally sync-suppressed scrambled TV signals that are authorized. Like interdiction, it could be installed anywhere along individual customer's drop cables. The technology has been prototyped and demonstrated, but it has not been developed as a product. Because of this, the final cost and features are unknown.

Unlike interdiction, it offers compatibility with the most common scrambling technology. Thus, broadband descrambling could be installed incrementally in a system already using descramblers and systems would realize the trunk line security resulting from headend scrambling of all optional services. Also, it is theoretically possible to further scramble non-selected channels, thus increasing security.

One limitation of the technique is that it is not compatible with all scrambling schemes. Thus, should there be a major violation of scrambling security, operators would be limited in available countermeasures.

Another limitation of broadband descrambling is that it requires time synchronization of all controlled channels at the headend. This must be done carefully so as not to increase overall system distortion.

In summary, broadband descrambling is a promising technology, but needs further work before it can be included as a viable solution.

Decoder Interface

The Decoder Interface (see Figure 6), as currently defined,[11] is a low-cost connector that can be included on TVs and VCRs to provide a loop-through for the video and audio signals after tuning and detection. It was designed so that all sync suppression and baseband scrambling systems then known could be accommodated in a tuner-less configuration behind the set. Currently, modifications are being considered to accommodate digital transmission so that it will also work with digital compression and HDTV.

The Decoder Interface, or MultiPort, solution offers many advantages:

- *Lower cost than set-top descramblers.* By eliminating the redundant tuner, remote control, cabinet and display, it is expected that Decoder Interface descramblers could be provided for less than one-half the cost of a conventional set-top unit.
- *Incremental deployment.* Because descramblers are compatible with existing security systems, they could be deployed gradually as new consumer receivers become available with ports.
- *Compliant with Cable Act requirements.* Descrambling takes place after the TV or VCR tuner, so nothing restricts the tuning capability of either device (provision of multiple decoders for PIP TV sets needs to be worked out). Tier services could be scrambled to restrict access without inhibiting consumer features, so the technology works well for separation of basic from tiered services.
- *Retains advanced program guide features, if properly configured.* In order to use down-loaded program guide information, the drop cable would need to loop through the descrambler on its way to the TV antenna terminals. With that installation option, the device should be able to access most advanced guide features.

Because both HDTV and digitally compressed NTSC channels are to be transmitted in standard 6-MHz channels, if the MultiPort definition is slightly modified to require passage of not only the detected signal, but the full-bandwidth pre-detection signal, then both new technologies can be accommodated in a MultiPort-type device. In order to assure this future upgradeability, however, the re-definition should take place before there is volume deployment.

Author's note: It has been suggested by some that, instead of providing an external jack for a descrambling adapter, the industry agree on a common scrambling method (as was done with VideoCipher in satellite feeds) so that receiver manufacturers could build the descarmbler in all new devices. In general, the cable industry feels that the incentive for pirates to break any such system would be very great. Should it be defeated, it would be very difficult to upgrade or change a nationwide security system. For that reason, that solution is not considered here.

Conclusions

It can been seen from the chart that, except for existing single channel con-

Continued on page 83

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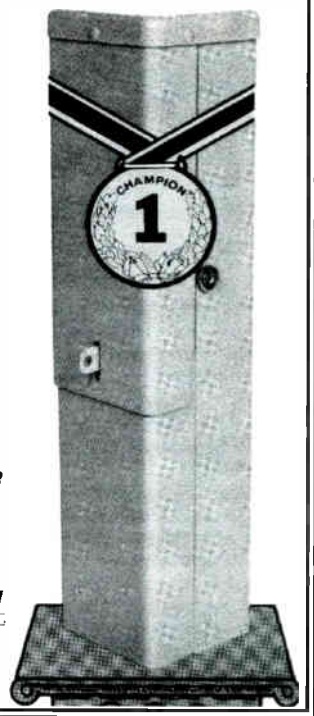

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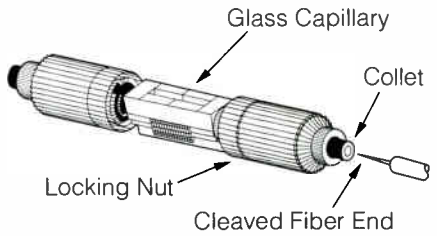

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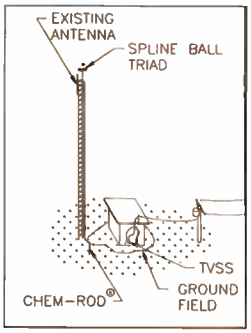

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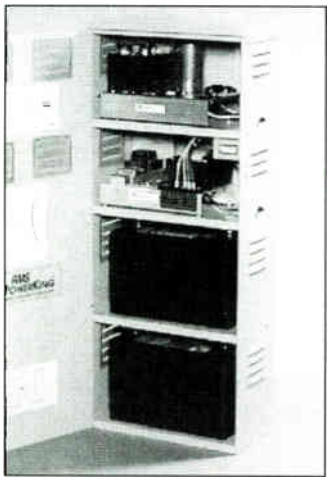

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Compatibility chart

The chart summarizes the degree of compatibility of various solutions with the Cable Act consumer interface requirements and extensions to HDTV and digital compression. It also shows the degree of addressable control provided, relative capital costs for full deployment and the practicality of incrementally deploying it where existing set-top descramblers are in use. Finally, the degree of signal security is shown. Shaded cells indicate areas in which a technology is superior. Relative costs and security are indicated by "+" (greater), "-" (lessor), or blank (about the same), relative to standard set-top descramblers.

Technology	Cable Act consumer compatible	Addressability			Future technologies		Relative NTSC		Incremental deployment
		Basic*	Tier	Premium	HDTV	Compression	Security	Cost	
Existing technology									
Set-top convertors	Partial	No	Yes	Yes	Replace	Replace			n/a
Traps	Yes	No	No	No	No	No	-	-	n/a
Set-top convertor modifications									
Dual descrambler	2 channels only	No	Yes	Yes	Replace	Replace or augment	+	+	Yes
Bypass switch	Basic only	No	Yes	Yes			+		Yes
Bypass filter	Basic + 1 other channel	No	Yes	Yes			+		Yes
Bypass filter + trapped tier	Basic, tier & 1 premium	No	No	Yes					Yes
Broadband solutions									
Interdiction	Yes	Yes	Yes	Yes	Yes	Add bypass digital convertor	+	+	No
Broadband descrambling	Yes	Yes	Yes	Yes	Yes		?	?	Yes
Decoder interface solutions									
Decoder interface	Yes	No	Yes	Yes	Augment		+	-	Yes

* Note: Basic service addressability can be provided with any technology through use of an addressable switch at the tap ("addressable tap") for added cost of approximately $20-$30 per passing.

Continued from page 74

vertors (and possibly those with just a bypass switch), all of the solutions discussed meet the specific requirements listed in the Cable Act of 1992. Some, on the other hand, go far beyond the minimum requirements in both consumer friendliness and extensibility to future technologies.

The solutions each offer some unique advantages:

• Traps offer few consumer interface problems, but are plagued by their lack of addressability, poor security and unavoidable picture degradations. Nevertheless, they are the most cost-effective solution for many small and/or rural systems.

• Various modifications to conventional set-top convertor/descramblers (especially the bypass filter) go a long way toward overcoming the limitations of standard units. They have the advantage that they can be installed as required and co-exist with other convertors and/or MultiPort-equipped receivers. Also, while convertor-based solutions require replacement to accommodate control over HDTV or digitally compressed channels, that can, also, be done on an incremental basis. If operators choose to scramble, rather than trap, tiered services, they realize a higher overall security and flexibility, but at the expense of some consumer compatibility.

• The broadband solutions offer the greatest degree of consumer friendliness at first installation, controlling both NTSC and broadcast format HDTV without any hardware change-out required. They also offer higher security than conventional scrambling and operational benefits in controlling access to basic, as well as optional services. Against this, they have a relatively high first installation cost which will limit their cost-effective installation to dense, highly churned systems in which the operational savings can help pay for capital investment.

• The Decoder Interface approach offers the best benefit/cost ratio of any of the solutions. The MultiPort units are expected to cost enough less than conventional set-top boxes that, even with the additional cost for reception equipment (to cover the added cost for the jack) and separate decoders for VCR and TV, the total cost will be less than for a convertor.

Not only that, but initial installation and later upgrading to HDTV and digitally compressed services can be done incrementally, and for less cost than a full convertor changeout.

If addressable control of the lowest level of service is desired, in order to realize operational savings in convertor or

See "Large" on page 130

Defining 'cable-ready' consumer equipment

One of the many jobs facing the FCC under the Cable Act of 1992[1] is defining just what is meant by a "cable-ready" piece of television receiving equipment. One industry engineer has said that, in the loosest definition, any TV with an "F" connector input would qualify, but that by the strictest test (no avoidable interface problems) no TV that he was aware of could meet the standard. Detailed below is a definition of a cable-ready television reception device which assures a reasonable level of compatibility with cable systems.

The first question to be considered is what categories of device should be covered. The Cable Act of 1992 specifically refers only to television sets and VCRs and orders the Commission to determine what their characteristics must be if they are to be represented as "cable-ready" or "cable-compatible." Two simple tests should determine whether a device is covered: extended tuning range and suitability for direct connection to cable systems.

Extended tuning range. It would be a mistake for the FCC to define such sets only by the principle adjective used in their title. Otherwise, the market will simply be flooded with devices marketed as "cable-friendly" or some other moniker intended to imply compatibility without having to actually meet any technical requirements. A better, non-ambiguous test is whether the device tunes to channels used by cable systems and not in over-air broadcasting.

Suitability for direct connection to cable systems. The Part 76 rules specify a cable system's performance to the point of first connection to a subscriber device. As will be detailed below, the characteristics of whatever device is first connected to a cable system are critical to assure both non-interference to others and a reasonable expectation of functionality. Thus, any such device should be regulated under the new rules.

While the Cable Act specifically identifies TVs and VCRs, the rules must apply to customer-owned convertors as well. This is especially important because the Cable Act goes to some length to assure that customers have the right to purchase their own convertors from outside suppliers and these would otherwise be covered only by the minimal requirements of Part 15.[2] Since the main use of such convertors is to convert non cable-ready television equipment into cable-ready television equipment (by extending the tuning range to cover the cable channels), it is also consistent with the intent of the law.

Because FM radio receivers are typically very poorly shielded, it would be desirable to also include them under at least the sections having to do with ingress appearing at the input terminals and re-radiation of signals received at those terminals. Although cable operators can restrict the bandwidth of signals fed to these receivers, it is nearly impossible to prevent some aeronautical frequencies from being delivered to them as the aeronautical band is adjacent to the FM broadcast band at 108 MHz.

It is also almost impossible to prevent subscribers from making the connection to their FM receivers using unauthorized broadband splitters. The difficulty with including them under this regulation is that the tuning range of such devices is the same whether used for broadcast reception only or for cable FM reception and, thus, there is no way of distinguishing a "cable-ready" device.

Characteristics needed

Having decided which devices should be regulated, the next question is which characteristics of such devices should be regulated to achieve the aims of the new law. The following seem to meet the standard:

Characteristics which cause interference to others. Several properties of reception equipment can cause interference to reception by other subscribers, to non-subscribers or to other users of the radio spectrum.

- Local oscillator signals appearing at the input terminals.[3] With standard TV intermediate frequencies (IF), the local oscillator (LO) frequency when tuned to one channel will often be within another cable channel.[4] If this signal is transmitted back up the drop cable, some of it will couple through the tap and appear with the cable signals at the input to a neighboring receiver. In order to be imperceptible the level will need to be 60 dB below the desired channel. An interfering carrier at 55 dB down would be just barely perceptible.

Cable operators are required, under Part 76 rules, to maintain at least 18 dB of isolation between subscribers to minimize interference. In actuality, most taps sold are specified to have at least 20 dB of port-to-port isolation. Additionally, losses in drop cables add to the isolation. In an apartment situation, the connecting drop cables may be only 25 feet or so long, adding another 2 dB of total isolation.

The minimum signal level delivered by the cable operator must be at least 0 dBmV. Thus, the maximum tolerable local oscillator leakage is:

Minimum Desired Signal Level	0 dBmV
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= Maximum LO at interfered with subscriber	-55 dBmV
+ Subscriber Isolation	22 dB
= Maximum Allowable LO Leakage	**-33 dBmV**

This specification only needs to be met for LO frequencies which fall within the operating range of cable systems (a number which has risen to 1 GHz in 1992). Cable convertor manufacturers have solved the problem long ago (along with the image problem detailed below) by using double conversion reception in which the first LO falls above the cable system spectrum.

These problems can be difficult to uncover because they are transitory. The impaired receiver must be on a channel which is suffering from signals out of the other device. Changing either device's channel may temporarily eliminate the problem.

Another source of interfering backfed signals is all the digital circuits in modern TVs and VCRs. Digital circuitry is used in tuners, remote controls, on-screen displays and field stores for VCRs and picture-in-picture systems. Digital signals have an abundance of harmonics which can interfere with reception. Even switch-mode power supplies have troublesome harmonics.

- *Ingress signals appearing at the input terminals.* Sometimes, because of inadequate shielding, receiving equip-

By David J. Large, Director of Engineering, InterMedia Partners

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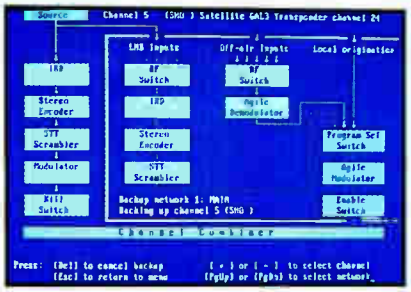

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ment picks up television or communications signals directly on its internal wiring. One symptom of this pickup is ingress interference (commonly called direct pickup or DPU) which affects the subscriber and is discussed below under performance issues. Another aspect, however, is the appearance of these signals at the input terminals where they can effect neighboring subscribers, just as LO leakage can.

The picture degradation can vary from "ghosting," if the same video information is present on the cable and off-air channel, to various kinds of beats, if the interfering signal is from a different radio service.

While the degree of tolerable leakage should be the same as for LO signals (-33 dBmV), it is more difficult to specify the maximum field strength of the off-air signal and the measurement technique. Both the Electronic Industries Association and CableLabs are looking into this problem. If it could be determined what percentage of television households live in what maximum field strength (and the cost of various degrees of shielding) the Commission could simply decide where the "knee of the curve" was in cost-benefit ratio in determining how many television viewers to protect from ingress problems.

The Canadian government has long held manufacturers to a standard of 100 millivolts/meter, however, many feel that a larger percentage of U.S. television households live in high RF environments. A 1 volt/meter standard has been suggested by some.

As cable bandwidth expands, the problem can be expected to get worse. UHF TV and radio signals are harder to shield. Circular polarization, becoming popular with broadcasters, also increases the penetrating ability of signals.

• *Re-radiation of cable signals from receiver wiring.* While cable systems are held to a standard of 20 μV/m leakage fields (measured at 3 meters from any part of the plant), consumer equipment is only regulated as to the leakage of internally generated signals, and to a much looser tolerance.

It is essential that equipment that may be directly connected to a cable system meet the same shielding standards as other cable equipment, when fed the maximum expected input signal level of +20 dBmV. Convertor manufacturers have built equipment for many years that meets this standard, so it can hardly be a major engineering effort or production cost.

• *Re-radiation of cable signals from customers' antennas.* In 1987, the Commission considered the problem of specifying adequate isolation in antenna selector switches to prevent harmful re-radiation of cable signals from antennas. It concluded that 80 dB of isolation was needed below 216 MHz and 60 dB between there and 550 MHz. On the other hand, it stated at the time:

"We have specified 550 MHz as the upper limit on the range of the isolation standard because it is generally the maximum frequency at which cable systems operate."[5]

In order to be consistent with the expanded bandwidth of cable systems, the upper frequency of 60 dB compliance needs to be extended to 1 GHz. The standard should be applied to all receiving devices with input selector switches that could be connected to cable and an external antenna, especially in light of the retransmission consent provisions of the Cable Act which might lead operators to drop some broadcast stations rather than pay fees for carriage. (Note that, for performance reasons discussed below, there is good reason for also extending the upper frequency range for 80 dB compliance.)

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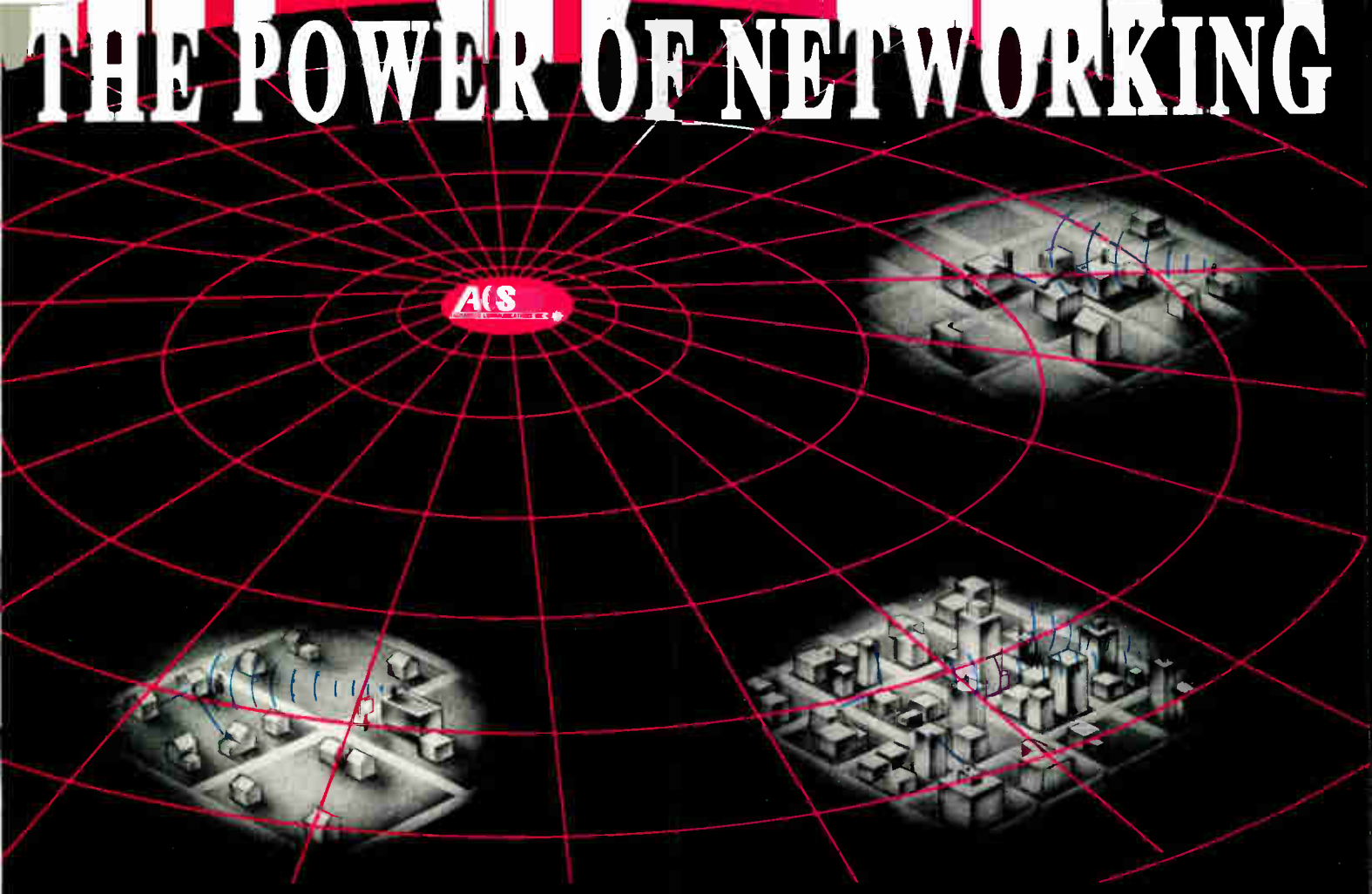

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dating inclusion of the jack on all cable-ready devices.[9] In addition to TVs and VCRs, that should include convertors, since they are used to convert non cable-ready TVs into cable-ready TVs. Without inclusion of the jack, the convertor would become useless if the subscriber were to desire a scrambled premium service.

Summary

The FCC has an historic opportunity to resolve, in one rulemaking, most of the interface problems between cable systems and consumer television receiving equipment. Reasonable cost performance and feature provisions on consumer equipment designed for connection to cable systems will not only assure present compatibility, but an easy transition to high definition television and digitally compressed television signals. CED

Acknowledgments

The author has relied heavily on the work of many others who have spent years working with the problems of consumer equipment compatibility, including several members of the NCTA Engineering Committee and the EIA/NCTA Joint Engineering Committee and, most especially, Walt Ciciora of Time Warner, who has chaired both. The opinions implied by the proposals put forth here, however, are the sole responsibility of the author and do not necessarily represent the opinions of any other individual or group.

Footnotes

1. *Cable Television Consumer Protection and Competition Act of 1992*, enacted Oct. 5, 1992.

2. *Cable Television Consumer Protection and Competition Act of 1992*, Section 624A(c)(2), in part: "*. . . The regulations prescribed by the Commission under this section shall include such regulations as are necessary . . . to promote the commercial availability from . . . retail vendors that are not affiliated with cable systems of convertor boxes; . . .*"

3. The author is indebted to the analysis done a number of years ago by Mike Jeffers for EIA/NCTA Joint Engineering Committee on the problems of local oscillator leakage and image response.

4. For example, a television set with a standard video IF of 45.75 MHz, when tuned to channel 24, will have a local oscillator frequency of 269 MHz, just 167 kHz from the chroma carrier of channel 31.

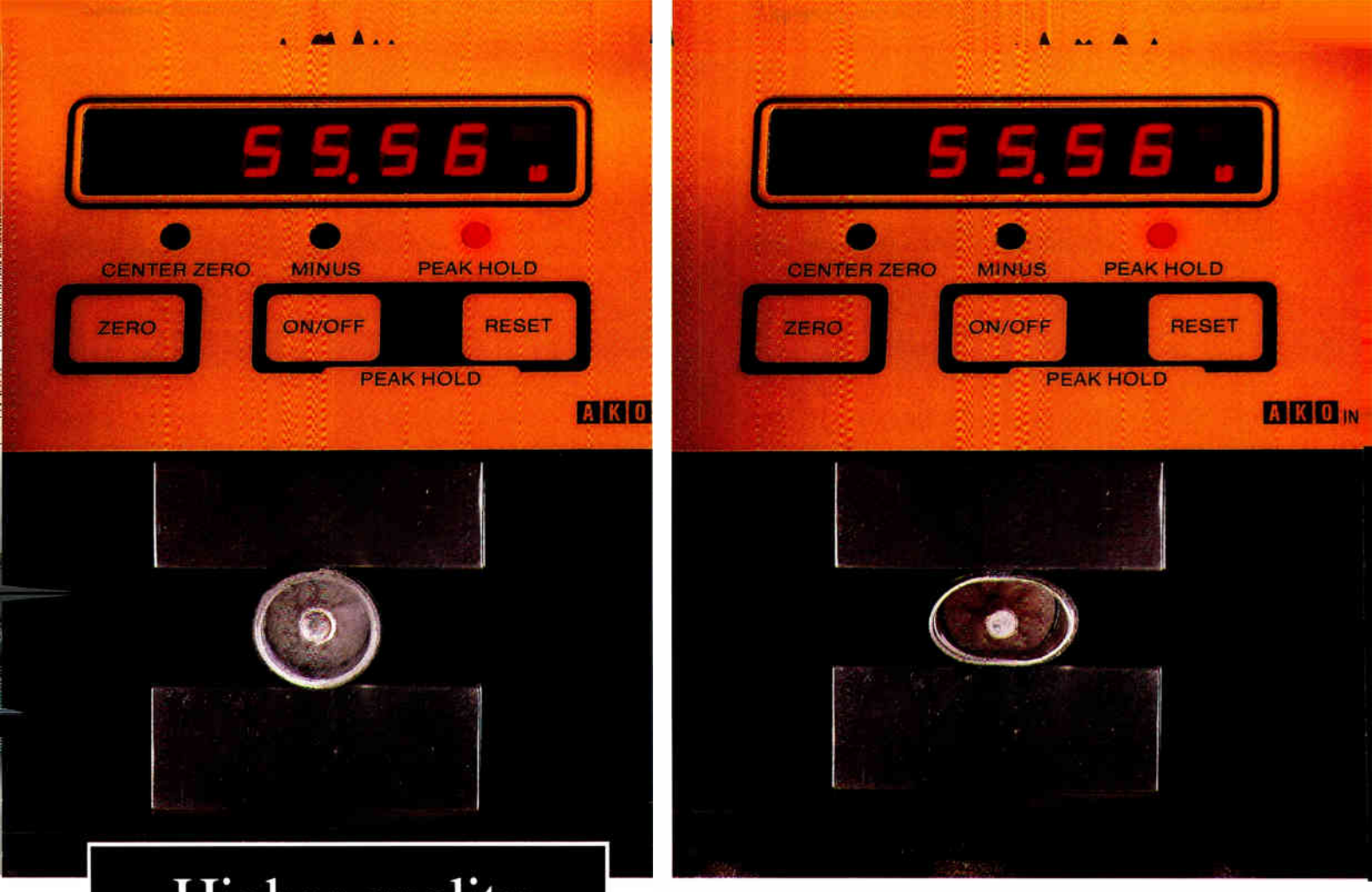
5. *Report and Order*, General Docket 87-107, FCC 87-357, Released Nov. 20, 1987, p.8, footnote 14.

6. These are spelled out in detail in the new Part 76.605(a) rules.

7. The remaining variation comes from headend variations and the basic frequency response flatness of the distribution system (peak-to-valley).

8. Typical convertor specifications are for -56 dB to -60 dB beat products of various types (cross modulation, composite second order and composite triple beat) when fed with a full spectrum of CW carriers at levels corresponding to sync tip power of +15 dBmV. Correcting for the use of modulated carriers and an increase from +15 dBmV to +20 dBmV results in the values given.

9. There is certainly precedent for mandated feature inclusion where it is determined that a public goal is met, for instance, the requirements on UHF tuners and closed captioning decoders. In this case, a greater percentage of viewers will benefit for a lower per-unit cost than was the case with captioning decoders.



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Subscriber-friendly ordering of near-video-on-demand

On-screen messaging eases program selection and ordering

Video compression and expanded bandwidth have opened the door to greatly increased flexibility in the delivery of impulse pay-per-view programming. This article describes an approach to delivering near video-on-demand pay-per-view which has been successfully employed in a real system for more than one year. On-screen messaging enables a subscriber-friendly, menu-driven program selection process and immediate feedback to ensure error-free movie ordering.

Proven NVOD technology

Since November 1991, Time Warner's Brooklyn-Queens Cable in New York City has offered its most popular pay-per-view movies in a multiplexed format. Several thousand subscribers to the two-way "Quantum" service, in selected areas, have been connected to 1-GHz cable service and provided with convertors that can tune this entire bandwidth.

Whenever I describe this system to someone not already familiar with it, the most frequent question I am asked is, "How can they fill 150+ channels with programming?" My reply usually comprises an outline of multiplexed pay-per-view (M/PPV) technology. The questioner is frequently impressed at how pay-per-view movies are available with no more than a 30-minute wait between start times.

The 30-minute rotation

Thirty-minute rotation requires multiple channels to be dedicated to each movie. The most popular titles are run on a continuously rotating schedule. For example, a movie between 90 minutes and two hours may run on one channel with a start-time schedule of noon, 2 p.m., 4 p.m., 6 p.m., etc. The same movie would then be shown on another channel at 12:30, 2:30, 4:30,; on another at 1 p.m., 3 p.m., 5 p.m.; and on another at 1:30, 3:30, 5:30. The system is flexible enough to accommodate longer movies by using five or more channels or by offering less frequent start times (see Figure 1).

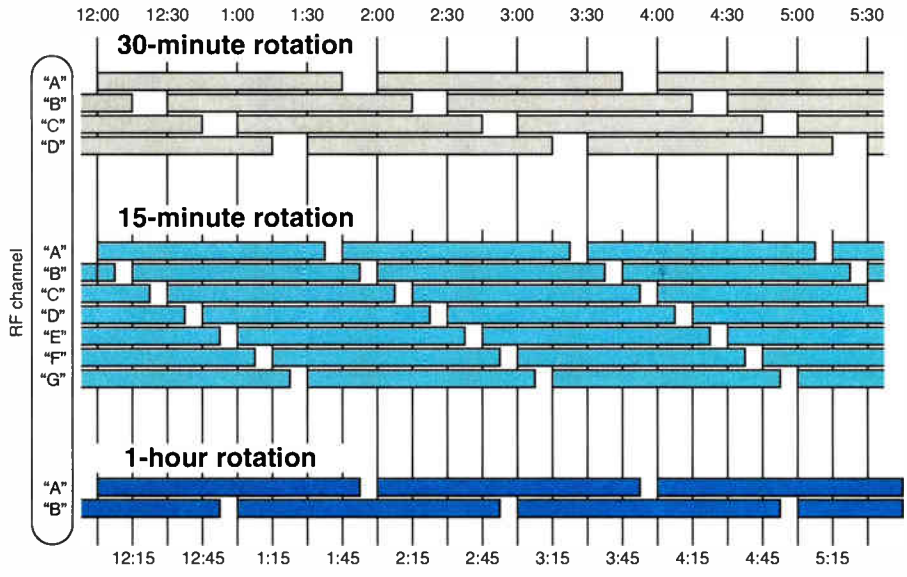

Figure 1

By offering such saturation programming, the system offering M/PPV is able to effectively compete with videotape rental outlets. The 30-minute rotation is an estimate of the amount of time it would take to go to a video store, rent a movie and return home. Given that a subscriber may start an M/PPV purchase at any point in the 30-minute rotation, the average wait time to see the start of the next M/PPV movie will be 15 minutes.

But think of the real advantages M/PPV has over the video rental process. Anyone who has ever tried to rent a newly released tape knows that the most popular titles are often sold out at the rental store, however you are virtually guaranteed availability of any title scheduled on M/PPV. There is also the convenience of not having to go back to the store to return the tape. With M/PPV, you save the gas and time involved in making as many as two trips per rental.

The number of CATV systems with more than 550 MHz of bandwidth is growing and compression is on the horizon. The increase in the number of channels these technologies provide makes M/PPV even more attractive. Because more channels can be dedicated to M/PPV, several titles can be multiplexed, making the selection greater than ever compared with conventional impulse pay-per-view. All these advantages over tape rental promise to offset the small price premium, if any, of an M/PPV movie.

On-screen display makes it easy

On-screen display (OSD) makes ordering a show through the set-top convertor much less complicated than one might expect—even when compared with conventional impulse PPV. Consider the increased complexity and chance for error with more than 50 pay-per-view channels. Instead of relying on printed program schedules and channel numbers to make a purchase, OSD lets the subscriber buy a movie by choosing titles and start times shown on the screen.

Marketing professionals will be quick to recognize that buy rates will not suf-

By Dan Wiltshire, Systems Engineer, Pioneer Communications of America Inc.

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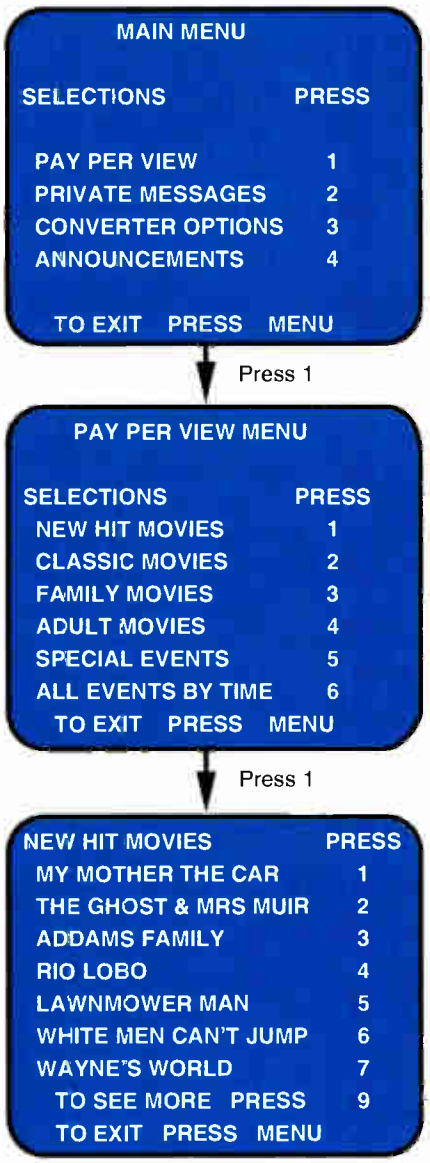


Figure 2

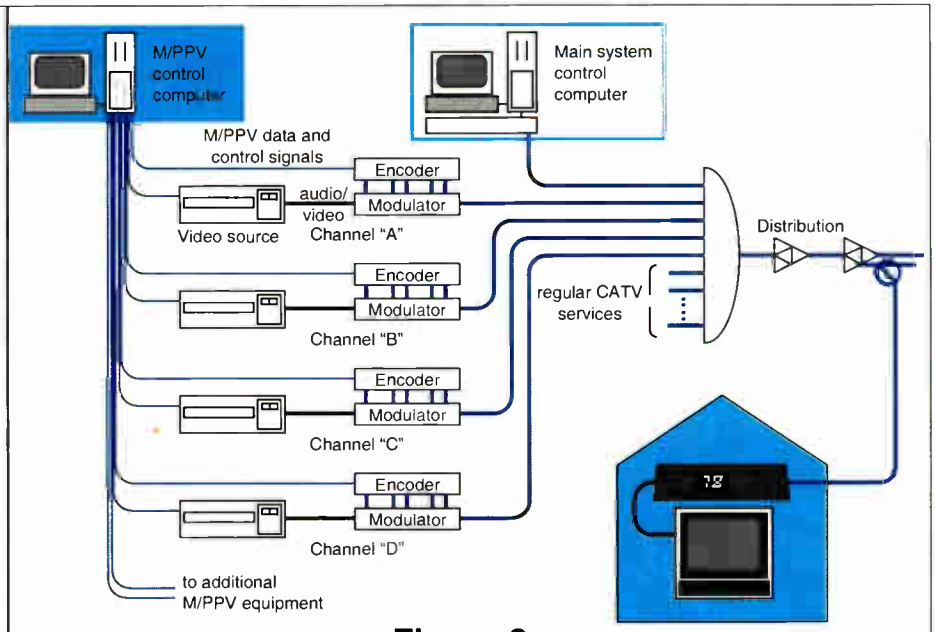


Figure 3

fer if the ordering process is easy (and fun!) whereas if it is too complicated, subscribers will simply not buy. A sample OSD menu sequence is shown in Figure 2. We will see detailed examples of OSD purchase sequences later.

There are some unique hardware requirements that make up the M/PPV system. Let's take a brief look at these.

System hardware requirements

First, consider a simple M/PPV scheme that offers one title with start times at 30-minute intervals. Let's assume that the length of the show is between 90 and 120 minutes, the average length of most of today's movies. As shown at the top of Figure 1, for the 30-minute rotation example, four channels will be needed to multiplex this title. Therefore, four channels of spectrum space would be needed, as well as four individual program sources—usually tape machines or laser disc players.

If 15-minute intervals were instead preferred, as we see in the middle of Figure 1, seven or eight channels and sources would be needed. For one-hour intervals, only two of each would be required. Figure 3 illustrates an example of the hardware set-up, showing four of the M/PPV sources and channels.

In addition, each M/PPV channel is scrambled so that only customers who purchase the show are able to view it. Upon authorization of the event—when viewing begins—the descrambler automatically kicks in.

Further, the M/PPV channel incorporates a data signal which (1) identifies it as an M/PPV service, and (2) contains information about the movie it is carrying. This movie information originates at a dedicated computer system. The system operator enters all pertinent information about each offered movie into a master schedule, including title, number of channels to be used, price, first show and last show starting date and time, and the rotation time (i.e. how often the movie starts). The master schedule controller is separate from the system's main controller which handles normal addressable functions of the set-top convertors.

Once the necessary information is loaded into the master schedule, the software automatically takes care of the scheduling and sets up all of the times and channels. The data stream is sent to the encoders. The encoders, controlled by the data stream, also transmit pertinent portions to the convertors whenever they are tuned to the channel so that the convertors receive their on-screen display information. The convertors then use "store and forward" technology to communicate the M/PPV purchases back to the system so that each subscriber can be billed appropriately.

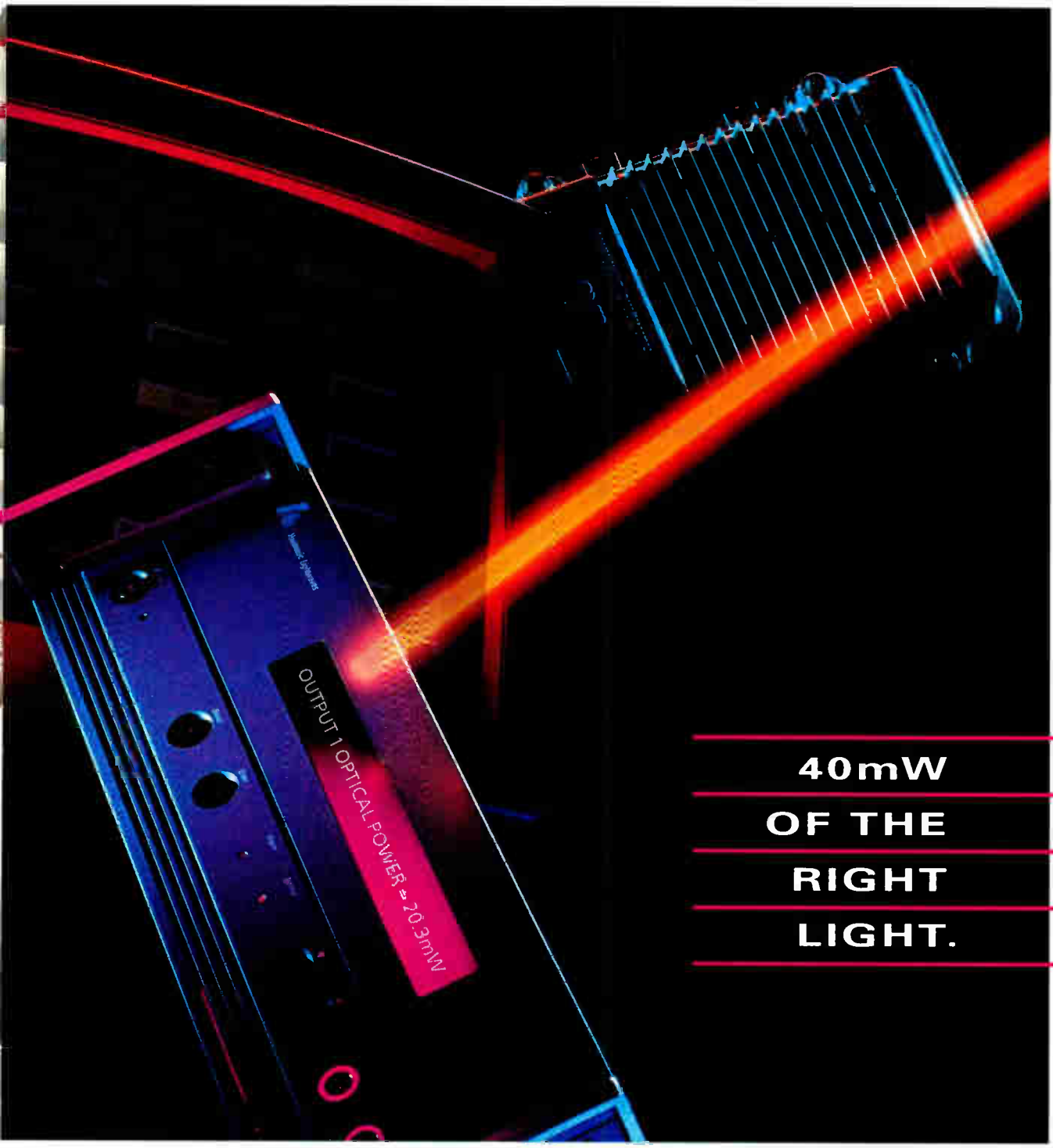
M/PPV concepts

To describe M/PPV implementation, there are a few terms which should first be explained. The entire M/PPV schedule can be broken up into units of time called "windows." Figure 4 illustrates these.

Purchase window. The cable operator may not want the subscriber to purchase a movie after so much of it has passed. In these cases, a window of time may be defined to allow the purchase of a movie only during the first several minutes.

Stagger window. A stagger window is the amount of time between successive start times of the same movie on a single channel. This usually equals the length of the movie rounded up to the next half-hour.

Preview window. The selections of video between the feature presentations on PPV channels—known in the industry as "interstitials"—are considered by many cable operators to be valuable promotional tools. The M/PPV system permits the viewing of these promos by all subscribers, free of charge, by defining a "preview window" in minutes cor-



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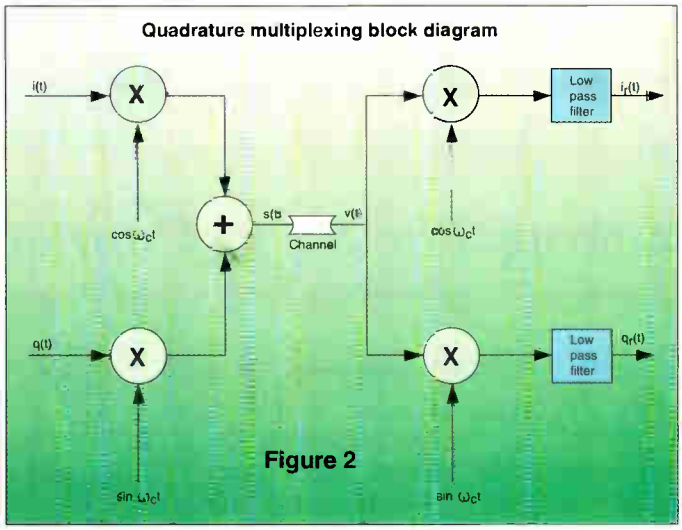

Figure 2

This shows that both I and Q control the amplitude and phase of the QAM signal and the signal can be completely described at any time t by its amplitude and phase. In the 4-level data case this leads to the signaling states shown in Table 1.

From the signaling state table comes the constellation diagram which indicates amplitude (distance from the origin to a point) and phase (angle from the positive I axis to the same point) of all 16 points in 16 QAM. A 16 QAM signal constel-

		s(t)	s(t)
I	Q	Amplitude	Phase
-3	-3	4.243	225.000
-3	-1	3.162	198.435
-3	+1	3.162	161.565
-3	+3	4.243	135.000
-1	-3	3.162	251.565
-1	-1	1.414	225.000
-1	+1	1.414	135.000
-1	+3	3.162	108.435
+1	-3	3.162	288.435
+1	-1	1.414	315.000
+1	+1	1.414	45.000
+1	+3	3.162	71.565
+3	-3	4.243	315.000
+3	-1	3.162	341.565
+3	+1	3.162	18.435
+3	+3	4.243	45.000

Table 1: 16 QAM signaling states

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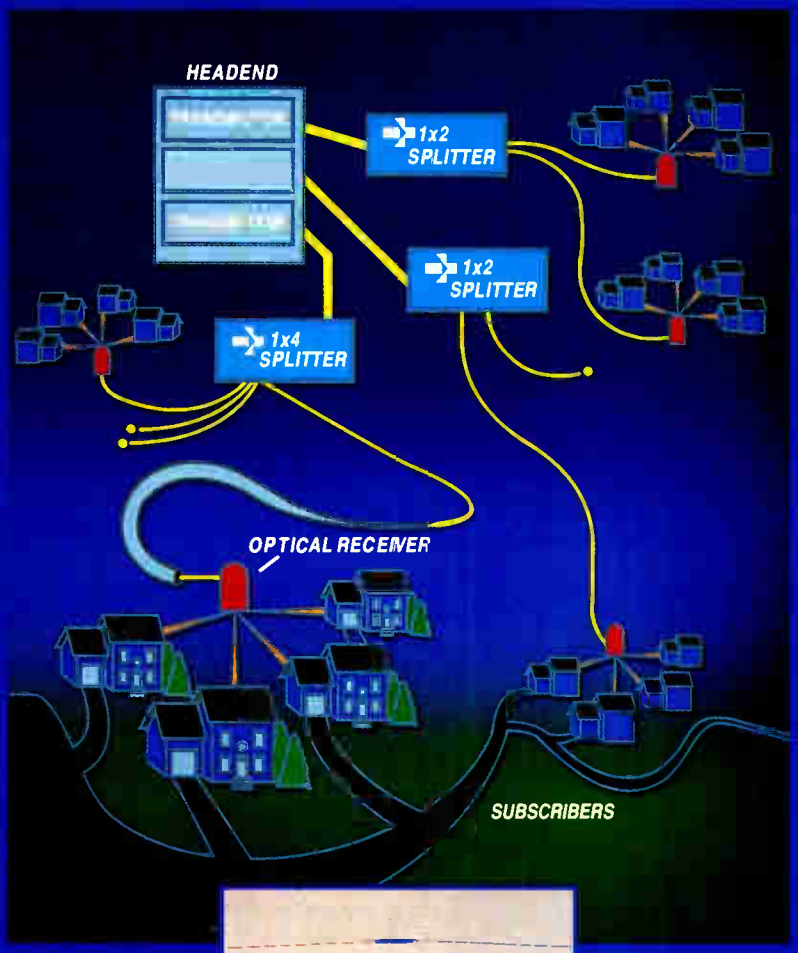

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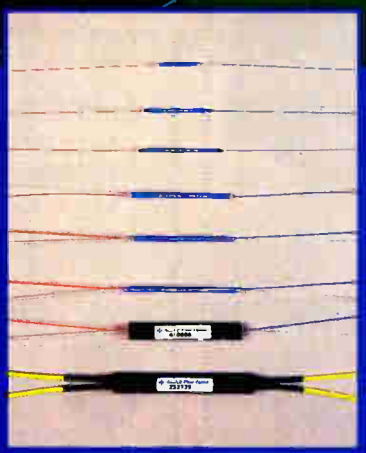

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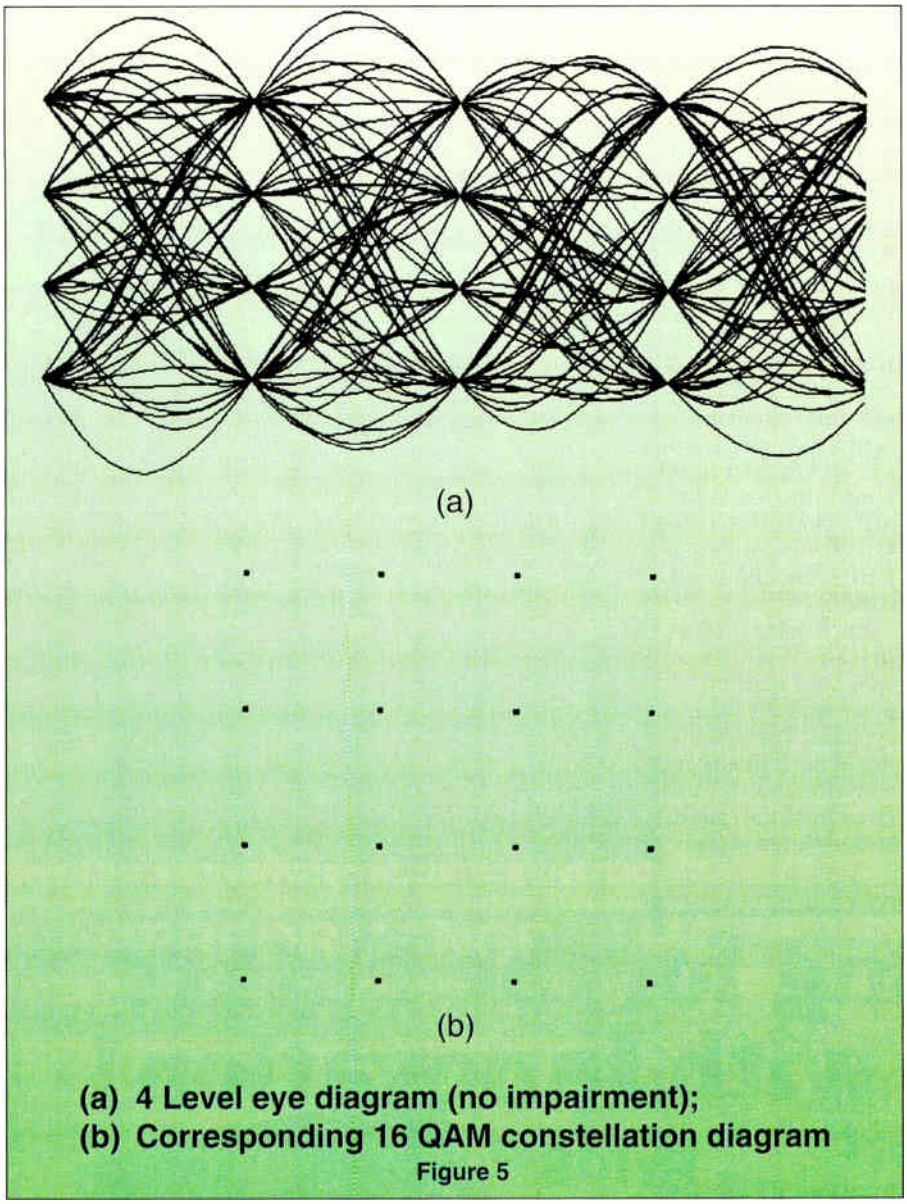


(a) 4 Level eye diagram (no impairment);
(b) Corresponding 16 QAM constellation diagram

Figure 5

responding to each of the adjacent symbols time displacement from the present output point. The output of this module is two data files (I and Q) representing the analog baseband Nyquist waveforms sampled at 16 points per symbol. These files can be displayed graphically and independently as eye diagrams, or together as a constellation diagram using the Simulation Tools module, which is explained next.

Helpful diagrams

Two of the most helpful tools in analyzing digital communication links are the eye diagram, and the constellation diagram. The eye diagram is an oscilloscope view of a single I or Q waveform sync'd to the symbol period. At the sampling points (once per symbol) maximum opening should occur between the traces. The "eye" opening size is a figure of merit and indicates how easy it will be to determine what level the data is in at each sampling instant.

As mentioned before, the constellation diagram is a two-dimensional plot of the amplitude of I vs. the amplitude of Q at the sampling instant. The sampling instant should be at the time of maximum eye opening and is, of course, at the symbol rate.

The tools module

The Simulation Tools module contains both eye and constellation diagrams. These tools can be utilized at any point in the simulation when I and Q waveforms are available, i.e. before and after channel impairments and adaptive equalization. Figure 5 shows eye and constellation diagrams generated by the simulation software for 16 QAM with no impairments and a rolloff factor = 0.2.

The simulation software would be of limited use if it could not include the effects of channel impairments. Channel impairments could come in many forms—such as additive noise, non-ideal frequency response in both amplitude and phase, intermodulation, etc. One of the biggest problems in many QAM channels is reflections. Strong reflections can be disastrous to a digital link, causing unacceptable bit error rates.

A reflection is a time delayed and amplitude scaled replica of the waveform which is summed with the original waveform, resulting in a distorted signal. Many physical sources of reflections exist in real life systems.[4] One important point in understanding and modeling reflections on a QAM signal is to understand that the reflection arrives at some phase angle of the carrier frequency ω_c determined by the time delay and the carrier frequency. The difference in the carrier phase caused by the time delay is:

$$\Delta\phi = \omega_c \cdot \Delta t \qquad (3.1)$$

This implies that three values are necessary to describe a reflection—amplitude, time delay and phase angle. The phase angle actually causes I information to spill into Q information and vice versa. Starting with equation (1.9), the equations for the resultant waveforms with additive reflections can be derived with algebra and trigonometry, yielding:

$$i_r(t) = i(t) + \Sigma\, \text{atten}_m [\, i(t-T_m) \cos \phi_m + q(t-T_m) \sin \phi_m \,] \qquad (3.2)$$

$$q_r(t) = q(t) + \Sigma\, \text{atten}_m [\, q(t-T_m) \cos \phi_m - i(t-T_m) \sin \phi_m \,] \qquad (3.3)$$

Each individual reflection is described by its attenuation (atten_m), time delay (T_m), and phase angle (ϕ_m). The summation index is m and sums all the unique reflections. The equation demonstrates the I/Q spillover caused by the reflection angle.

Adding in reflections

The simulation software channel impairment module adds reflections to the Nyquist waveform data by directly following equations (3.2) and (3.3). Figure 6 shows eye pattern and constellation diagrams for two reflections with attenuation, delay and phase angle of: -15 dB 3/2 T 45° and -18 dB 17/8 T 60°. Note the closing of the eye in the eye pattern and

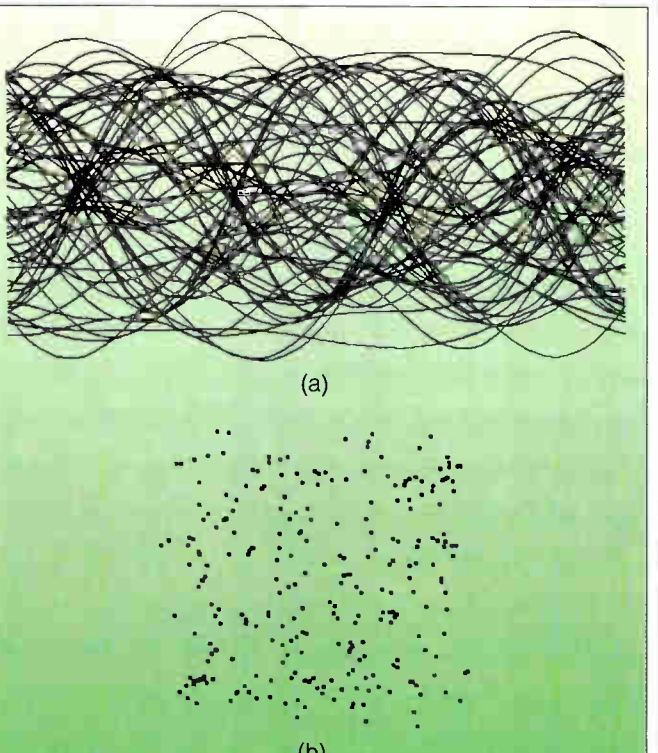
the smearing of points in the constellation diagram.

An adaptive equalizer (AE) at the receiver can be used to "clean up" the effects of the reflections shown in Figure 6. In many digital communications links, the AE is an absolute necessity for an acceptable bit error rate. An overview of adaptive equalization can be found in reference 4 with more rigorous mathematical derivations found in references 5 and 6.

The software is a valuable tool in understanding the communication link.

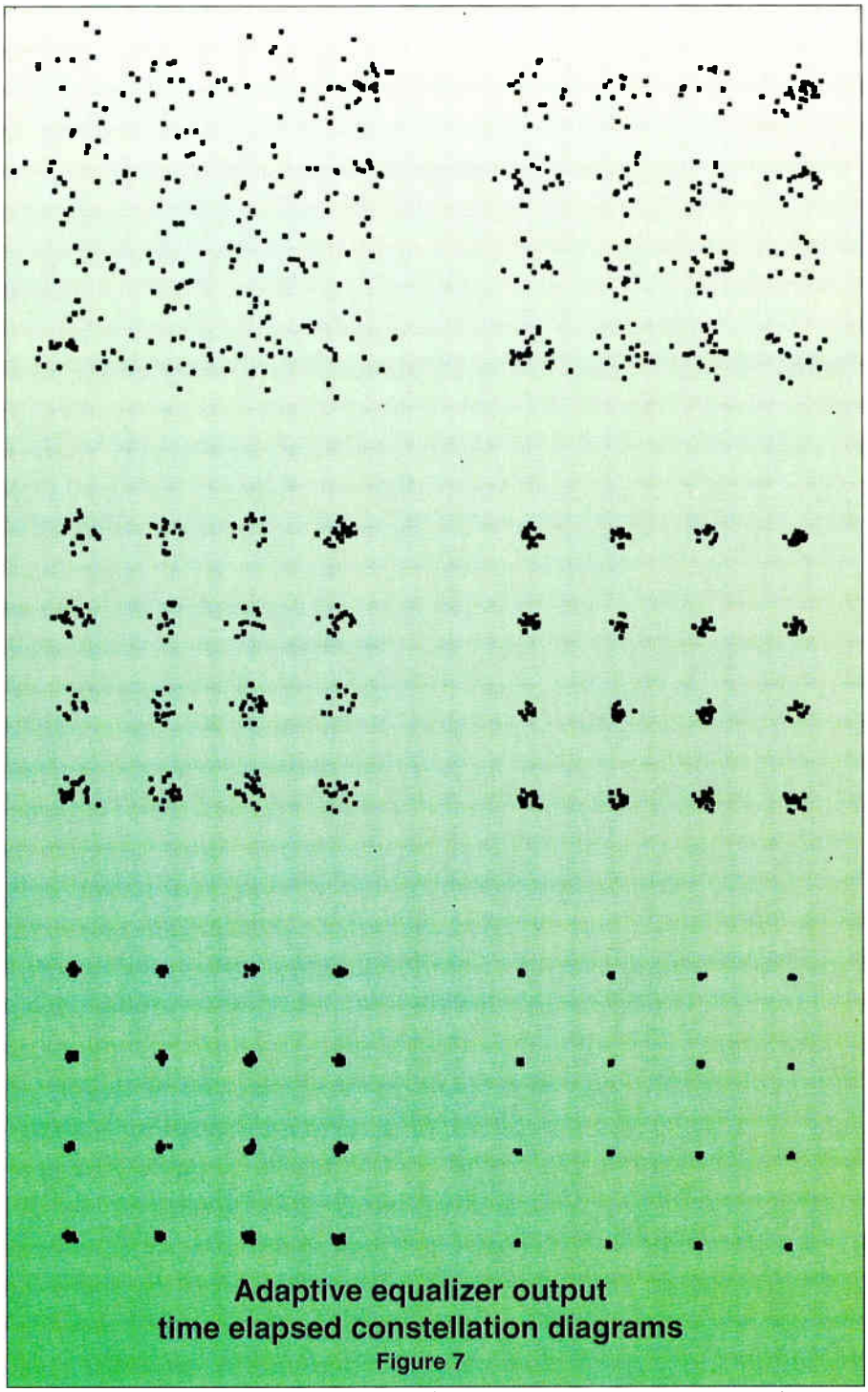
The principles, and especially the derivation of the AE filter algorithm, are quite fascinating in that extremely complicated mathematics reduce down to a single uncomplicated equation. It is worthwhile to review the derivation in one of the aforementioned references to appreciate the mathematical elegance, even if not following all of the math.

The AE is implemented as a digital filter whose coefficients (and thus transfer function) are adjusted over time to "adapt to" (cancel) the channel's distortion. In the frequency domain, the AE filter response is the inverse of the channel's response. The "adjusting" of



(a) 4 Level eye diagram (with reflections);
(b) Corresponding 16 QAM constellation diagram

Figure 6



Adaptive equalizer output
time elapsed constellation diagrams
Figure 7

the coefficients is determined by the AE algorithm used. One of the most popular algorithms, because of its simplicity and effectiveness, is the Least Mean Squared adaptive algorithm, summarized by the equation:

$$\underline{c}(n+1) = \underline{c}(n) + \mu\, e(n)\, \underline{x}^*(n) \qquad (4.1)$$

where:

$\underline{c}(n)$ is a vector representing the present filter coefficients;

μ is a constant (step size) which determines how quickly the algorithm converges;

$e(n)$ is the error between the desired and the actual filter output;

$\underline{x}^*(n)$ is a vector representing the complex conjugate of the present filter inputs;

$\underline{c}(n+1)$ is a vector representing the updated filter coefficients.

The basic process of the AE is to compare the filter output with the desired output (choosing the closest desired value) and calculating an error value $e(n)$. As equation (4.1) states, this error value, along with step size μ and the complex conjugate of the present filter inputs $\underline{x}^*(n)$, is used to update the coefficients. Reference 4 steps through this process for several iterations. There are many forms and implementations of the LMS algorithm based on available hardware, necessary convergence speed, final error, etc.

The AE simulation module implements the LMS algorithm as shown in equation (4.1). Since the signal is two dimensional (I and Q), the input, output, error and filter coefficients are all complex valued. All addition, subtraction and multiplication is complex. Complex multiplication, necessary for complex FIR filters, might seem esoteric, but can be implemented with four real value multiplications followed by additions/subtractions utilizing the property:

$$(i + jq) \bullet (c_r + jc_i) = ic_r - qc_i + j\,(ic_i + qc_r) \qquad (4.2)$$

The AE simulation module continuously displays the constellation diagram as the AE does its work. The constellation pattern is seen to start out blurry, and then converge to something close to the ideal. Filter coefficients are stored at various points in the convergence. The operator watches as the AE process takes effect.

Figure 7 shows the pre-equalizer constellation diagram, and the constellation diagrams at subsequent stages in the AE simulation. Note that an eye pattern for equalized data is not provided. This is because the input and output of the equalizer is at the symbol rate (sometimes at twice this rate) and correspond only to sample points at maximum eye opening. Eye pattern displays are therefore not applicable to equalized data. Figure 8 shows the initial and final filter coefficients.

Conclusion

This article has provided a review of digital QAM modulation and adaptive equalization, with an emphasis on PC software to simulate the transmission link. The software is written in C, making it easily adaptable to many situations. It is written in modular style to enable the inclusion of custom modules such as random noise and other channel impairments.

Other models of adaptive equalizers, simulating different convergent algorithms, different hardware implementations, and different mathematical

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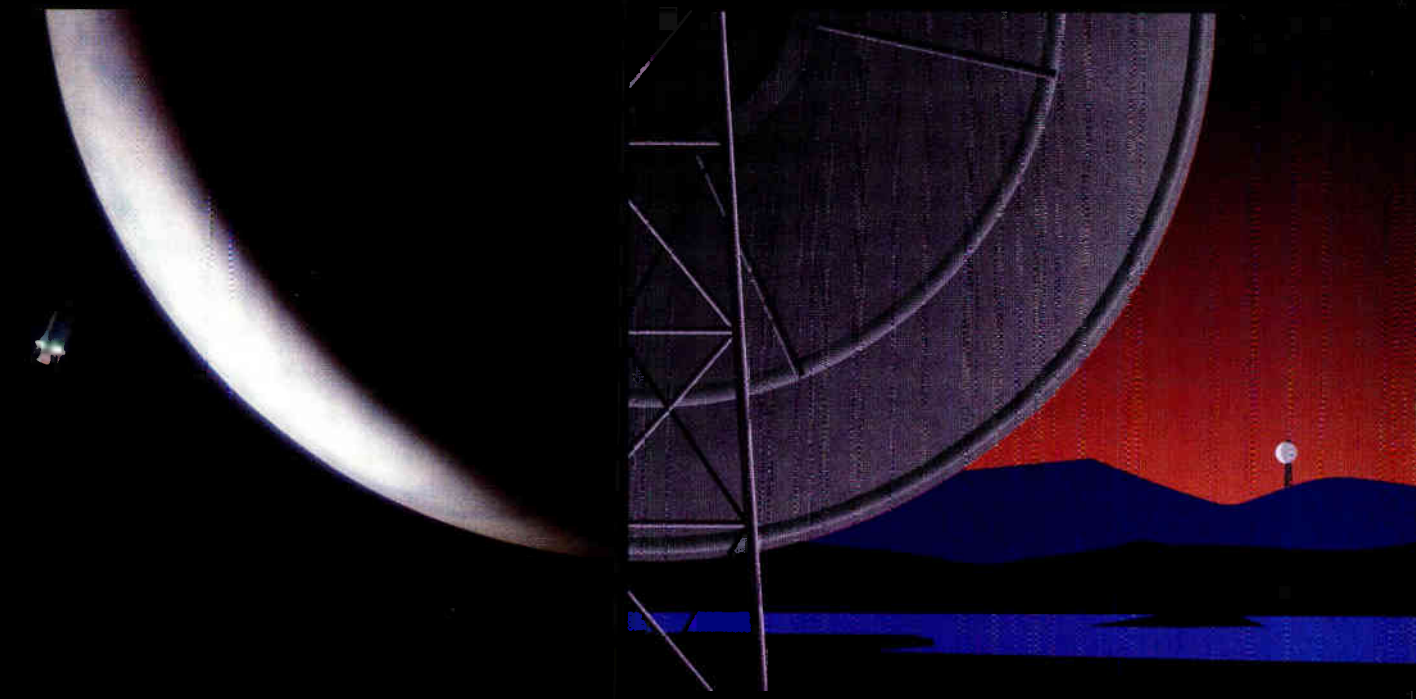

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types (floating point/fixed point/resolution), can also be implemented by following the structure of the present AE simulation model. The software is a valuable tool in helping understand the communication link and in determining necessary and optimum adaptive equalizer parameters. CED

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	(a)		(b)
C_{-5}	0.0 + 0.0j	C_{-5}	-0.001489 + 0.000829j
C_{-4}	0.0 + 0.0j	C_{-4}	0.002373 - 0.002227j
C_{-3}	0.0 + 0.0j	C_{-3}	-0.003024 + 0.003341j
C_{-2}	0.0 + 0.0j	C_{-2}	0.007110 - 0.005601j
C_{-1}	0.0 + 0.0j	C_{-1}	-0.012534 + 0.011493j
C_0	**1.0** + 0.0j	C_0	1.021105 - 0.019398j
C_1	0.0 + 0.0j	C_1	-0.075059 + 0.064914j
C_2	0.0 + 0.0j	C_2	-0.135891 + 0.188784j
C_3	0.0 + 0.0j	C_3	-0.011377 - 0.056919j
C_4	0.0 + 0.0j	C_4	-0.022501 - 0.037278j
C_5	0.0 + 0.0j	C_5	0.016629 + 0.011388j

(a) Initial filter coeffieients;
(b) Final filter coefficients

Figure 8

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5. ☐ MDS, STV, or LPTV Operator
6. ☐ Microwave or Telephone Company
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8. ☐ Cable TV Component Manufacturer
9. ☐ Cable TV Investor
10. ☐ Financial Institution, Broker or Consultant
11. ☐ Law Firm or Government Agency
12. ☐ Program Producer, Distributor or Syndicator
13. ☐ Advertising Agency
14. ☐ Educational TV Station, School or Library
15. ☐ Telecommunications Consulting Firm
16. ☐ Local Area Network End-User
17. ☐ Local Area Network Equipment/Services Supplier
18. ☐ Other Allied to the Field (please specify) _____

3. Are you a member of SCTE? ☐ Yes. ☐ No.

4. In the performance of your job, check the product categories you authorize, specify or purchase: (check all that apply)

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- ☐ b. Fiber Optic Equipment
- ☐ c. Test Equipment
- ☐ d. Distribution Equipment
- ☐ e. Headend Equipment
- ☐ f. Contract Services
- ☐ g. Other (please specify) _____

5. What is the approximate dollar value of the annual budget you are responsible for?

- ☐ a. over 1,000,000
- ☐ b. 500,000 - 1,000,000
- ☐ c. 250,000 - 500,000
- ☐ d. 100,000 - 250,000
- ☐ e. 50,000 - 100,000
- ☐ f. less than 50,000

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71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
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Fiber safety: It's a matter of common sense

Question: What do sensible shoes, plastic bottles with twist-off (*not* pop-top) caps and smooth floors have in common? Answer: They're all a matter of common sense. And while most grandmothers would shrug at the tips following the sensible shoes, fiber optic safety trainers would not—particularly if they've viewed a new training video titled *Fiber Optic Safety*, where plastic bottles and smooth cement floors are just two among many fundamental safety practices related to fiber optics.

The 25-minute video, produced by The Light Brigade, illustrates several safety precautions related to fiber optic lab work, field installations and laser usage. Why is the film important? Because, as the film states early on, many people insist on working on optical fibers without protection. Without adequate protection for the eyes and hands, fiber fragments can (and do) penetrate eyes, fingers or other exposed areas.

Among the general safety precautions relayed in the film:

- If a fiber fragment does happen to penetrate the skin, use a teflon-coated pair of tweezers to remove it.
- Always wear protective glasses with clear plastic lenses to prevent stray fibers from piercing the eyes. Wavelength-specific eyewear is also available for those working around optical lasers. These protective goggles can be purchased to shield the eyes from a variety of different operating wavelengths.
- When working with optical fibers, the use of a chemical-resistant black matt is helpful to provide contrast against the transparent fibers.
- Thoroughly cleanse the hands after working with optical fibers, because glass fragments can stick to the skin. As the film points out, no grade of safety eyewear can be protective if it isn't used properly—for example, removing the goggles to rub tired eyes could prove harmful if a fiber fragment is still clinging to the fingers.
- Never eat when working with optical fibers. As mentioned previously, stray fragments resident on the hands can unwittingly be ingested, causing possible internal damage.
- Smooth, cement floors in work areas are better-suited than carpet for fiber optic procedures such as splicing or cleaving, because any fallen fragments are easily swept up and disposed of.
- Never throw waste fiber fragments into the trash—or the next person to act as "garbage compactor" with either foot or hand will get a porcupine-like surprise. Nor is it a good idea to stick discarded fragments onto a piece of adhesive tape, which the film does an excellent job illustrating. Picture a person with a piece of duct tape stuck to his thumb and you'll get the general idea. A better method, the film offers, is to use a plastic bottle with a twist-off lid. A pop-top lid, the film warns, can be disastrous if the user upsets the contents while trying to remove the lid. (How many people have *not* dumped a bottle of aspirin while trying to get the lid to pop off?)
- When working in computer-room environments with raised floors, always be sure to wear protective eyewear when accessing any cables under the sub-floor. Because the sub-floor often doubles as a ventilation air duct, the removal of a tile is often accompanied by a gush of air. Thus, any debris that gushes with the air can enter the unprotected eye.

Parameters of Class 1 lasers

Operating Wavelength	Light Type	Output Power
200-400nm	ultraviolet	<0.8 microwatts
400-700nm	visible	<0.4 microwatts
700-1,000nm	infrared	<200 microwatts
1,060-1,400nm	infrared	<0.8 milliwatts
1,400-10,000nm	infrared	<0.1 watts

Table 1

Note: Pigtailed and connectorized CATV lasers also fall within this category, regardless of higher output powers.

Laser safety: You make the call

The second half of the film discusses laser safety, where various classes of lasers and their potential health risks are carefully defined. Because the light emitted from communications lasers—and particularly, the 1300 nm and 1550 nm operating wavelengths used in cable television applications—reside in the infrared spectrum, it is not visible to the human eye. However, the light can still be hazardous (depending on output power) because it is focused by the eye into the retina. The film cites blind spots and loss of visual acuity as potential risks associated with unsafe laser practices.

Laser classes, depend on several factors, including operating wavelength, output power and whether the light is pulsed or continuous wave. The good news is that most of the lasers used in cable television applications are specified as "Class 1" devices, meaning they are considered to be eye-safe. The parameters of Class 1 lasers are shown in Table 1.

An important side note related to the table is that although the lasers used in cable have significantly higher output levels (some specified at 13 mW or higher), the devices still fall within "eye-safe" range because they are both pigtailed and connectorized. According to Jerrold's Cableoptics director David Robinson, there is no real means by which light could escape to damage the human eye.

However, the film is quick to point out that shorter light wavelengths (particularly those under 1550 nm) are more heavily absorbed by the retina of the eye. Further, as video transmission applications over fiber increase, so does the trend toward increased laser output and the possibility that communications lasers will fall into a higher—and potentially more hazardous—class.

Because of those factors, the film advises adequate labeling of all lasers within the work environment. Also, because potential danger is the highest at the optical output ports of laser devices, the film suggests capping any unused ports. Remember, a laser's light is invisible.

Overall, the Light Brigade's new offering is a handy reference tool for cable's safety trainers. The film's laser safety coverage is meaty, without being too broad—with loads of common-sense safety tips that could save a few Band Aids. Granted, these aren't the kind of common-sense tips to share with your grandmother (who is most probably wearing sensible shoes). But for safety trainers looking for fiber material, the video is a nice fit. CED

By Leslie Ellis

Conference scares up telcos—and their worries

How terribly illuminating, to be a fly on the wall amongst a bunch of telephone folks talking turkey.

While nationwide advertisements promote the telephone industry's perceived image as the leader in fiber optic technology, behind closed doors that industry's perception of itself is much different. In short, it's an industry that is worried, confused and exceptionally curious about broadband services. It wants to partner with cable companies. Further, it's well aware of its weaknesses as an industry, and isn't afraid to chide itself about them.

Only one attendee was bold enough to privately shun cable and its high-capacity networks. "Why are you working in cable? There won't be any cable industry in 10 years," the man said during a luncheon. "All your video will be pumped down the phone line, from the phone company."

Outside of this *CED* journalist, however, not many cable representatives showed up for the recent Western Communications Forum, held last month in Phoenix, Ariz. and hosted by the National Engineering Consortium. Dick Green, president and CEO of CableLabs, was there to deliver the keynote speech (albeit with a horrendous case of laryngitis), as did three other cable people. However, despite the apparent dearth of cable representation, cable services were clearly a key focus among the mixed congregation of telephone engineers and strategic planners.

Broadband, broadband, broadband

Clearly, the focus of the conference was broadband—as in what it takes to get from existing low-capacity networks to a high-bandwidth payload. Whether it's delivered via some flavor of ADLS, HDSL or over fiber, the ability to deliver varying amounts of bandwidth for services like PCN, video on demand (VOD) or long-distance learning is a top concern among the telcos.

Competition is also a worry amongst the telcos—as in, they worry about cable as much as cable worries about them. In one of many handouts available at the Forum, Bell-Atlantic's President of Information Services Arthur J. Bushkin was quoted as saying that the telephone industry is much like a duck: "What you see above the water looks tranquil. But below the water, we're paddling furiously."

Green wants cooperation

In his keynote address, CableLabs president and CEO Dick Green cited current moves by the Clinton/Gore administration to build a $1 billion high-speed, digital broadband network as "very good news for the technologist, because we now have allies in Washington.

"Between the capabilities of the cable and telephone industries, we have all the ingredients for a national telecommunications superhighway," Green said during the luncheon. "Telephone drops reach 99 percent of American homes; cable drops pass 95 percent of American homes."

Green enumerated technological advancements by such cable players as Time Warner, TCI and TelePort as further proof toward cable's role as a communications leader. "The concepts (put forth by these companies) make the old version of cable an anachronism," Green said. "Indeed, traditional cable operations that stay within the comforts of the status quo cannot survive in today's changing environment."

But, he said, if the cable and telephone industries are to partner, the real question is what the users want. "User needs are heterogeneus. Some will need asymmetrical transfer; some will need symmetrical capabilities. Some will need narrowband; others broadband," Green said, adding that users clearly do want digital services to the home available via an interconnected web-type network, and not a single network.

"There are many interesting questions here," Green mused. "My suggestion is that we, as technologists in the technology community, continue to support ventures between the cable and telephone industries." Also, Green said, interface standards for digital signal delivery are needed, as is continued work with the government.

"The new realities are convergence, competition and cooperation," Green said in closing.

In an exceptionally candid session about competition in the local loop, US West's Director of Public Policy Sue Mason expressed her concerns about cable television advancements. "The 1970s marked competition in the customer premise equipment (CPE) realm, followed by long distance competition in the 1990s," Mason said. "The '90s will mark a decade of competition in the local loop, and that's scary."

Competition worries

Mason was clearly well-versed on cable television applications and its need to augment current video service revenues with other, telephony-like applications. "Let's face it—the cable operators are putting in fiber. The reason they're doing it is for new service delivery and reliability," Mason said. "If you have fiber, it really doesn't cost you much to deliver a 3 kHz voice channel."

Further, Mason said, the list of perceived "problems" associated with the cable television industry, such as poor service quality and a lack of voice communications experience, just aren't real. "Cable operators can buy the expertise they need, and they're focusing their attention on quality," she said. "A case in point is TCI, in Denver. They're offering a two-hour installation window or the install is free. That's a *lot* better than what US West offers."

Mason also emphasized that, in her opinion, cable TV is "clearly the most significant threat to local loop competition than anything else. PCS is something they can handle, and likely can offer a better product than the telcos now do," she said.

The telephone industry, she continued, has inherent limitations because of its high cost. "How many US West people are in this room?" Mason asked of the attendees.

Nearly one-quarter of the people in the room raised their hands in response. "In a competitive environment, there wouldn't be that many people from one company at a conference," she emphasized.

To remedy that, Mason said telephone operations need to re-scale their operations, to reduce cost. But, she said, "you have to upgrade your networks. Twisted-pair copper just isn't going to cut it in the long term." CED

By Leslie Ellis

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Cellular: Controlled optimism

In spite of the fact its customer base increased by 46 percent in 1992, the mood at the cellular industry's annual convention and trade show put on by the Cellular Telecommunications Industry Association (CTIA) last month in Dallas was one of controlled optimism. Interspersed with accolades for being a shining example of all that's right with U.S. business were regular reminders that the industry is still in the midst of a cancer scare, is still facing strong competition from new technologies like PCS, and has yet to come up with a real plan that will ensure smooth transition to digital for its customers.

Congratulations began during the opening session from the likes of Apple's John Sculley and Microsoft's Bill Gates, and continued through keynotes by cable expatriate Dr. Art Ulene and FCC Commissioner Ervin Duggan. The 10,000-plus attendees heard each speaker quote an impressive litany of industry accomplishments:

- From start-up to more than 11 million customers in less that 10 years, including the addition of some 3.5 million subscribers in 1992 alone;
- Annual service revenues of more than $4 billion in 1992, and capital investment of more than $11 billion;
- The direct creation of over 34,000 jobs in less than a decade.

But the mere selection of Dr. Ulene as a keynote speaker was an indication that all was not well in cellularland. Since January, the industry has been barraged by media attention initiated by a Florida lawsuit claiming that the electromagnetic radiation resulting from heavy use of a portable cellular phone caused a fatal brain tumor. Rather than attempting to comfort attendees by siting evidence vindicating electromagnetism as a carcinogen, Ulene recapped the largely mythical historical basis for the public's suspicions "going back 2,000 years in the process" to demonstrate that while scientifically the cancer scare may be without grounds, it is deeply rooted in the public's consciousness. According to Dr. Ulene, this fact alone requires that it be considered a very real matter.

Competition is another threat the industry appears willing to take seriously. While several speakers, including Commissioner Duggan, indicated they expect cellular to be a dominant player in PCS, the general attitude was clearly that cellular could not expect to be the only player. Duggan said "it is likely for the Commission to allocate PCS spectrum over the next several months." And while there was no consensus as to how, or even when, licensing would be handled, the underlying assumption was that multiple licenses would be awarded in most metropolitan markets, and that existing wireless players would have plenty of company among licensees.

It was also clear that the inclusion of spectrum auction revenue in President Clinton's recent economic proposal greatly increased the likelihood that at least some spectrum would be bought and paid for in the future, and that PCS licenses would be auctioned. Duggan said he wasn't ready to declare a position on the issue, but did have some real concerns about auctions limiting minority ownership and entrepreneurial participation.

During a panel on spectrum allocation issues, Dr. Thomas Stanley, FCC chief engineer, said that if auctions were un-

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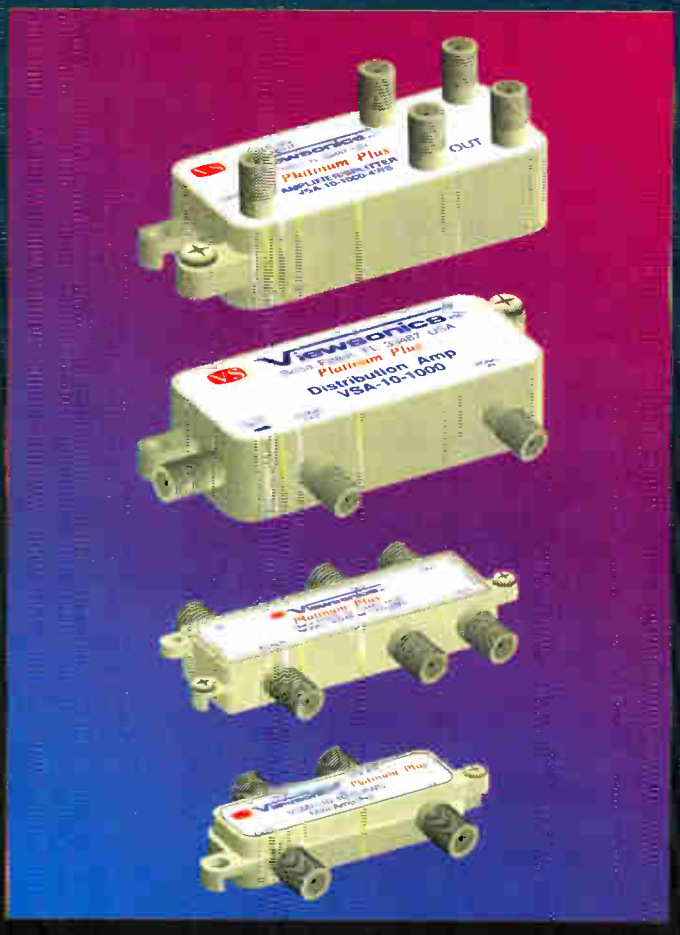

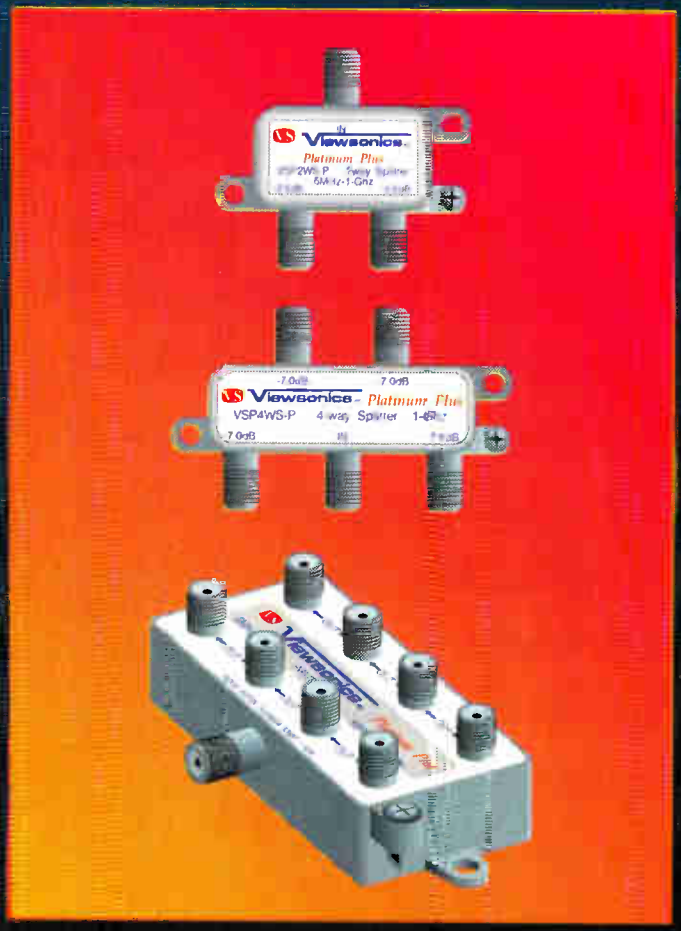

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dertaken, he couldn't think of a more appropriate application than PCS licensing. However, Dr. Stanley refrained from advocating auctions.

The recent tentative selection of three companies, including Cox Cable, to receive PCS Pioneer's Preferences also generated a great deal of discussion. Interestingly, while several speakers questioned the merits of the applicants selected and the limited number of Preferences awarded, Cox seemed to be considered the most solid choice. Otherwise, the cable industry wasn't a primary topic of discussion at conference sessions.

Cable did enjoy some representation, with Comcast's (also a cellular operator) Vice President of Strategic Planning Mark Coblitz participating in a panel on PCS technical developments, and Scientific Atlanta's Vice President of Strategic Operations Bob Luff, speaking on future wireless services. Of course, with last year's appointment of Tom Wheeler as President of the CTIA, cable can claim some ongoing representation in cellular by virtue of the fact that Wheeler served as president of the NCTA from 1979 to 1984.

Huge growth potential

If the cellular adoption curve mirrors that of other popular consumer innovations including VCRs and color TV, the industry is poised for a period of growth in which subscriber counts and penetration literally doubles over the next three to four years, reaching the 22- to 23-million subscriber level in 1995 or so. Customer counts would double again between 1995 and 1998 or so if the analogy proves correct.

Motorola Vice President Jim Caile predicted at the meeting that, by the year 2000, cellular penetration would stand at 30 percent of homes, a figure consistent with the adoption curve modeled on VCR penetration. Impressive as cellular growth has been so far, an inflection point in the adoption curve may have been reached, the earlier VCR and color TV adoption curves suggest.

Other wireless segments also stand poised for growth, according to Clifford Bean, an Arthur D. Little director. Last year, 12 million customers used private radio services while 12 million more were paging system subscribers. Added to the 11 million cellular subs, that suggests a 1992 U.S. wireless services market of at least 35 million customers.

By the year 2002, Bean suggested, some 90 million U.S. customers would be using PCS, cellular and other wireless voice networks. Perhaps 20 million will use enhanced paging and messaging services, he argued. The U.S. PCS market consists of 185 million vehicles, 92 million residences, 115 million employed people in offices and factories and 45 million employees whose jobs require them to travel from their premises on a regular basis. Bean predicted that cellular telephone penetration would equal about 17.5 percent of the installed base of wireline connections by the year 2000 or so.

"PCS is the first market-driven telecommunications offering," said Bean. "Users know what they want and will buy it today, if it's available." What they want, he said, is a two-way, ubiquitous service, wristwatch terminals, eight hours or more of battery life between recharges and features such as call forwarding, call waiting and caller identification, he said. Prices should be in the range between cellular and wireline local access.

To succeed, PCS firms must offer low call blocking, accurate billing, low-cost and light-weight handsets with days of battery life between recharges, and pricing in the $25 to $45 a month area, with reasonable air time included in that charge. Bean noted that in addition to that, users want functionality that is nearly identical to cellular service, though at lower cost. "Cellular functionality and PCS functionality are very similar in terms of user demand," said Bean. That might serve as a warning to PCS providers and a clue for cellular operators. If Caile and Bean are right, digital cellular service at lower prices is a functional substitute for PCS.

American Personal Communications President Al Grimes, whose firm has been testing Telepoint (outbound calling only, no cell handoff) services in the Washington and Baltimore areas, said users would expect monthly fees and handset costs of:

- Cellular, $60 to $100, handsets of $350 to $1,500
- PCS, $30 to $50, handsets at $100 to $150
- Outbound calling, inbound paging, $25 to $35, handsets at $125 to $175
- Outbound calling only, $15 to $25, handsets at $75 to $125.
- Paging, $10 to $20, handsets at $75 to $100.

Significantly, Grimes said the network APC would deploy would feature "ubiquitous, high-speed handoff." That, despite APC's testing of an outbound-only, pedestrian-oriented service with no cell handoff at all. PCS proponents, make note of the change. CED

By Tom Brooksher and Gary Kim

RETURN PATH

Signal leakage and proof testing

Remember the big rush to meet the signal leakage compliance deadline in 1990? Doesn't it seem like that was a lifetime ago? Well, we'd like to find out if signal leakage is still troublesome or whether cable systems have largely licked the problem.

To respond to the survey, simply make a copy of this page, fill out the questionnaire and return the survey to our offices (via fax to 303-393-6654 or mail to 600 South Cherry Street, Suite 400, Denver, CO 80222). We'll tally the information and print the overall results in a future issue.

So, if you've ever wanted to add your input to the industry's conventional wisdom surrounding these issues, now is the time to do it.

Please answer the following questions as honestly as you can. Remember, no names will ever be used.

	Yes	No	Don't know
1. Would you say the management of your system takes signal leakage seriously?			
2. Do you think your system has greatly reduced or eliminated signal leakage when compared to a couple of years ago?			
3. Does your system find it difficult to meet leakage specifications on an ongoing basis?			
4. How does your system perform signal leakage tests:			
Via flyovers?			
Drive-outs performed by system personnel?			
Other monitoring methods?			
5. Would you say you have adequate equipment and resources to perform regular leakage monitoring?			
6. If you could grade your system's leakage performance (A = excellent, F = failure), what grade would you give it? Grade_____			
7. Has your system been inspected by the FCC anytime in the past year?			
8. If so, was the FCC satisfied with your signal leakage levels, logs and procedures?			
9. Do you think your system would pass if a leakage inspection were to take place this month?			
10. Speaking of inspections, were you satisfied with the way your system performed in the proof of performance tests in January?			
11. Which proof test(s) were the most difficult for your system to pass?			
12. Will your system be able to deliver 43 dB carrier-to-noise ratio to the home in 1995 as is—or will it require an equipment upgrade?			
13. Overall, would you say your cable plant delivers high-quality video?			

Please provide the following information:

Your title _____

Your job function _____

The size of your system (# of subs) _____

The length of your CATV career (years) _____

The state in which you work _____

Your MSO (optional) _____

RETURN PATH

Results of training survey

Managers take note: An overwhelming majority of the readers who responded to our survey on training say they think their company's approach to training employees needs to be reviewed or overhauled. This feeling crossed regional boundaries, job titles and all sizes of systems, according to the survey results.

To put a positive spin on things, one respondent—the technical trainer/safety supervisor for Cox Cable Spokane—noted that "all training *needs* to be reviewed/updated periodically."

An analysis of the survey results indicates cable systems are light on formal, in-house training programs for installers and technicians, yet are relatively generous to individuals who choose to join the SCTE and/or enroll themselves in courses in cable television technology.

For example, roughly one in five systems offers formal training to service techs, maintenance techs and headend techs, yet four out of five would pay at least a portion of an employee's tuition expenses if he chose to enroll in a college or vocational school. About three out of five systems will pay for BCT/E reference material and exams, however.

But the two most revealing responses came to questions related to employees having adequate training to do their jobs and whether they feel their company's training programs need to be overhauled. The results of the entire survey are printed below. Answers shown are in percentages.

	Yes	No	Don't know/did not answer
1. Does your company have formal, in-house training programs for:			
Installers?	40	60	-
Service technicians?	20	80	-
Maintenance or line technicians?	20	80	-
Headend technicians?	20	80	-
2. Does your company offer formal in-house training in customer contact skills for installers and technicians?	40	60	-
3. Does your company offer formal in-house training in selling cable services for installers and technicians?	50	50	-
4. Does your company provide any in-house training in fiber optics?	20	80	-
5. If you chose to pursue college or vocational training in electronics, would your company pay at least a portion of the tuition?	70	20	10
6. If you chose to take an outside course in cable television technology, would your company pay for or reimburse you for the tuition?	80	10	10
7. If you chose to join the SCTE, would your company pay your membership and/or meeting fees?	90	10	-
8. Does your company provide time away from the job to attend SCTE meetings?	80	20	-
9. Would your company pay for you to take SCTE BCT/E certification exams?	70	20	10
10. Would your company reimburse you for the cost of BCT/E reference materials?	60	20	20
11. Does your company pay for the cost of the SCTE Installer Certification exam and practicals?	60	10	30
12. Do you feel like you have received adequate training to effectively do your job?	60	30	10
13. Do you think your company's approach to training employees needs to be reviewed or overhauled?	80	10	10

Hello?... It's for you!

- How will TeleWest and Time Warner Cable integrate businesses on one network?
- Should you consider the Competitive Access Business?
- What do Pulse Code Modulation, Fractional T-1's and Host Digital Terminals have in common?

The March issue of Communications Engineering & Design helped provide the answers to over 14,000 professionals.

CED is the magazine that has helped define the future of Broadband Technology for over eighteen years.

If you would like a copy of this special issue, call Michelle Pazar at (303) 393-7449 or fax a request including your name, title and company to (303) 393-6654. For subscription information call (212) 887-8560.

CED

The Premier Magazine of Broadband Technology

California chapters host 'mini-Expo'

Ron Stoneburner performs the connector test during the Cable-Tec games.

Nearly 500 cable system personnel and equipment vendors flocked to the Holiday Inn in Fairfield, Calif. in February for the third annual "Northern California Vendors Day," a two-day event sponsored by the Sierra, Central California, Golden Gate and Shasta chapters of the SCTE.

Sixty-three companies spent $50 each to rent a table-top during the event, and nearly all reported brisk activity and a high level of interest shown by the 350 system personnel who streamed through the exhibits and sat in on about two dozen different technical seminars.

The event was created in the spirit of the SCTE Cable-Tec Expo, a trade show which has gained prominence as the single "hardware-only" event for the cable industry, according to Steve Allen, engineering manager at Jones Intercable in Roseville, Calif., and the event coordinator. "We wanted to try that concept on the local level so we could get current product information into the hands of the people who use them," he said. "It has succeeded tremendously."

Nationally recognized speakers

Event organizers were successful in attracting nationally recognized experts in technology, including Scott Bachman, a CableLabs vice president, and Ken Wright, director of engineering for Jones, who is also chairman of the SCTE subcommittee on emergency broadcasting.

Bachman provided an update of the activities of the CableLabs Outage Task Force, which has focused on three main areas:

- assess customer reaction to outages and correlate them to customer attitudes;
- track outage trends and performance indicators;
- determine outages causes and propose solutions.

Separate customer attitude surveys performed by Viacom Cable and Jones Intercable determined that outages are a key complaint among customers, who are twice as likely to disconnect from cable service—or downgrade— if there are more than two outages every three months.

Contrast that fact with a Westinghouse study that determined the industry average for outages is 5.6 outages every three months and it's easy to understand why viewers perceive that cable systems have reliability problems.

After working to understand the nature of the problem, the CableLabs Task Force began working to better track outages and find preventive methods. For example, Viacom and CableData are working to automate outage tracking within CableData's 8.12 software release, said Bachman. This should reduce reliance on subjective definitions of

outages while cutting back on the labor needed to track the events.

Bachman said the Task Force is now determining methods to model cable system reliability as a function of the design process. The model measures reliability in Mean Time Before Failure, or MTBF, and allows prediction of the number of outages based on how a system is designed.

A key concept of the model is that failure rates are additive in a tree-and-branch system, said Bachman. Therefore, a trunk amp that may be reliable for an average of four years may only have a rated reliability of 1.6 *months* when it's part of a 30-amp cascade!

So, the Task Force has concluded that amplifier cascades cannot exceed 25 units in length if a system wants to experience fewer than two outages a month. However, reduction of cascades below 12 amps provides little reliability improvement, according to Bachman. Similarly, power supply cascades should not exceed seven for optimum reliability.

Proof tests

The program was also able to draw experts from the Bay Area, including engineers from Viacom Cable and a representative of the Federal Communications Commission.

Viacom staff engineers George Campbell, Tim Habiger and Wayne Pope presented attendees with a snapshot of how seven Viacom systems, representing 500,000 subscribers, fared in the January proof-of-performance tests (please see related story, pg. 36). They reported few problems in meeting the specifications, but said the 24-hour tests gave them the most problems.

If the cable industry feels as though it's under scrutiny, it should look at what the FCC is up against, remarked Kate Henton, a public affairs specialist with the San Francisco FCC field office. "We are really an agency under siege right now" because of the complexity of last year's cable legislation and the number of inquiries that will take place this year, she said.

"I feel sorry for the cable industry right now because the Cable Act is so complex," Henton added. She said estimates are that the Cable Act will cost every local franchise authority between $5 million and $8 million, according to the government's Office of Management and Budget.

Yet, in spite of it all, the FCC inspections of cable systems will continue in earnest, with signal leakage being a top priority, said Henton.

By Roger Brown

SCTE®

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

April 7 *Badger State Chapter* Installer and BCT/E exams to be administered in all categories at both levels. To be held in Fondulac, Wisc. Call Brian Revak, (608) 372-2999.

April 7 *Delaware Valley Chapter* "Safety Issues" and BCT/E exams to be administered in categories II and IV, both levels. To be held at Williamson's Restaurant. Call Lou Aurely, (215) 675-2053.

April 7 *New Jersey Chapter* Installer exams to be administered. Call Linda Lottie, (908) 446-3612.

April 7 *Central New York Meeting Group Installer exams to be administered. To be held in Syracuse, N.Y. Call Vincent Cupples, (315) 652-4698.*

April 8 *Satellite Tele-Seminar Program* "Customer Service and Safety Issues, Part II," from Cable-Tec Expo '92. To be transmitted on Galaxy I, transponder 14. Call SCTE headquarters, (215) 363-6888.

April 8 *Greater Chicago Chapter* "Installer Basics" and BCT/E exams to be administered in all categories, both levels. To be held at the Quality Inn, Palatine, Ill. Call Bill Whicher, (708) 362-6110.

April 8 *Iowa Heartland Chapter* "OSHA Safety Standards." To be held in Cedar Rapids, Iowa. Call Mitch Carlson, (309) 797-2580, ext. 3700.

April 8 *Music City Chapter* "Digital Audio Services" with Steve Broyles and George Hale of Viacom Cable. Installer and BCT/E exams to be administered in all categories, both levels. To be held at the Ponderosa Steakhouse in Nashville. Call Dale Goodman, (615) 244-7462.

April 13 *Desert Chapter* "Status Monitoring and Return Systems." To be held at the San Georgio Inn, Banning, Calif. Call Doug Williams, (619) 340-1312, ext. 277.

April 14 *North Central Texas Chapter* "Back to Basics on Fiber." To be held at the Arlington Community Center, Arlington, Texas. Call Scott Wilber, (817) 328-1281.

April 15 *Rocky Mountain Chapter* "HP Spectrum Analyzers." Call Patrick Kelley, (303) 267-4739.

April 21-24 Cable-Tec Expo '93 Orlando, Fla. Undeniably, the biggest technical event of the year. Call SCTE Headquarters at (215) 363-6888 for more information or to register.

SCTE Subcommittees

The **SCTE** will be holding subcommittee meetings prior to the annual Cable-Tec Expo. Volunteers are still needed in virtually all areas. The meetings will be held April 20 at the Orlando Convention Center. Times and exact locations are as follows:

1:00-2:30 p.m. *In-home Cabling Subcommittee*, Room 12 A-B; *Design and Construction Subcommittee*, Room 12 C-D

2:25-4:15 p.m. *Interface Practices Subcommittee*, Room 12 A-B; *Emergency Broadcast Subcommittee*, Room 12 C-D

4:30-6:00 p.m. *Maintenance Practices and Procedures Subcommittee*, Room 12 A-B; *CLI Subcommittee*, Room 12 C-D

CommPerspectives

May 13-14 Multichannel CommPerspectives has announced a conference titled *Convergence I: Telephone and Data Services*, to be held at the Radisson South, Denver, Colo. The conference is designed to provide an in-depth look at the convergence of cable television and the voice and data services traditionally provided by the telephone companies. Scheduled sessions will include: "How to run a CAP," and "Opportunities for Cable Operators in the Wireless Revolution," among others. For more information, call Tom Crookshier at (303) 393-7449.

The CABLE POLL

Midwest CATV • CED • Cablevision

Set-top convertors here to stay

In a world of rapidly changing technology, one thing appears certain: The set-top convertor is going through yet another metamorphosis that will likely keep the technology in the home for years to come.

In the early days of cable, convertors were widely welcomed by cable subscribers, deemed the breakthrough that enabled reception of multiple signals while enhancing the clarity of local and distant off-air signals. Then, convertors became the enemy in many cases. As recently as last year Senator Patrick Leahy delivered an incensed speech to Congress which described all the ways in which the features on his brand-spankin' new television were foiled by the convertor box.

And then there was digital compression. Last December, Tele-Communications Inc. grabbed headlines nationwide when it announced a plan to deploy digital compression—via digital set-tops—in millions of its U.S. cabled homes. More recently, Comcast Cablevision and Sammons said they will deploy digital set-tops. Clearly, these announcements paint a picture of a home environment that still includes some form of cable box planted squarely on top of the television set.

There's more. In the most recent edition of the Cable Poll, 89 percent of the 200 general managers polled reported the current use of convertors in their systems. Most (62 percent) use non-addressable devices; only 34 percent report using addressable versions.

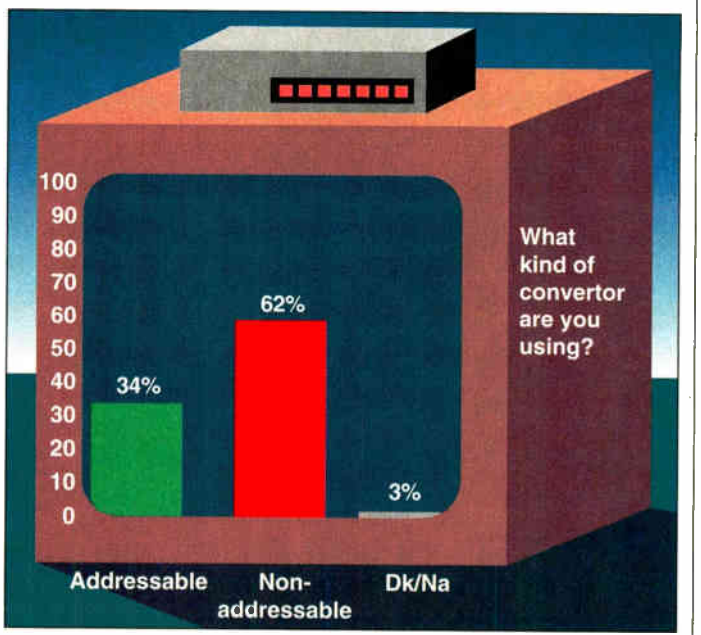
Most GMs (72 percent) report an average convertor age of one to six years. Only 15 percent say their convertors are between six and eight years old, and a scant five percent report owning convertors older than eight years.

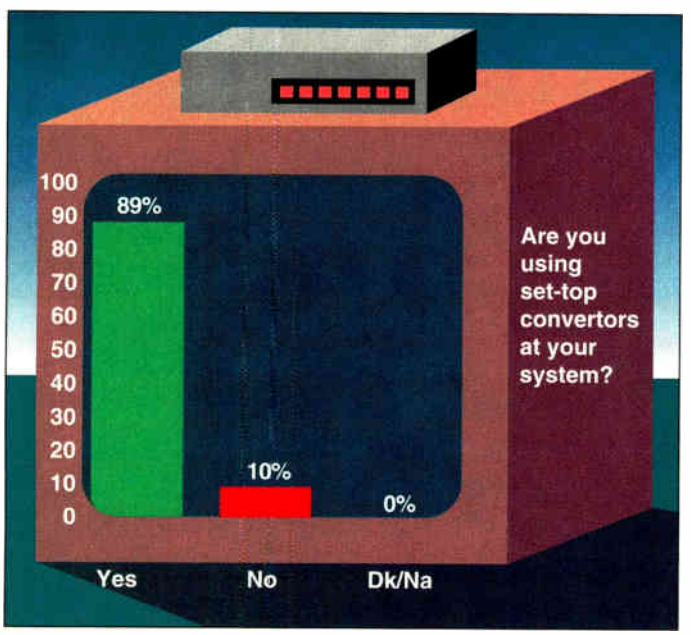
But are GMs ready to replace their existing convertor base? Not really, according to the Poll. The majority, at 81 percent, revealed little to no interest at all in supplanting their existing devices.

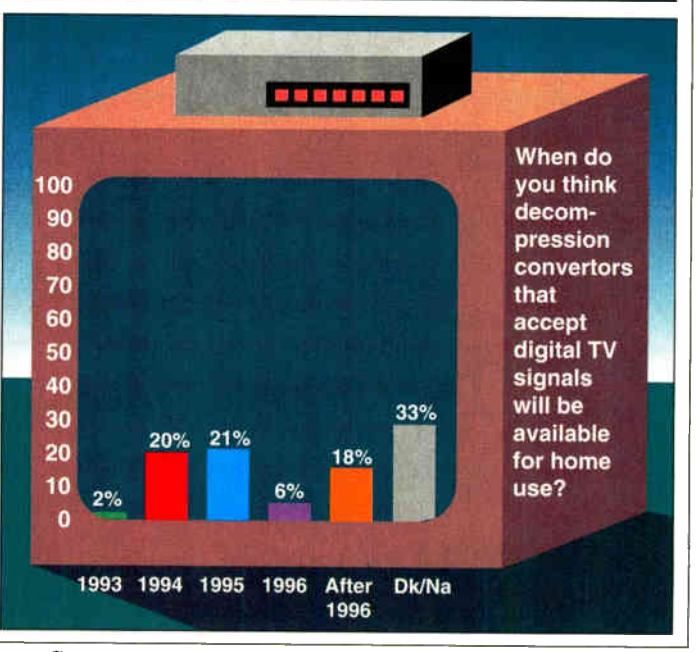
Perhaps the low desire to replace existing convertors stems from the fact the most of the respondents, at 41 percent, say digital decompression convertors will not be available until 1994 or 1995. In fact, in this category, the stoutest majority (at just one-third) say they don't know when the digital devices will be available for home use. Then, there's the issue of cost. Alarmingly, 36 percent say they're willing to pay the same price for digital decompression devices as they do for current analog devices. A more realistic 22 percent say they'd pay $150 to $250 more for the value-added devices; a whopping 40 percent don't know what a realistic price figure is.

Granted, convertors have some distance to travel in the compatibility department before they can put a smile on the face of Mr. Leahy. But whether he's pleased or not, this new, digital breed of convertor—combined with the existing mix of installed analog devices—seems firmly planted into the future of cable communications. CED

By Leslie Ellis







New products

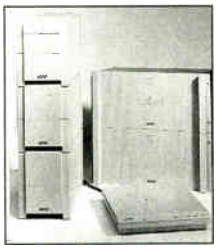
Surge protector

ECTOR, Texas—New from **ACT Communications** is its ACT 451 single-line surge protector. The device has surge protection capability of up to 85,000 amps and is equipped with a 10 amp circuit breaker which provides a visual indication if the protector is in a failed state. The unit, ACT officials say, reacts in less than a nanosecond and has an optional remote alarm feature. The surge protector was designed to defend electrical equipment located in remote locations.

Circle Reader Service No. 127

Three new UPS devices

WEST KINGSTON, R.I.—**American Power Conversion (APC)** has announced three new UPS models to complement its line-interactive Smart-UPS series. The new 250 volt-amp, 2000VA rack-mountable and 2000VA extended-run units were designed for local area network (LAN) applications and feature adjustable warnings, customizable options and synchronized power return.



APC's Smart-UPS series.

Standard features of the power supplies include a UPS control language, which informs users of UPS performance; a "replace battery" indicator, site wiring fault indicators; load meters; a voltage booster and an optional support and interface kit.

Circle Reader Service No. 128

Rotating bucket

ARMSTRONG, Iowa—New from the **Armlift Division of TG Industries** is its rotating, walk-through bucket, designed specifically for telescopic lifts. The hydraulically-controlled bucket features 200 degree rotation and an infinitely locking brake for stability in any work position, Armlift officials say. An optional fiberglass lid and full splicing curtain, folding seat and bucket heater are also available.

Armlift's new rotating bucket

The rotating bucket enables operators to conveniently position themselves when performing splicing applications, without repositioning the splicing machine or truck, officials submit. Both side and end-hung buckets are available.

Circle Reader Service No. 129

System design software

Cadix International, Inc. has announced three workstation-based products for CATV plant design. CX-2001 is a design system that aims to automate the plant design process by performing on-line engineering analyses and assisting in plant maintenance. The AD-4001 automatic digitizing system works by converting manual drawings and maps into CAD-ready vector data. And, Cadix's FX-7001 software is an integrated drawing management system which stores and manages multiple drawings and map on compact optical disk storage.

Circle Reader Service No. 130

Power inverter for mobile apps

ST. PAUL, Minn.—New from **Dimensions Unlimited Inc.** is a power inverter that transforms DC battery power to AC current, designed for CATV trucks which use power-sensitive video equipment.

Dimensions Unlimited's new Super Inverter.

Features of the inverters include wall or shelf mounting and an improved waveform stabilizer circuit, Dimensions Unlimited officials say. Further, a new "video wave" option has been added for cable TV applications. The option provides a "correct AC waveform for distortion-free monitor viewing," officials submit.

Continuous power ratings range from 1,200 to 2,100 watts and measure 15.5x16x7.5 inches. A 90-day field trial is available.

Circle Reader Service No. 131

Digital/analog switch system

Broadband Networks Inc. has introduced a network management and switching system for interactive video applications called Edcomm. The system enables point-to-point, point-to-multipoint and video-on-demand conferencing via a metropolitan area fiber optic network.

Both RF and baseband techniques are combined in a distributed architecture, say Broadband Networks officials, making the system cost-effective over conventional, centralized switching approaches. Further, in addition to conference switching, the system enables users to schedule year-long conference curriculums and provides different conferencing formats for business or education users while providing billing information to the service provider. Analog and digital transmission links can coexist in the system, controllable by a single software package.

Circle Reader Service No. 132

Video distribution amp

ESE has announced its ES-201 4x1 video distribution amp, which features separate gain and equalization controls for each of the four outputs on the unit so that up to 1,000 feet of RG-59 cable can be compensated for. Each of the four video outputs are independently adjustable via separate front panel controls; a loop-through input and four isolated outputs are accessible via rear panel-mounted BNC connectors.

ESE's video distribution amp.

Circle Reader Service No. 133

Multichannel video transmission

New from the **Grass Valley Group** is its MCF-series video transmission system, which transports multiple channels of full-bandwidth digitized video, audio and data over a single fiber optic cable.

The system uses a high-speed, time-division multiplexed bus architecture as its platform, which offers transport of up to 12 channels of broadcast quality (10-bit) video, each with up to four channels of audio or data. Or, the system can transport up to 16 channels of commercial-quality (8-bit) video, each with two channels of audio and data. The system, which is uncompressed, is built primarily on point-to-point, unidirectional communications links with a transmit and receive end and optical tributary cards.

The system is both NTSC and PAL compatible, and is housed in a modular six rack unit frame.

Circle Reader Service No. 134

Handheld NTSC test signal generator

BAYVILLE, N.Y.—**Multidyne** has announced its TS12 handheld NTSC test signal generator and a rack-mounted version of the same device, both of which were designed to assist cable engineers when performing the FCC's recently mandated amplitude characteristics tests.

Multidyne's signal generators.

The 12 NTSC test signals include a 5 MHz line sweep, multiburst, sinx/x, multipulse, NTSC-7 composite, NTS-7 combination, among others. Multidyne officials say the handheld unit operators up to 12 hours on battery power. The handheld TS12 device is priced at $675.

Circle Reader Service No. 135

Analog DFB laser diode

Philips Key Modules has announced eight new laser diodes including analog, digital and pump models. The two analog lasers (CQF93/D and CQF/94D) are 1310 nm and 1550 nm DFB types, designed for cable television and telecom applications. Specifications for the laser diodes include a bandwidth range of 600 MHz to 5 GHz, a minimum of 60-channels of loading and a maximum relative intensity noise (RIN) of -155 dB/Hz. Built-in optical isolators and thermoelectric coolers are included.

Circle Reader Service No. 136

Automated OTDR

BEAVERTON, Ore.—New from **Photon Kinetics** is a modular OTDR (OASYS 1000) system which combines automated design and a menu-driven interface for OTDR measurements on both singlemode and multimode fiber optic cables. Designed for multiple fiber testing, the OASYS 1000 can perform repeatable and unattended OTDR measurements of fiber ribbons or up to five "ribbonized" loose tube fibers.

The system includes an OTDR, a multiple fiber handler and a system computer. Under the control of the system computer, the multiple fiber handler sequentially aligns the OTDR pigtail to each of the fibers in a fiber ribbon for testing. The computer also controls the OTDR, including measurement configurations, signature acquisition and analyzation and report generation. Measurement results include single and bidirectional attenuation, point defect location, loss and reflectance, and attenuation non-uniformity.

Photon Kinetics officials submit that a bidirectional, two-wavelength OTDR fiber test can be accomplished with the OASYS 1000 in under 90 seconds, from fiber alignment to report generation.

Circle Reader Service No. 137

Fiber cleaver

HICKORY, N.C.—**Siecor Corp.** has announced its FBC-006 precision fiber cleaver, designed to cleave 250 micrometer and 900 micrometer coated fibers to lengths required for fusion or mechanical splicing.

No special training is required to operate the new cleaver, Siecor officials say. Once the fiber coating is removed, the fiber is placed into the cleaver's fiber guides at the desired cleaved fiber length. A press on the top of the unit completes the cut, without any series of flaps, levers or slides. Length scales are included to permit accurate cutting to any desired length between five and 15 millimeters.

The unit includes a diamond cutting blade for accuracy. Cleave accuracy averages less than 0.7 degrees from perpendicular, Siecor officials say.

Circle Reader Service No. 138

Multipath ghost eliminator

New from **Spectrum** is a direct pickup filter, the Ghost Buster, designed to eliminate or reduce cable TV signal interference caused by external RF signals picked up and carried by the shielding of a coaxial cable communicating with a TV or VCR.

Company officials say the unit is particularly effective in eliminating or reducing double images, horizontal beats and diagonal lines/color distortions seen on subscriber television sets, when those disturbances are caused by insufficient shielding of the television or VCR's tuner.

The unit features insertion loss of 0.6 dB, return loss of 18 dB and RF shielding of 100 dB.

Circle Reader Service No. 139

Standby power enclosure

NAPERVILLE, Ill.–**Standby Electronics** has introduced its 2000-series pedestal enclosures, designed to take advantage of new or emerging technology implementation without the need for multiple pedestals or upgrades. The enclosures support a variety of standby and standard power supplies, optical bridger or trunk applications and up to four full-size batteries. Accessories include universal mounting brackets, fused wiring harnesses and a fiber optic cradling system.

Circle Reader Service No. 140

Modular satellite tracker

ROCKLIN, Calif.—New from **Superior Satellite Engineers** is a modular tracking system design for retrofit into existing satellite antenna positioner systems. The Traxx-10 system adds inclined orbit satellite tracking capability to a positioner which currently has only satellite-locating abilities.

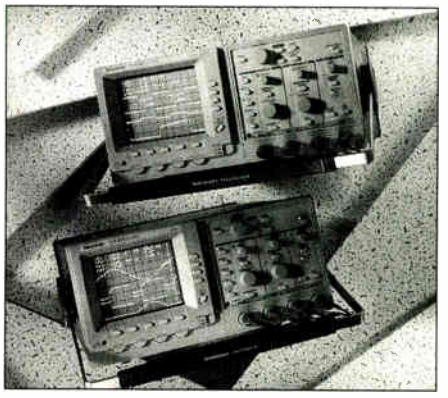
The unit is rack-mountable and is designed for installation into either fixed or mobile satellite communications systems, and is designed to interface into any three-axis steerable satellite antenna system. It operates by sampling the AGC voltage from an associated satellite receiver and making corrections to the position of the antenna to maintain the receiver AGC signal at a maximum. Under normal operation, the system can be set to track the satellite closely enough that the satellite signal remains within a 1 dB window, officials say.

Circle Reader Service No. 141

Four-channel o-scope

BEAVERTON, Ore.—**Tektronix** has announced the addition of two new four-channel oscilloscopes to its family of analog, real-time scopes. The new 100 MHz TAS 475 and 200 MHz TAS 485 scopes were designed for "tough service applications" where multiple channels need to be displayed to troubleshoot circuit conditions, such as three-phase power or logic circuitry. The TAS 475 is priced at $2,395, and the TAS 485 is priced at $3,495.

Circle Reader Service No. 142



Tektronix's two new four-channel scopes.

Texas Show: Telephony discussions abound

For anyone who needed further evidence of an impending technologies convergence, February's annual Texas Cable Show was yet another proving ground. Held in San Antonio, Texas, the confab featured a patchwork of discussions from telephone, competitive access and utility company representatives, with one common thread: Cooperation.

Indeed, a more apt word may be *co-operation*—because in a session titled "Telecommunications Opportunities for Cable Operators," representatives from Sprint Corp., Kansas City FiberNet and the Iowa Public Utility Co. all expressed and implied a desire to work together with cable operators. Phrases like "let's work together" and "strategic alliance" seasoned the well-attended session, where the three vastly different firms almost lobbied attendees to consider them for future voice-delivery agreements.

Why CAP is hot

However, if cable operators *do* decide to test the alternate access waters, they'd better do so quickly. That was the message from Ron Johnson, VP and general manager for MWR Telcom, who spoke on behalf of the public utility companies. "The window of opportunity (for non-telco-provided voice services) is slamming shut—so get your fingers out of the way," Johnson said.

Why should cable operators get stirred up about telephony? Consider this: Kansas City FiberNet, a competitive access company with roughly 25 business customers in the Kansas City, Mo. area, estimates it will make $1 million/year in revenues for its alternate path to the city's long distance exchange. "The key for us is our affiliation with TeleCable, the local franchise holder in the area. We view it as almost a kingpin of the future success of this endeavor," said Robert Niles, president of Kansas City FiberNet.

By contrast, David Scott, a strategic planner for Sprint, relayed the following revenue figures as another financial carrot:

- Cable television: $12- to $13-billion/year
- Telcos: $90 billion/year
- Long distance carriers: $65 billion/year
- Cellular industry: $4 billion/year

"So—is the opportunity real? It's not only real, but it's central to your future," Scott emphatically told those in attendance. "Not only because of the magnitude of the potential revenues, but because of your technology." Cable television, Scott noted, is probably in the catbird seat right now (in terms of network superiority)—but needs to cautiously guard its technological edge.

The risks

Clearly, such a high-ticket payoff doesn't come without some risk, mostly notably that of competition. "Competitors are all over the place in the local exchange," Niles said. Scott agreed: "It's getting awfully crowded within the local exchange. Cable's advantage is that its competitors are going to find it very difficult to respond for a long, long time because of telco's inherent regulatory restrictions and high-cost structures."

Further, Scott noted, the telephone industry is saddled with a network that is "outmoded," although he foresees change. "Some of (the telcos) are making fairly sophisticated moves to combat their inefficiencies," Scott said, citing recent announcements by Ameritech and Southwestern Bell.

Niles cited several other risks associated with alternate access-type voice services, including regulatory and reliability concerns. The educational ramp-up time required to learn the telephone business can also be tricky, Niles said. "Just the language used in the telephone industry is not necessarily easy to learn," Niles said.

But perhaps more importantly, the issue of equipment cost can surface as a hazard. "This is turning out to be a very capitally-intensive business, which raises the question of how we pay for the opportunities we pursue," Niles said. "The days of luxury when we could build a network piece by piece are over. To be successful, you need to spend a lot of money in a hurry."

All of the participants cite the strategic alliance as a means to get a leg-up on the provision of voice services. Sprint, for its part, said it is actively pursuing "fairly specific allegiances" with cable and "other" players—which will possibly include wireless, utility and local exchange companies.

"We plan to announce some trials soon," Scott said in the session. "Also, we're working on a marketing alliance to be used to see if cable operators can provide good, honest telephone service to the residence."

Possible steps to take

Johnson offered this advice to cable players who want to get in on the voice business: "Focus is the most important thing to remember. Aside from that, keep your costs down, provide a redundant network—the price of down time is astronomical—and consider changing your name from something other than that of your cable business. When you go out to sell alternate access services, you don't need the perceived reliability problems of the cable system hanging over you."

Further, Johnson said, cable operators should be aware that utility companies across the nation are going to install fiber "in a big way."

"It's natural for us to partner with one another," Johnson emphasized. "We're all stringing lines on the same pole. By partnering with a local utility company, on one cable instead of three, you save one-third of the installation costs and get your signal higher on the pole." Doing so, Johnson said, will enable the alternate access firms, utility companies and cable companies to "come out of their respective corners."

"Together, we could go after the telephone companies," Johnson said.

Other Texas Show news

Haag named chairman of SCTE IPS

Also in Texas, TCI's Director of Testing and Evaluation Jim Haag was named chairman of the Society of Cable Television Engineers' Interface Practices Subcommittee, replacing interim chairman Steve Willardson of Tele-Communications Inc. and outgoing chairman David Franklin of Time-Warner Cable.

"I want to move fast, and submit for adoption as many standards and practices as is possible," Haag said at the Texas Show. The group has already adopted a standard for the male port of the F-connector interface, and is now pushing for a standard on drop cable, F-connector female port, push-on F-connectors and trap interface specifications, Haag said. Also, the number of test methods being studied by the group has increased to 22—five of which will

be re-submitted for adoption by the SCTE following revisions.

Also, the IPS has asked for CableLabs' assistance in developing a standard for the effectiveness of RF shielding. "We've asked the Labs to help us with the structured testing to help set standards in that area," Haag says.

Haag noted that a new reference publication titled "Recommended Practices and Test Methods for the CATV Industry" is available in limited quantities. The 1,000-plus page binder includes all of the currently available SCTE standards and testing documentation, in a three-ring format so that sections can be replaced as finalized standards become available. The 30-section book, which Haag jokingly refers to as "the IPS Bible" because of its breadth and girth, is available by contacting him at (303) 267-5169.

Channel, Optical Cable ink deal

Channell Corp. and **Optical Cable Corp.** announced the signing of an exclusive agreement wherein Channel will market, sell and distribute Optical Cable Corp.'s D-series tight-buffered fiber cable. Optical Cable Corp., prior to its entry into the cable market, supplied cable for local area network applications.

The D-series cable uses a tight-buffered approach as opposed to loose-tube, gel-filled versions. The actual glass used is the operator's choice, officials say. Both armored and non-armored versions are available.

Other news

Augat division moves

Augat Inc. has announced that its Communications Products division has moved from its West Seattle locations into a new $5 million, 75,000 square-foot manufacturing facility in Kent Valley, Wash. With the move, Augat consolidated all of its operations and 150 employees from four West Seattle buildings into one building. Augat's new address is 23315 66th Ave., South Kent, Wash., 98032. The new phone is (206) 854-9802.

Mind Extension gets SCTE nod

Four interactive video courses developed by **Mind Extension Institute** have been approved for recertification credit by the Society of Cable Television Engineers. The courses "Customer Service: Your Key to Success," "Sales through Service," "Installer Training" and "General Safety" are worth two credits each. Also, the "Installer Training" course helps students to prepare for BCT/E Category VI (terminal devices).

New company formed

A new corporation was started recently to supply new and used cable equipment to the cable industry. Called Quality Cable and Electronics Inc., the firm is run by David Green and will sell headends, earth stations, line actives and passives and more.

SCTE President Bill Riker (second from left) and Director of Chapter Development Marvin Nelson (left) meet with Connie Buffalo and Victor Harrison of MEI to announce qualification of MEI interactive video courses for SCTE recertification credit.

Wright files comments to FCC

Ken Wright, director of technology for **Jones Intercable** and an active participant in the cable industry's response to an FCC Notice of Proposed Rulemaking on emergency broadcast systems (EBS) apparently felt so strongly about the subject that he decided to file his own, personal comments.

In his comments, Wright notes that he is "very concerned" about the "extreme financial burden which the new system may place on cable operators." An attachment to Wright's comments estimates a potential $100 million to $500 million price tag for cable participation in EBS, depending on an impending FCC decision.

"I believe that serious consideration should be given to whether cable operators should be required to override both audio and video programming, and/or whether equipment purchases should be mandatory unless funding is made available to offset these costs," Wright noted of the potential cost figures.

Patent received

Instant Video Technologies has announced receipt of an Australian patent (number 627841) for its burst transmission technology designed to send and receive video and audio programs across a variety of networks in "a fraction of real time," officials there say. Specifically, the transmission system can transmit a two-hour video program over fiber optic cables in roughly 15 seconds, although the company submits that cable TV and satellite transmission require "slightly longer" transmission times.

The company believes the technology to be an essential component in various video-on-demand applications within the home.

Ameritech announces re-org

Ameritech has announced a new plan to create 12 business units focused on "helping customers realize the promise of the information age," said William Weiss, chairman and CEO for the company. Eleven of the units will be organized around specific customer groups, plus a single unit to run the company's network in Illinois, Indiana, Michigan, Ohio and Wisconsin. Ameritech's Bell companies will continue to function as legal entities owning current Bell company assets in each state.

Under the new structure, Ameritech customers eventually will have a single point of contact to order telephone service, arrange for communications equipment, and handle advertising directory needs. "In effect, the customer will call the shots in how he or she wants to be served by us," Weiss said.

Wegener, Medical News Net agree

Wegener Communications Inc. has been selected by **Medical News Network** to supply addressable video receivers. The network will begin broadcasting this spring, and is provided to doctors via a direct broadcast into their offices.

Photon Kinetics, AT&T ink deal

Photon Kinetics Inc. and **AT&T** have announced the signing of a technology transfer agreement in which Photon Kinetics will have exclusive rights to commercialize the optical fiber preform measurement technology developed by AT&T Bell Laboratories. Photon Kinetics plans to use the technology for the development and production of optical fiber preform profiling systems, which will be made available to manufacturers of optical fiber worldwide.

By Leslie Ellis

Large,

continued from page 83

Decoder Interface installations, then conventional taps can be replaced by addressable taps which control only an on/off function. This is already a mature product that has been installed in hundreds of thousands of locations.

So what is the industry (and FCC) to do about the situation, given a lot of very complex choices?

First, recognize that no single technology will fit all situations. System size, density, existing control technology, plans for introducing new technologies, rebuild schedules and many other things will affect the optimal choice. The FCC rules should be sufficiently flexible to accept any solution that satisfies simultaneous access to two channels, without requiring simultaneous access to all premium services.

Second, the Commission should avoid hampering the development of digital compression by forcing the same standards on it as on analog channels. The most likely uses for digital compression are for delivery of multi-channel PPV and various narrowcast services. These are not the sort of services that are "skimmed" the way broad interest programming is, and, therefore, are not at the root of subscriber dissatisfaction over tuning limitations. Should the nature of this, still very new, transmission method change, the rules can be revisited.

Third, realizing the tremendous upside potential from a wide deployment of Decoder Interface solutions, the Commission, as part of its definition of "cable-ready" reception equipment (see companion article, page 84), should mandate the inclusion of this low-cost connector in any set that tunes the cable-exclusive channels. The EIA/NCTA Joint Engineering Committee should be given the mandate to modify it sufficiently to accommodate upgrades to HDTV and digitally compressed signals.

It is the author's opinion that most cable operators who now use addressable convertors would readily adopt this solution as the best for themselves and their customers if connectorized sets were commonly available.

Finally, operators need to carefully study all of the alternatives, make their feelings known to the FCC, and be prepared to adopt the solution which best balances capital and operating costs, customer benefit, and competitive challenges for their system.

Footnotes

1. *Notice of Inquiry, In the Matter of Implementation of Section 17 of the Cable Television Protection and Competition Act of 1992; Compatibility Between Cable Systems and Consumer Electronics Equipment*, ET Docket 93-7, FCC 93-30, Adopted Jan. 14, 1993, Comments due March 22, 1993, Reply comments due April 21, 1993.

2. *Cable Television Cosumer Protection and Competition Act of 1992*, Enacted Oct. 5, 1992, commonly called the Cable Act of 1992.

3. Several provisions of the law have been challenged legally, but until the courts rule otherwise, it must be assumed they will be upheld.

4. Stations received by satellite are not required to be in the basic tier.

5. *Cable Act of 1992*, Section 623(b)(7)(A).

6. *Cable Act of 1992*, Section 614(b)(6).

7. *Cable Act of 1992*, Section 623(b)(8). It should be noted that cable operators who cannot technically offer such a tier are granted a 10-year exemption from this requirement.

8. *Cable Act of 1992*, Section 623(b)(4)(B).

9. *Connecting Cable Systems to Subscribers' TVs and VCRs—Guidelines for the Cable Television Industry*, issued by the NCTA Engineering Committee's Subcommittee on Consumer Interconnection, chaired by the author, 1987.

10. A new positive trap technology has been introduced that replaces the interfering carrier by a pre-distortion of the video sideband. While this allows trap use at higher frequencies and improved picture quality, it does not overcome the broadband loss of the trap.

11. The Decoder Interface Connector, commonly called the MultiPort Jack, is a fully negotiated and released standard, recognized by both the American National Standards Institute and the EIA as standard ANSI/EIA 563.

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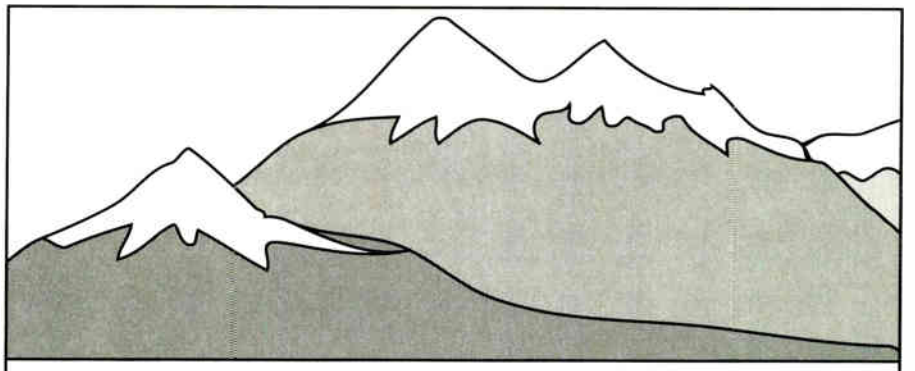

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		BEIGE	4,816'	.30/FT
M-15D	1½X1½" MOLDING	REDWOOD	4,032'	.40/FT
		WHITE	1,584'	.40/FT
M-750D	¾X1¼" H MOLDING	BEIGE	7,040'	.24/FT
M-10D	1"X1" MOLDING	REDWOOD	3,360'	.28/FT
Q-700D	/x3½" MOLDING	BROWN	4,240'	.21/FT
Q-70D	½x3½" MOLDING	BROWN	6,120'	.16/FT
C-1200D	2½" COVE MOLDING	IVORY	10,680'	.36/FT
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Wide-screen NTSC

Jean-Luc Renaud, Contributing Editor to TBI *(Television Business International)*, is the author of a pregnant article in the November 1992 issue entitled: "HDTV: A Runaway Train?"

Is the public really clamoring for large, wide-screen, high resolution television sets? Do they expect to pay $5,000; or, are they hoping to pay $500? Will they make room for a 3-foot by 5-foot TV screen in their little apartment, or trailer?

If not, why should they buy HDTV which may not look any better than NTSC on a good 21- or 24-inch screen? Why is it that terrestrial broadcasters have become so skittish about the relentless drive toward HDTV, which some believe will be devastatingly expensive with dubious returns?

Revolutions take place one step at a time. Fifteen years elapsed between the Declaration of Independence and the Bill of Rights, not all of that in warfare. Clearly, HDTV will not overnight become as commonplace as color. There can be no doubt that enormous changes in what we now know as television will come to pass. How we get from here to there is worthy of some serious speculation.

Aspect ratios

The first step is now taking shape. Five companies have announced the introduction by mid-1993 of wide-screen NTSC TV sets with 16:9 aspect ratio. JVC and Panasonic will offer wide-screen projection models in 50W to 58W sizes. Thomson Consumer Electronics, Philips, and Sharp will offer 34W direct view CRT models.

The JVC model is quoted at $4,495. The FCC Advisory Committee believes that by 1998, mass produced 34W HDTV CRT sets will be priced around $2,550; 56W projection at $3,850. Wide-screen display of NTSC should be available at much less cost.

The "W" designation is used by Television Digest for 16:9 screens, representing screen width rather than viewable diagonal ("V") as has been standard for 4:3 screens. The chart below shows equivalent screen sizes for comparable screen height at both aspect ratios.

Many movies were originally recorded on film or tape at wide aspect ratio (mostly close to 16:9, although Cinemascope is about 21:9). These are sometimes broadcast at full width and displayed on 4:3 TV screens in "letterbox" format, with blank spaces at top and bottom.

However, they would easily fill the widescreen at 16:9. Programs originally shot at 4:3 aspect ratio—live sports for example—or that have been adapted from wide-screen originals, would normally have to be displayed on the 16:9 screen with blank spaces at each side of the picture.

Existing NTSC standards do not provide for filling blank spaces with advertising, or program guides, as would be possible with HDTV standards. Some vertical overscan may be acceptable, but runs the risk of cutting off heads, or part of the titling information. JVC "progressively stretches the right and left edges . . . to fill the 16:9 screen." For wide-screen videocassettes from the video store, Thomson has a wide-screen VCR that automatically sends a code to switch the wide-screen TV set to the 16:9 mode.

Designation	Aspect ratios	Height	Width	Diagonal
34W	16:9	19.13	**34.00**	39.01
32V	4:3	19.20	25.60	**32.00**
50W	16:9	28.13	**50.00**	57.37
48V	4:3	28.80	38.40	**48.00**
58W	16:9	32.63	**58.00**	66.55
55V	4:3	33.00	44.00	**55.00**

Consumer interest

Television Digest reports (Dec. 7, 1992) that a consumer survey in Europe, conducted by a British firm, found that "56 percent liked 16:9 wide-screen sets better than conventional models and said they would be willing to pay average of 28 percent premium."

> By the mid-'90s, widscreen TV will be as well-known as Cinemascope movies.

Development of a substantial market for wide-screen TV receivers depends on the coalescing of several key elements. Reducing the cost from $5,000 to $750 to $1,000 could only be achieved, if at all possible, with very large volume—say millions or tens of millions of units. Large volume depends on the popularity of the programming made available to the public in wide-screen format. The availability of popular programs depends on negotiation for copyrights and early release, which in turn depends on the size of the potential audience and projected box-office returns.

Coupled into this circular pattern is the TV dealer's need for new product to render existing TV receivers obsolete, and a certain amount of consumer peer pressure, or "keeping up with the Jones's." Historically, the replacement cycle for TV sets has been 10 to 15 years, for reasons of both obsolescence and deterioration.

Wide-screen is not HDTV

Wide-screen is not HDTV. But it is the opening gambit in a game in which neither subsequent moves, nor even the ultimate objective is clearly perceived. By the middle of this decade, wide-screen TV will be as widely known (although not nearly so widely distributed) as Cinemascope movies. Before the end of the decade, the public will be ready for the next step, and the market will be ready to supply it, whether it be improved pictures (HDTV), larger screens, interactivity, multimedia or even Videophone. CED

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

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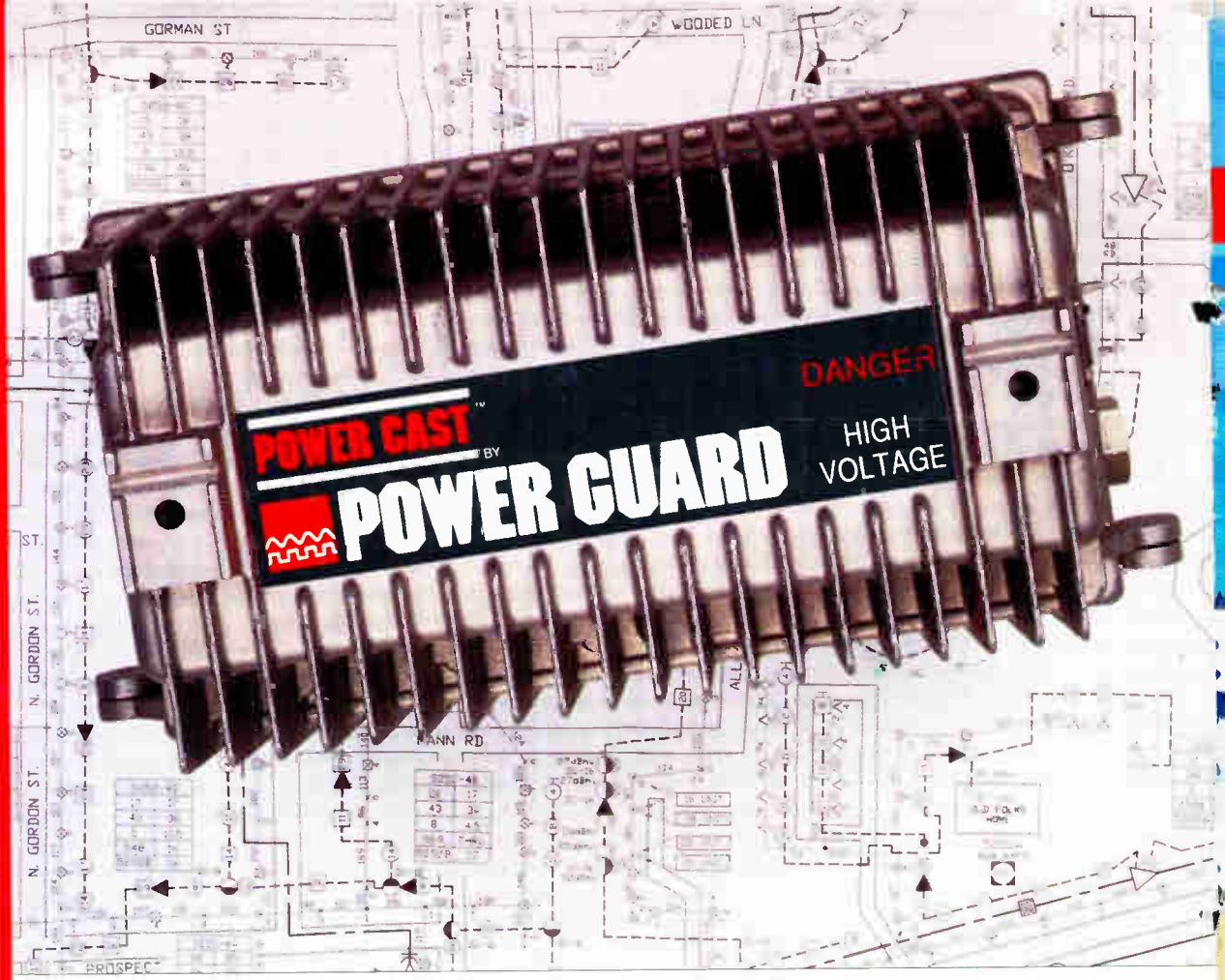

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