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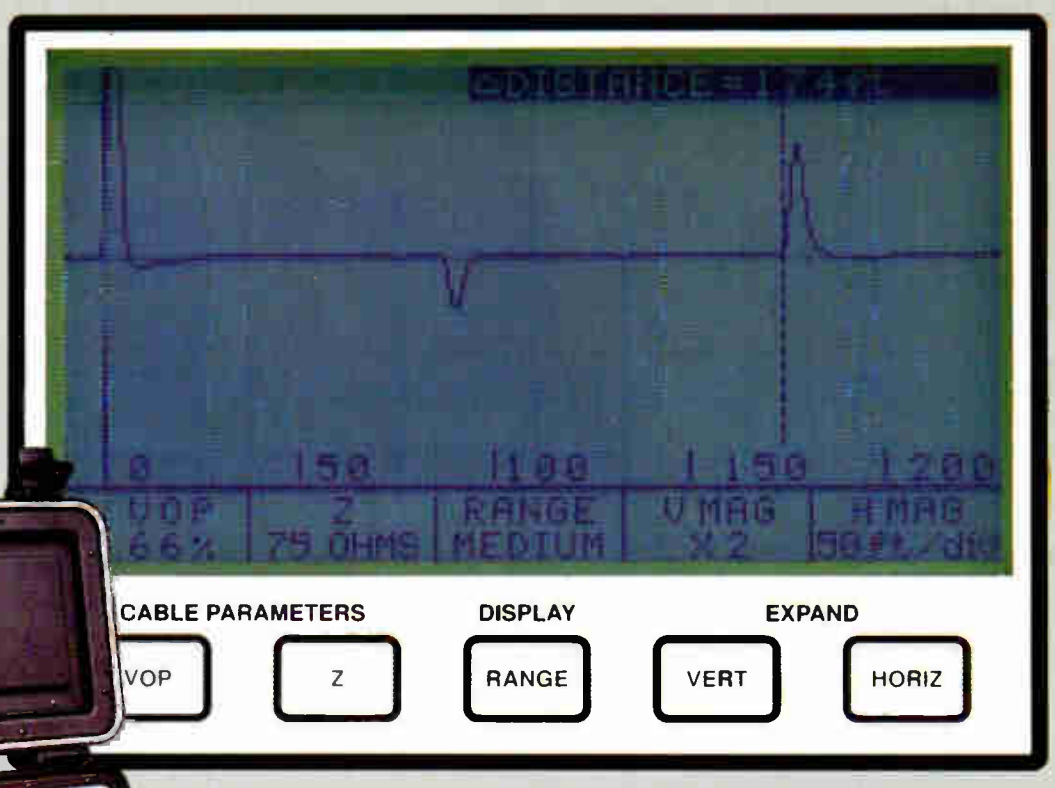

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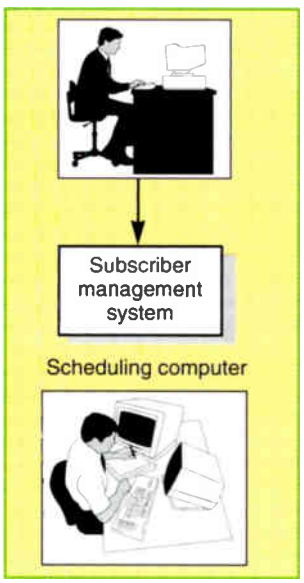

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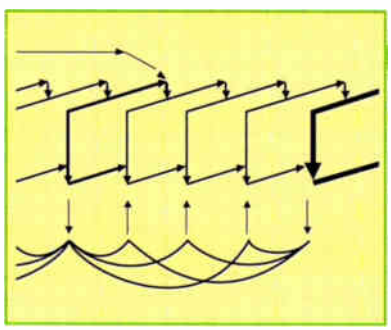

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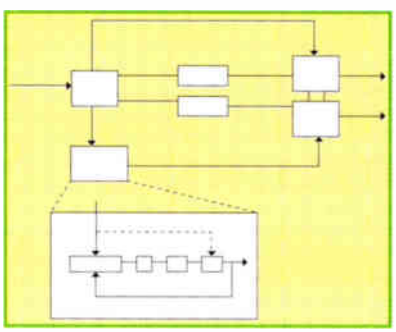

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A pull-out wall chart covering cable and over-the-air assignments from 300 kHz to 30 GHz.

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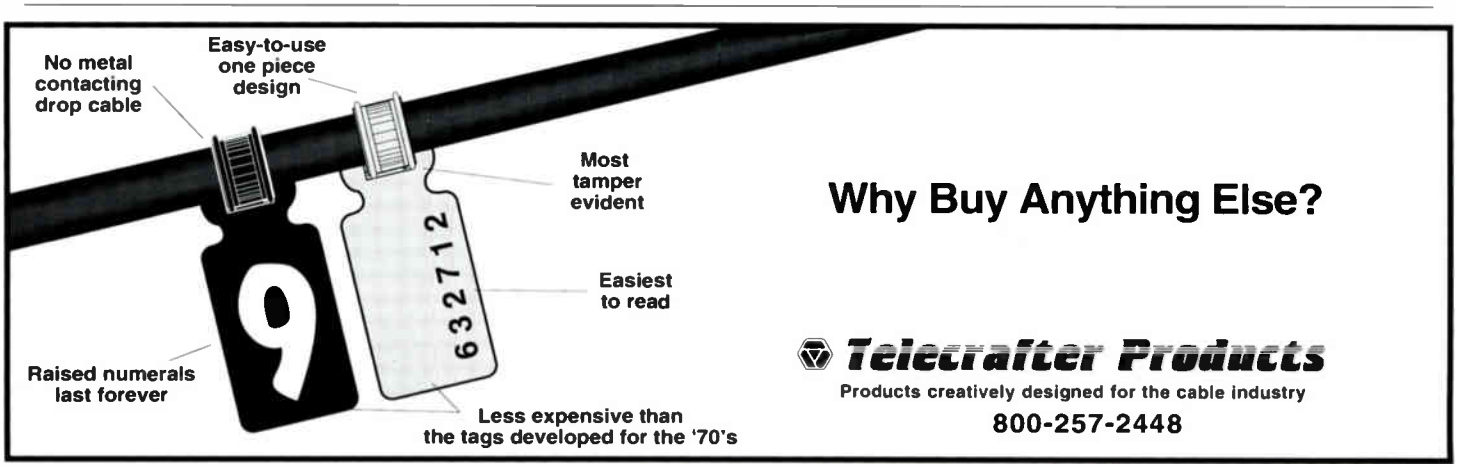

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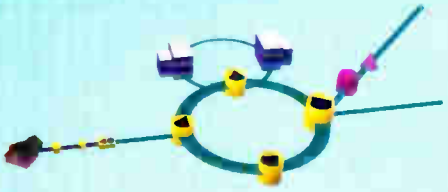

Our Cable Integrated Services Network provides a plan for integrating digital rings into the information highway, making services like videoconferencing and telecommuting a reality.

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Reader Response Number 4

Convergence conversations

The scene was Jerrold's Christmas party in Denver. It was nice to see many old industry friends and acquaintances and toast the upcoming holidays. Not surprisingly, the chit-chat centered on the recently announced mergers between cable and telephone companies.

One long-time friend, a purchasing agent at a major MSO, commented on the benefits of the convergence of the two industries. She echoed the feelings of many at that holiday celebration: New capital from the mergers will allow additional growth; we'll have access to new ideas, technology and resources; telephone and cable will combine to form a revolutionary new business.

I walked away from that conversation with a suddenly uneasy feeling. Yes, convergence generally will be positive for both industries. CATV system personnel will have an opportunity to work in what will literally be a brand new industry. In the end, the consumer will be the true beneficiary.

But what of the people who work in the corporate offices of the MSOs who are merging with the phone companies? Think about it for a moment. Can you tell me a single situation where one company merged with another and then retained the entire staffs of the two original companies?

Why on earth would a large telco — with its corporate staff that already includes human resources, communications, marketing, legal, operations, engineering and purchasing departments — keep duplicate functions in an acquired CATV corporate operation? With the possible exception of engineering, which likely would be absorbed by the telco, the other departments' responsibilities probably can be handled by the telco's own people.

Granted, the percentage of corporate types who might possibly be displaced by these mergers, at least compared to field personnel (someone has to run the systems), is fairly small. And don't think I'm being a curmudgeon about all of the recently announced mergers. Quite the contrary: I'm an advocate of convergence. But it may not bode well in the long run for folks like my purchasing agent friend. Only time will tell.

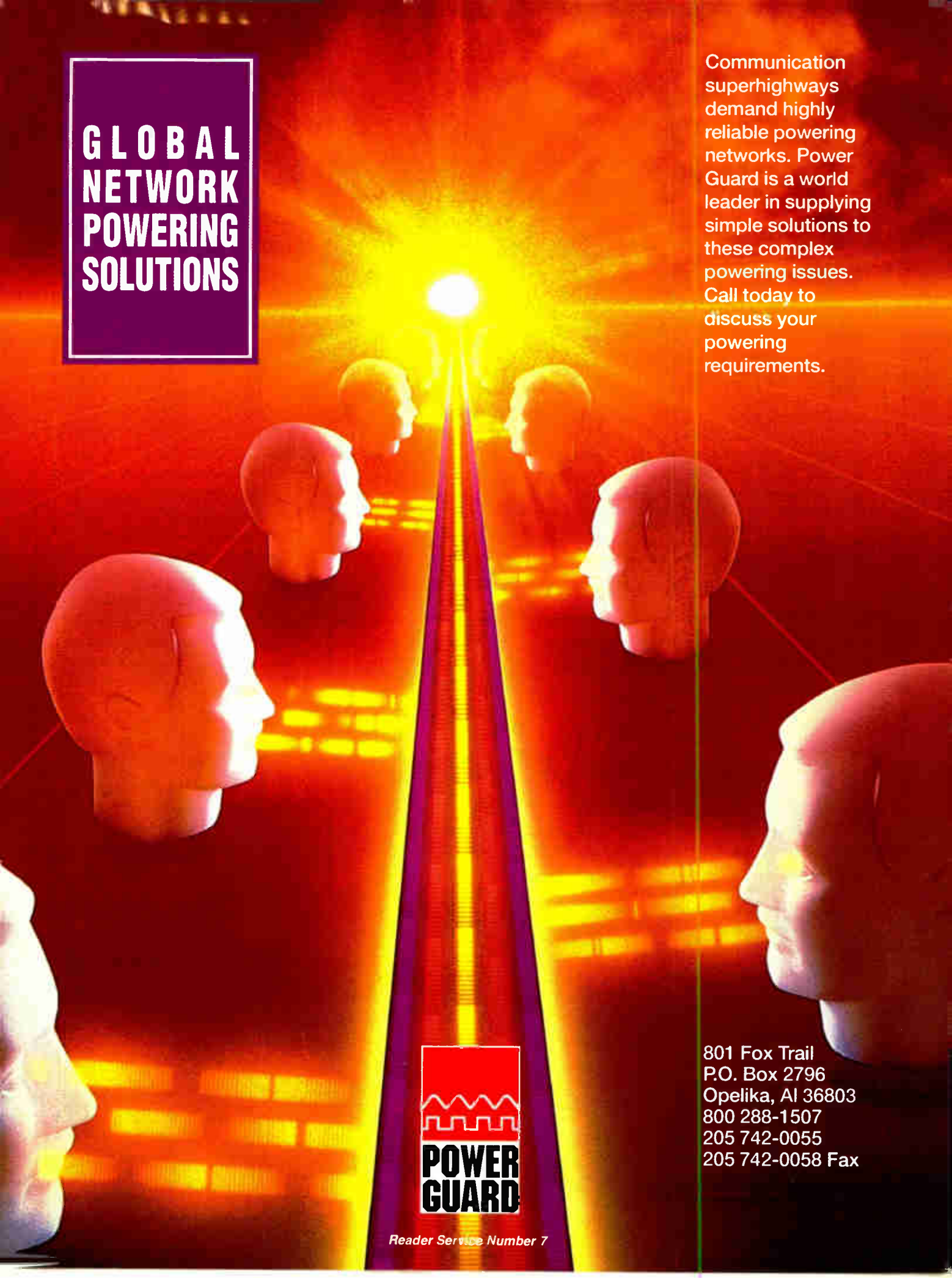
Lists

Jonathan Kramer, CompuServe's broadcast professional forum CATV sysop, recently announced that he is putting together a list of Society of Cable Television Engineers members who are available on-line. The purpose is to encourage direct E-Mail contact between SCTE members, forum visitors and interested parties. The list will be posted in the library section of the BP forum.

If you want to be on the list, drop Jonathan an E-Mail via his CompuServe address: 73300,2161. Be sure to include your name, addresses (please identify by service), SCTE member status and number, chapter or meeting group affiliation, and any additional pertinent information (chapter official, ham call sign, interests, etc.).

Speaking of lists, if you're a ham radio operator, don't forget that Time Warner's Steve Johnson maintains a list of hams in the CATV industry. To date it numbers in excess of 500, and you can add to that total by calling Steve at (303) 799-1200.

Ronald J. Hranac
Senior Technical Editor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ET '94: CATV's bright future

PHOENIX — The excitement over the coming generation of cable TV technologies drew a larger than expected crowd to the SCTE's 1994 Conference on Emerging Technologies. Hundreds of cable, telephone and computer technicians and engineers converged on Phoenix to find out about everything from the latest success with ultra-high bit rate digital modulation techniques, to what technologies the competition is stocking in their arsenal.

Didier Le Galle, vice president of research and development at C-Cube discussed the current state of the MPEG-2 standard, the preferred compression technique for CATV. He said that digital optical discs capable of data rates of 4-6 Mbytes will be shipping soon. He also pointed out that an MPEG-4 standard for personal video communication is in the process of development. It will enable wireless terminals to download video at data rates of only 10 kbytes.

AT&T researcher Clive Holborow dug into the details of MPEG modulation. He said that the MPEG working group built a virtual VCR place holder into the MPEG standard, which will provide consumers with VCR-like control while watching MPEG movies. Holborow pointed that politics were involved in incorporating this unfinished piece into the MPEG standard. It was felt by MPEG people that they were the right organization to specify it, and they felt that if there was no place holder, then it may have gone to another organization.

Bill Nash, TCI's digital compression product engineer, reported on the results of their experimentation with multi-megabit digital transmission over a variety of media in a real world environment. With the exception of AML microwave, all of the digital links running on 64 QAM did just as well as expected. The problem with AML microwave appeared to be excessive phase noise.

Nash said that one of the problems with digital systems is that they either work or they don't. Consequently, there may not be an indication that the network is about to fail, as snowy pictures can indicate for analog systems.

In the cable plant, ingress could play havoc on a digital system. Nash said, "You really need to have a tight plant or you are setting yourself up for ingress." Impulse power from devices like blenders and radio emissions from pagers can be sources of ingress into the cable plant.

Brian Bauer, applications engineering manager at Raychem, pointed out that the ingress from a loose connector is 30 dB more than a tight one. He described a new kind of tap connector that does not swivel and drastically reduces problems. In a recent trial, a cable company was able to reduce service calls from bad connections by 100%.

Jack Terry, a researcher at Bell Northern Research, discussed a novel architecture for interactive services

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based on active taps, which are capable of converting a digital signal into an analog signal, and passing it to a home. Terry claimed that this type of architecture resulted in lower costs and lower power consumption.

Al Johnson, president of Synchronous Communications, described how 1,550 nm technology is finding a variety of uses in cable TV. He said that one of the myths of 1,550 nm systems is that they create chirp. The reality is that DFB lasers create chirp at any wavelength, but at 1,550 nm, dispersion makes the chirp a problem. Synchronous has developed an external modulation system that delivers linear chirp-free performance.

Jim Chiddix, senior vice president of engineering at Time Warner, gave an overview on the state of the Full Service Network being built in Orlando. Chiddix plans to drive fiber wherever he can, even if it is a little bit more expensive than coax. Time Warner will bring fiber to 500-home nodes, which will be coupled into four more fibers, each serving 125-home nodes. Chiddix said that this will increase reliability dramatically. While a standard all coax-based cable system is out for an average of nine hours per year, tests have indicated that a fiber rich system can reduce that to 1.5 hours per year.

Craig Mundie, vice president of advanced consumer technology at Microsoft, described their strategy for providing an operating system for consumer devices. He said that the set-top box of the future will not be just an independent box, but a gateway into a local network in each consumer's home.

Mundie said: "As devices grow in processing power, people will demand that they interoperate. Not in the sense that they change media, but in the sense that they can interact." In addition to changing channels, the set-top remote of tomorrow may control lights, stereos and dishwashers as well.

But at the end, arch skeptic Gary Arlen, president of Arlen Communications, threw a bit of water on the excitement. He pointed out dozens of examples of companies that in their moment of excitement believed that their interactive service would lead to incredible revenue growth. In its heyday, Qube brought Warner a tremendous growth of new franchises. But in the end, most of these services fell flat on their face when reality began to catch up with their myth. — *George Lawton, West Coast Correspondent*

The following is technical news from the Western Cable Show held in Anaheim, CA, Dec. 1-3, 1993. For more from the show, see the "CT Daily wrap-up" beginning on page 67.

Western Show packs technical wallop

The Western Show held in December boasted a wide variety of sessions covering new technologies and emerging engineering trends.

At the "Multimedia/Interactive Services and Applications" session, speakers pondered the future of multimedia and what it will mean to the cable industry. For starters, it is important to understand that multimedia and interactivity are different types of services that can work together. Multimedia is the fusion of audio, video and data controlled by a computer.

On the other hand, Pete Miller (vice president of corporate development at Viacom) suggested, "Interactive is not

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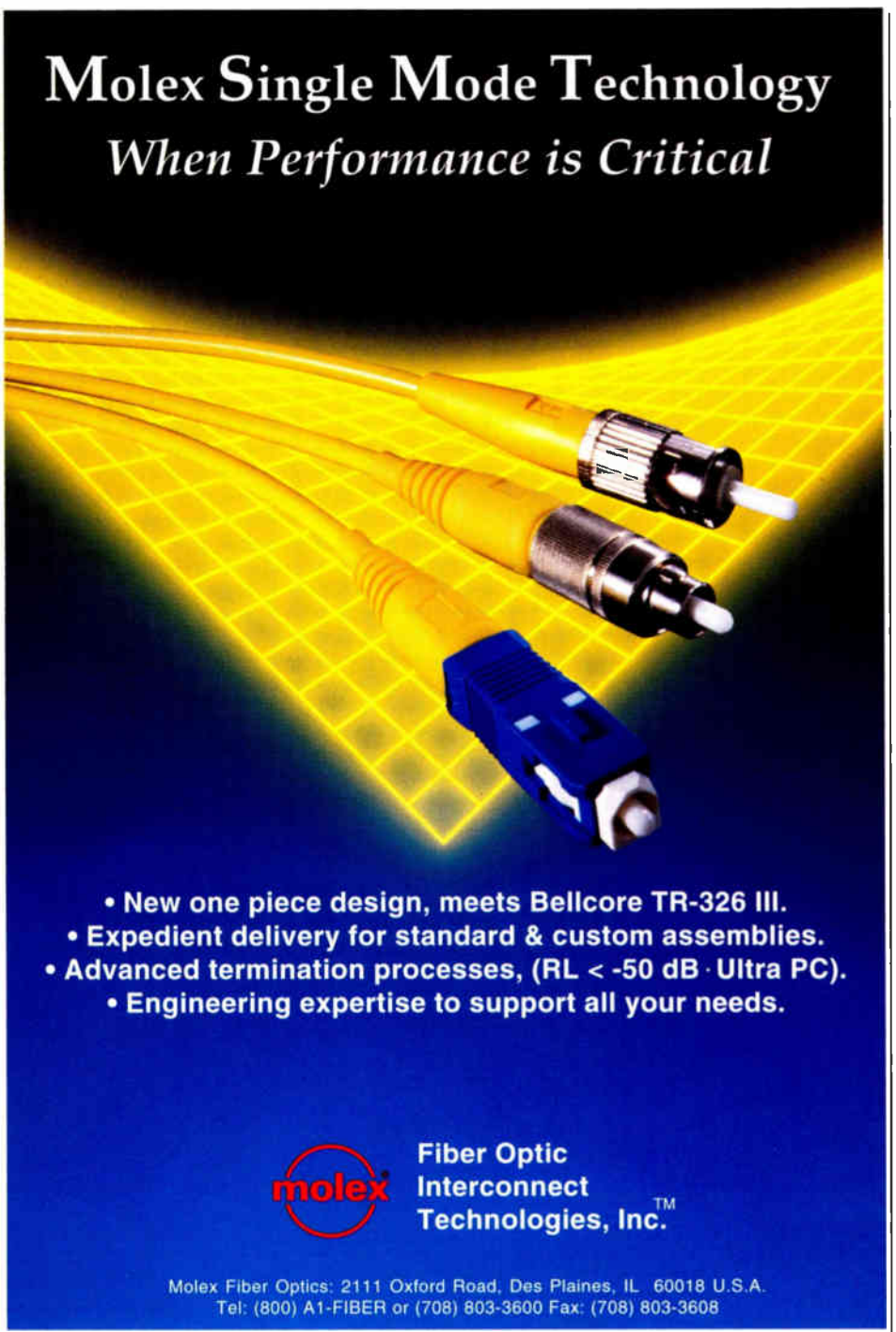
computer technology connected to a television. It is not multimedia. It is not a technology at all. The way to think about interactive television is that it is TV augmented with interaction, and that is all."

Miller believes that a shift in programming will occur in the next year as creative people get their hands on the tools. "In my company we are looking forward to getting our hands on the authoring tools to really push and see what they can do."

Rick Tompane, vice president of technology at startup 3DO, believes that the advent of a new programming medium will accelerate the development of new software. 3DO is licensing out a technology for extremely realistic 64-bit computer games. Before 3DO, software developers had to pay a royalty on the order of $10 to Nintendo or Sega for every cartridge they sold. 3DO enables software to be published for about $2 a copy. Eventually, video-on-demand will allow the same kind of cost reduction for multimedia and interactive applications.



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Tompane said, "It is no longer the assembly line bit twiddlers that have to make this work. They are not just creating video games, but flight simulators and educational games. It amazes me how many creative titles are being created. Owing to the sheer momentum of this kind of stuff, people are going to see applications that appeal to people's interest."

In the "Intelligent Converters vs. Intelligent Networks" session, participants debated how deeply to embed intelligence in future cable TV networks.

Leo Hoarty, president of ICTV, suggested that the headend is the best place to put intelligence. His company has been working with IBM and New Century Communications on an architecture that places multimedia processors in the headend, where they can be shared by a number of users. This enables lower startup and upgrade costs than an intelligent converter architecture.

In ICTV's network, only a small number of multimedia processors are used, on the assumption that only a few users will initially make use of multimedia services at any given time. As revenues go up, the cable company can incrementally add new multimedia processors to suit them. Each home is equipped with a cable box with a $50 modem. All interactive services are transmitted to consumers via the spare analog channels on the network.

This architecture enables ICTV to put a $2,000+ computer in each processor, since there are so few. Also, when it comes time to upgrade the processor, the cable company only has to change out half a dozen boxes, not a thousand.

Jeffrey Huppertz, director of video systems at Scientific-Atlanta, argued that putting intelligence in the home is a better idea. "Americans value convenience above all else. They demand they get what they want, when they need it. I feel that to have an unintelligent set-top box in the house running back to a server is like going back to the '60s. We feel this is an issue of time-sharing vs. distributed processing."

Huppertz said that putting intelligence in the home leads to centralized cost, requires considerable bandwidth, and is less fault-resistant.

It seems like the reality falls between these extremes. The ICTV architecture has a lower startup cost. But as

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usage grows, it will not be able to support an entire network via the excess analog bandwidth. At that point, it will make sense to place a digital video decompression box in everyone's home, while keeping the processing power in the headend, where it can be shared.

Participants in the "Fiber Architectures in an Interactive World" technical session discussed different possibilities for building the next generation network.

Carl McGrath, a technical manager at AT&T, said the major impediment to information services is the return channel problems. He suggested there were some ways of alleviating these limitations. There could be multiple independent coax loops beyond a fiber node. This would increase the available upstream bandwidth for each user.

The return paths from these coax loops could be block shifted on a single fiber. For example, the first loop goes back at 5-30 MHz, the second at 50-75 MHz, and so on.

Steven Fleming, director of strategic marketing for Northern Telecom, suggested that SONET could be integrated with a cable network for improved performance by separating the video from the data. In Fleming's scheme, two fibers would be carried out to each neighborhood, one for 750 MHz video, and the other for SONET. The interactive services will be transported over SONET.

Fleming does not believe that this type of architecture will make economic sense this year. But ultimately, it could grow in popularity because "it is a strong expression of convergence because all of this ATM and SONET will be the same whether you are a cable company, a power company, or someone bought out by a telephone company." — *George Lawton, West Coast Correspondent*

Alliance creates interactive network

Arizona State University, Digital Equipment Corp. and Times Mirror Cable Television announced they have entered into a strategic alliance to develop an interactive network that connects large manufacturing companies to their suppliers and subcontractors. The purpose of the network is to make American corporations more competitive, nationally and worldwide, by using real-time, bidirectional, broadband communications to increase product quality and reduce time to market.

Network users will access a wide variety of interactive software applications and information repositories. Applications fall into two broad types. Text-based applications handle administrative functions, letting manufacturers bid jobs, execute purchase orders, revise product specifications, and perform scores of other tasks. Visual-based applications let users transmit images, the information format used most in manufacturing. Images transmitted include complex two- or three-dimensional CAD drawings, white boarding, video desktop applications, electronic mail, videoconferencing and multimedia presentations.

The network will link the standalone computers and LANs of manufacturers, including prime contractors and a group of their first and second tier vendors. The first implementation will include McDonnell Douglas Helicopter Systems and two suppliers, Tempe Precision Instruments and Modern Industries Inc.

The partners will divide development and operation of the network along func-

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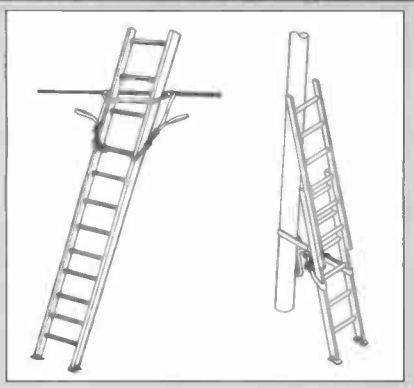

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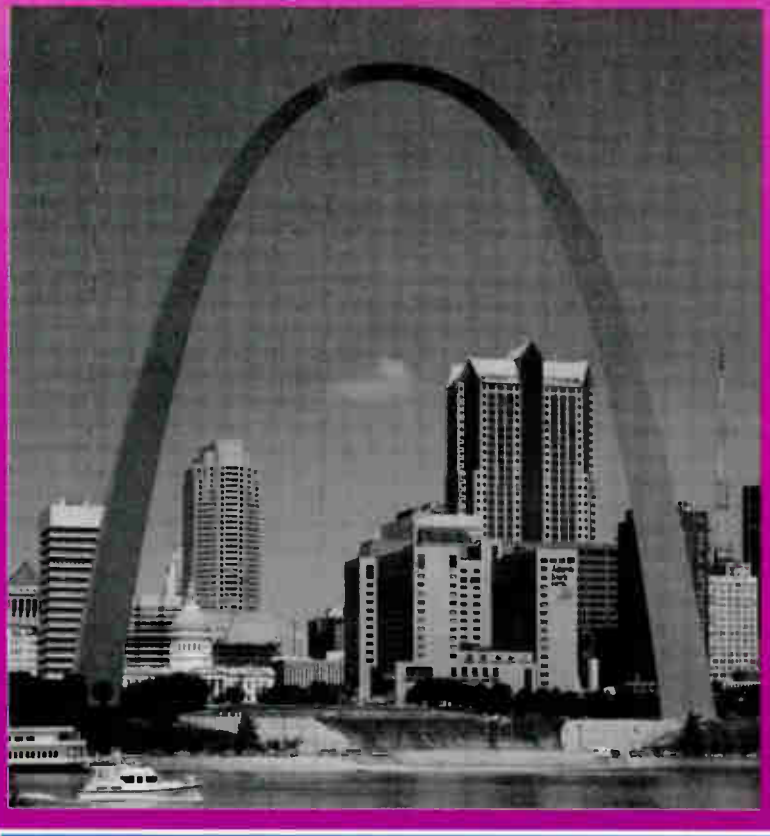

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tional lines. DEC will serve as the network operations manager, providing customer support, security and network traffic management, as well as the engineering, networking equipment, computer systems and hardware support required to turn the existing cable TV system into a bidirectional network. Arizona State University's Computer Integrated Manufacturing Systems Research Center will develop an intelligent graphic user interface for workstations and personal computers, and applications software to aid manufactures with purchasing functions. Network operations and management functions will be run from the ASU campus in Tempe. Times Mirror, which owns Dimension Cable Services of Phoenix (its largest cable operation), will provide the network infrastructure and manage business planning, marketing and regulatory affairs functions.

Specifically, Times Mirror is the primary provider of transmission infrastructure and connectivity over its existing fiber/coax cable in Phoenix.

DEC has provided its Digital Channel Program including the new ChannelWorks technology, which allows for low-cost 10 Mb Ethernet connectivity via the cable network over distances of up to 70 miles. DEC also will provide FDDI products composed of bridges and network management software that converts cable systems into two-way interactive, high-speed networks that support video, voice and data applications. DEC's Alpha AXP computer systems will be included in the network as well.

The Computer Integrated Manufacturing (CIM) Systems Research Center of ASU acts as the focus for new applications development. In addition, the center will collect and measure data to determine the benefits beta test participants receive from the network and the critical success factors needed to commercialize such a network.

SCTE sponsors FCC Washington update panel

Pointing out this is the 10th year the Society of Cable Television Engineers has sponsored technical sessions at the Western Show, SCTE President Bill Riker welcomed attendees to the "FCC Washington Update" session and told them that this was to be a straight-from-the-horse's-mouth discussion since four representatives from the FCC were part of the panel.

Helena Mitchell, chief of EBS at the FCC, gave details on cable's integration into the Emergency Broadcast System. Field tests and new equipment demonstrations have kept Mitchell busy over the last six months and she noted that even the FCC staff has been amazed at some of the products suppliers have demoed that essentially allow the public to be informed of an emergency "anywhere no matter what you're doing." As Mitchell has stressed many times, she again repeated that the FCC's EBS department is "open and receptive to your ideas and thoughts." The commission is still seeking a new name for EBS that will better include cable's involvement. New name ideas are welcome.

Alan Stillwell of the FCC discussed cable's compatibility problems with consumer equipment and the FCC's involvement in solving the problem. He mainly covered what is CATV's biggest compatibility problem with consumer's TV sets and VCRs — the set-top converter. The FCC recognizes the need for set-tops especially as a means of preventing theft of service, but also recognizes the public's desire to use their VCRs without the limits attached by a set-top or use the remote controls that came with their "cable-compatible" TV sets. Stillwell discussed the FCC's study into the use of a new interface that would be built into cable-ready VCRs and TV sets that would reduce the set-top compatibility problem.

The next FCC representative to speak was Ron Parver, chief of the Cable TV Branch. His main point was that "must-carry is a gray area in the Cable Act."

Assistant Chief of the Cable TV Branch John Wong disagreed. He said must-carry in the act "was quite blacky." He also informed the audience that photos and videotapes sent in to the FCC to prove the presence or absence of a TV signal are only a support tool, but not full proof of compliance. As for signal leakage, Wong was disconcerted with what he has seen with many of the 85% of '93 CLI filings that have already been made. He said he recognized signal leakage was playing second fiddle to other issues brought about by the Cable Act, but warned he saw "a dramatic deterioration in the quality of filings" that was unacceptable.

Wendell Bailey, vice president of science and technology at the National Cable Television Association, wrapped up the session first by stressing that he believes the FCC truly has the best intentions to do what's best for all with new regulations, but that the commission needs to listen to the technical side of the story more before making any more policy. Replying to Wong's comment about the deterioration of CLI filings, he said he laid the blame at the feet of the commission. "The general policies of the FCC have forced reliable, honest businessmen out of the business," he quipped. As for proof-of-performance, Bailey stressed to the audience that it wasn't really the FCC's job to show them exactly how to perform the tests and they "shouldn't let the FCC do your engineering for you."

One year later: What's new with proof-of-performance?

The opinion is that proof testing is, for the most part, enjoying smooth waters. The initial "up in arms" reaction of operators seems to have subsided somewhat. But this doesn't mean that everyone is testing competently. It just means that all the paper work has yet to be checked.

Steve Allen of Jones Intercable addressed testing's importance in his opening of this Western Show session, stating, "I feel proof-of-performance tests truly are necessary and benefit our customers." His impression is that most operators are satisfied with their system's performance, though still think the testing causes too many interruptions. What this needs to be coupled with, says John Wong of the FCC, is a little common sense. Wong lives in Washington, DC, where the local cable operator rightly notified its subscribers that at midnight on a given day, service would be interrupted for mandatory testing. Service was shut off promptly at midnight — right in the middle of a Washington Redskins football game. Wong received all the phone call complaints, an unnecessary case of finger pointing. "Look at your programming," he pleaded, shaking his head with a laugh.

Jones Intercable's Saconna Blair detailed a six-step implementation plan designed to close the gap between perception and reality. He stressed understanding of requirements, communicating information, establishing timelines, using adequate and accurate test equipment, determining personnel requirements and documentation.

Jonathan Kramer of Communications Support covered his list of reality checks and hated proofs. Just as inadequate as incomplete documentation, Kramer urged the avoidance of over-documentation that makes no sense and creates inconsistencies. He lamented the use of out-of-calibration equipment and tests that appear to be falsified. "Don't rely on summary results," he stressed. Operators need to read the data. A good fail safe? Have a peer review your proof.

In conclusion, Wong recommended following NCTA's recommended practices and lauded signal leakage as the perfect way to upgrade. In his opinion, though automated testing is a great time saver for the engineer, there is no substitute for a competent person performing the tests.

CLI receives $10.8 million order

Compression Labs Inc. announced that Thomson Consumer Electronics awarded the company a $10.8 million contract amendment to purchase additional compressed digital video (CDV) encoding systems for North America's first high-power direct broadcast satellite system.

In April 1992 Thomson awarded CLI an initial contract for up to $5 million to furnish CDV encoding systems for DirecTv, a unit of GM Hughes Electronics, and Hubbard Broadcasting's U.S. Satellite Broadcasting subsidiary.

The additional encoding systems will be used to expand the DBS system being built by Hughes to carry programming channels offered by the DirecTv programming service. The encoding systems are based on the MPEG-2 standard.

John Tyson, president, CEO and chairman of CLI, said, "As the world shifts from analog to compressed digital video technology, we see the rapid emergence of new delivery systems for home entertainment. Direct broadcast satellite is an exciting system that will change the way television is broadcast to the home."

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SCTE NEWS

SCTE

Nominations open: Member of the Year

The Society is currently seeking nominations for its 1994 Member of the Year Award. Presented each year at the Cable-Tec Expo, this award is given by the SCTE board of directors to recognize a member for outstanding contributions to the goals and purposes of the Society.

All persons nominated for the award must be Active members of the Society. Nominations must be received in writing by SCTE national headquarters no later than March 1, 1994. All nominations will be presented to the board of directors for consideration and the selected person will receive a plaque recognizing this honor at the 1994 Cable-Tec Expo, to be held June 16-18 in St. Louis, MO.

Since its establishment in 1974, the SCTE Member of the Year Award has been presented to 20 individuals. Previous recipients of the award are as follows: Bill Grant (1993); Ron Wolfe (1992); Steve Allen (1991); Richard Covell (1990); Paul Beeman (1989); Mike Aloisi (1988); Rex Porter (1987); Sally Kinsman (1986); Pete Petrovich (1985); David Franklin (1984); John Kurpinski (1983); Clifford Paul (1982); Yves Fortier (1981); Thomas Polis (1980); Kenneth Gunter and Ralph Haimowitz (1979); James Grabenstein (1978); Frank Bias (1977); Glenn Chambers (1976); James Collins (1975); and Steven Doudourfis (1974).

For further information on the Member of the Year Award, please contact SCTE national headquarters at (610) 363-6888.

Polaris Award given to Ludington

The second annual Polaris Award was presented to Time Warner's Jim Ludington in a ceremony held Jan. 5 during the Society of Cable Television Engineer's 1994 Conference on Emerging Technologies at the Pointe Hilton Resort on South Mountain in Phoenix, AZ.

The Polaris Award is sponsored by Corning, *CED* magazine and SCTE to recognize a cable TV engineering manager at the system, MSO or supplier level who recognizes the strategic benefits of optical fiber technology.

Ludington has an extensive background in working with fiber. First involved with fiber backbones, he subsequently began installing fiber-to-feeder networks, handling the 270 MHz to 550 MHz upgrade in Kansas City, MO. From 1988-1991, he managed Time Warner's (ATC's) construction division, which did the pre-engineering and installation of fiber plant in 15 to 20 ATC divisions during that time. He was responsible for taking concepts created by Jim Chiddix and Dave Pangrac and implementing them in the field. He has installed thousands of sheath miles of fiber throughout the U.S.

Jim is a graduate of the National Cable Television Institute's fiber-optics course and has taught that subject at the Time Warner National Training Center. In addition, several of his articles on fiber construction practices have been published in the trade press and he is a frequent speaker at industry conferences and seminars.

SCTE President Bill Riker was joined at the ceremony by last year's award recipient Tom Staniec, who presented Ludington with the award. In addition to receiving a piece of Steuben crystal entitled "Rising Star," $2,000 was donated by Corning in Ludington's name to SCTE's Scholarship Program to fund fiber-optic training.

Marketing plan underway

Late last summer, national headquarters staff embarked on a marketing plan intended to increase awareness of the Society's programs and services throughout the CATV industry. An article in the August/September *Interval* outlined SCTE's short- and long-range public relations goals. At that time, the focus was on targeting cable industry CEOs, company presidents and managers. As a result of the merger of many cable systems with telephone companies, it has become more important than ever to convince system managers and telco personnel of the value of technical training. As of January 1994, the Society's staff has implemented two ideas that were suggested by IBS, an Exton, PA, marketing firm.

The first, an executive newsletter entitled *Interface* was unveiled at the Western Show in Anaheim, CA, on Dec. 1. A quarterly publication, *Interface* has been written as an informa-

tional piece for both cable and telco senior management. With a focus on company training incentive programs, SCTE activities with government and regulatory agencies, and interviews with industry leaders who recognize the value of the Society, the intent is to encourage management to provide employees with opportunities for training that will improve job skills, resulting in increased knowledge and productivity.

The second item, a technical term-a-day calendar, was developed to demonstrate the value of SCTE training to the industry by teaching a cable term each day in 1994. The calendars were sent to chapter presidents and cable and telephone management personnel during the last week in December. They also were available at the Emerging Technologies Conference in Phoenix.

Certification: Digitrace incentives

Digitrace Inc. of Flint, MI, has instituted an incentive program for its employees who upon successful completion of the Society's Broadband Communications Technician/Engineer (BCT/E) program become certified at the Technician and/or Engineer level. Although several companies already have such incentives in place, what makes Digitrace unique is its commitment of offering to conduct the classes after normal work hours, on site, thereby making it convenient for employees to participate.

The incentive program is comprised of the following: Digitrace will purchase the complete set of SCTE training videos, the BCT/E "Certification Program Reference Bibliography Reprint Manual" and an additional instructional video covering signal level meters; the company will conduct a two-hour training session every other week on a regular schedule; and Digitrace will award a $1,000 bonus upon completion of certification at the Technician level, and $2,500 for certification at the Engineer level. The program is open to all employees, but each candidate must be a national member of SCTE.

Other companies offering incentives include: Jones Intercable (Albuquerque, NM); TCI Cablevision of California (San Mateo); Continental Cablevision (St. Paul, MN); Monmouth Cablevision (Belmar, NJ); Cardinal Communications (Columbus, IN); Cochran Communications (Cathedral City, CA); and Columbia International (San Angelo, TX).

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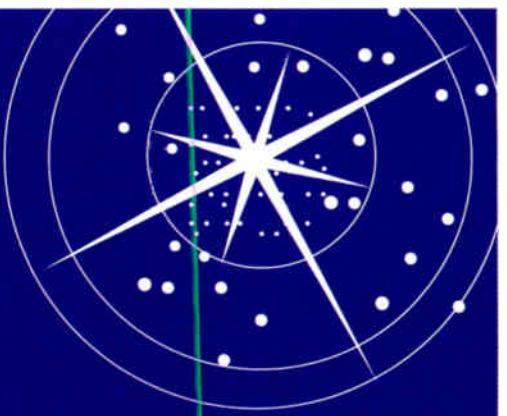

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Reader Service Number 30

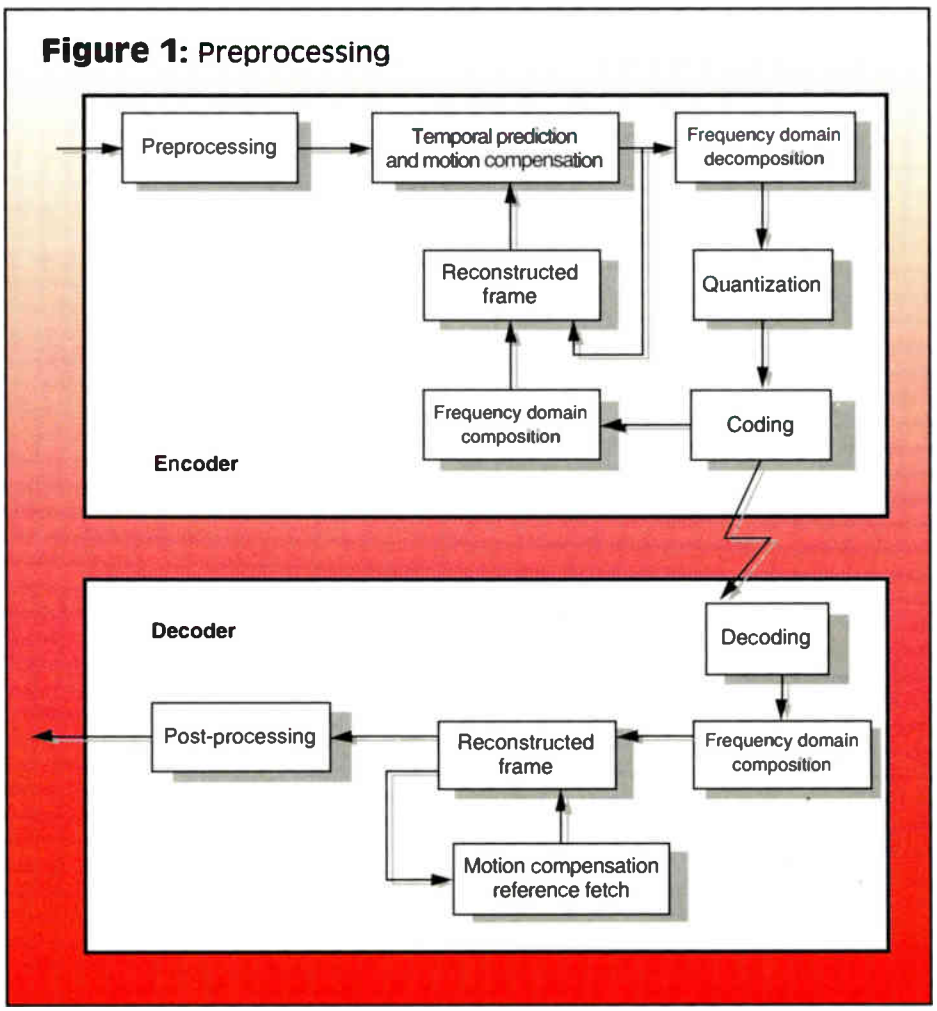
Compressed digital video: A new world of broadcast potential

By Padmanabha Rao
Senior Staff Scientist, Compression Labs Inc.

Television is exploding with new applications that can increase business productivity, improve the flexibility and quality of TV entertainment, and allow far greater interactive use of the TV media. But while the potential of television has grown steadily, the actual pace of expansion has been drastically restricted by the high cost and limited availability of transmission time — limits imposed by the same bandwidth bottleneck affecting today's data networks.

A quantum leap in digital compression technology now increases the amount of video data that can be transmitted over existing bandwidth resources by more than 500%. The technology changes the economics of television, opening a media that has been virtually closed to many private broadcasters by the high, fixed cost of bandwidth. Reducing the cost of broadcast by dramatically increasing the amount of data that can be transmitted at this fixed cost opens the market to a wide range of applications, including cable, television, business TV and distance learning.

Figure 1: Preprocessing



New twists on proven technology

The ability to compress digital broadcast signals to the point where satellite bandwidth is affordable to a broad range of markets is an outgrowth of technology that has been used for over a decade in videoconferencing applications. The primary differences between broadcast applications and videoconferencing applications are the volume of data and the quality of signal required.

Videoconferencing signals typically consist of people sitting in a conference room. This includes very little movement in a static background. Movement is localized to the upper bodies of people who are typically seated — a scenario known as "talking heads." Because one of the key elements in data compression is transmitting only data that has changed from one video frame to the next, the amount of data that must be sent in a videoconferencing application is minimal.

Broadcast applications, in contrast, typically contain continual movement and changes in scene, requiring much more data to be coded for transmission. The quality required for broadcast, much of which is used for en-

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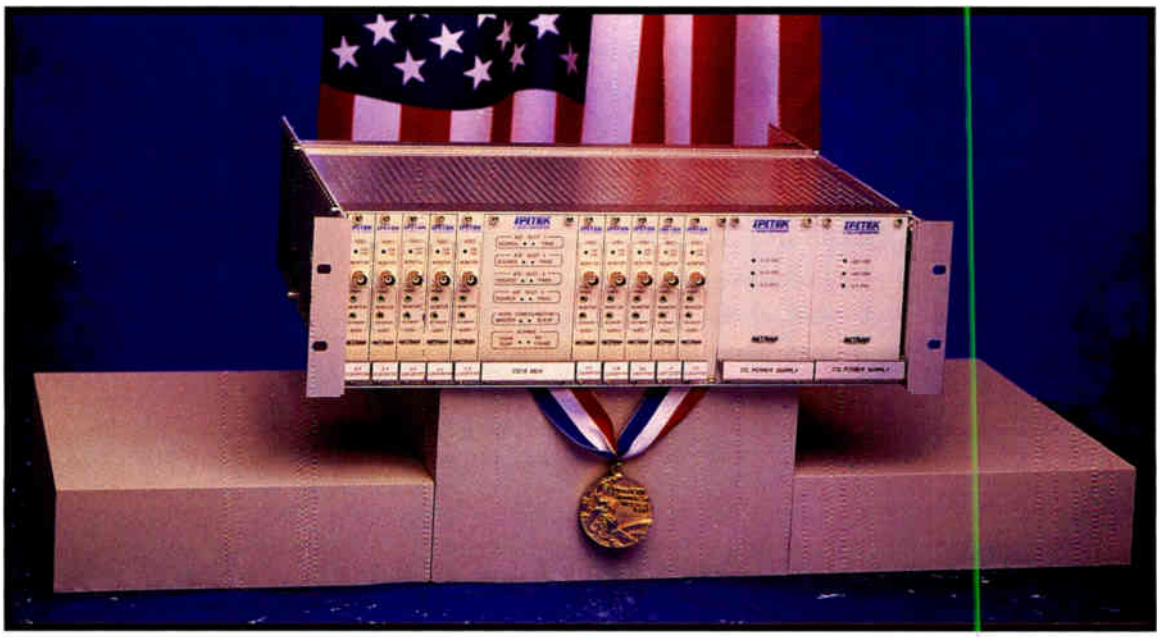

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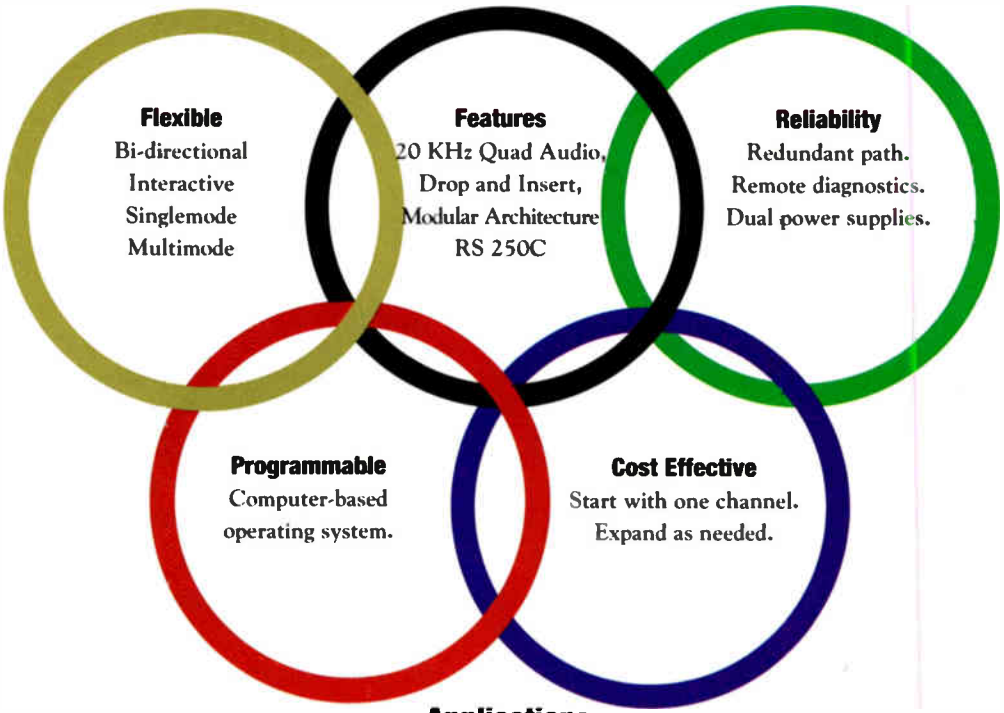

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tertainment purposes, also is considerably higher than what is acceptable for videoconferencing. However, the core digital compression technology needed for broadcast applications is the same as that required for videoconferencing.

MPEG, a video signal decoder standard generated by the Motion Picture Experts Group under the direction of the International Standards Organization, is a key standard for video compression technology. Although MPEG's efforts originally were intended for the storage of video images on compact discs and other media, it soon became clear that the committee's work had far broader applications — ranging from cable TV delivery to high definition TV (HDTV).

The MPEG standard is now designed to support the rapid expansion of digital TV and ensure that proliferating applications work together efficiently and effectively. MPEG-1 was designed primarily for storage media. MPEG-2 is a generic video coding standard for applications such as broadcasting, interactive video and HDTV.

For the consumer, MPEG standards promise to greatly increase competition at both the decoder box level and the system component level, resulting in dramatic price decreases and spurring the home entertainment and information service markets. As a result, MPEG-compliant encoder products are in great demand.

Compressing digital broadcast signals

Compressing a broadcast signal involves minimizing the amount of data that must be transmitted to achieve a quality image in order to maximize the amount of information that can be transmitted over a fixed amount of bandwidth. This is accomplished by eliminating all data within the video signal that is unnecessary for achieving acceptable quality of the transmitted signal.

"Over the long term, current and future MPEG standards will encourage a melding of video and computer technology."

The data elimination process involves a step-by-step procedure. Each step in the procedure focuses on a specific element of the video signal and eliminates unnecessary data within that area. But while the compression procedure is fairly standard, the efficiency of each function — the balance between eliminating as much data as possible to maximize compression while retaining the highest possible quality of picture — is determined by how each function is implemented. While Compression Labs is the first vendor to offer MPEG-based digital video compression encoding, as other vendors enter the market, each offering will be differentiated by the efficiency with which compression functions are implemented.

Compression also can be achieved without implementing all available compression functions. However, the cost of implementation is such that systems that do not make use of all of these techniques suffer significant performance disadvantages, while showing minimal cost benefits. The cost benefits of these partial implementations are

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INSTRUCTIONS FOR SUBMITTING ABSTRACTS: Please send via electronic mail a short abstract (up to 700 words in ASCII or PostScript) describing a position statement in one of the areas above to **cn-workshop@opera.hpl.hp.com**. Note that submissions longer than the limit above will not be reviewed. Only if electronic submission is impossible, a hardcopy version may be sent to: Riccardo Gusella, Hewlett-Packard Laboratories, 1501 Page Mill Rd., MS 1U-17, Palo Alto, CA 94304, USA. Participation in the workshop will be by invitation only based on the Program Committee's review of position statements. Some of the authors will be asked to submit extended abstracts and to present their positions during the workshop. Workshop size limitation may preclude attendance of all authors of multi-author abstracts.

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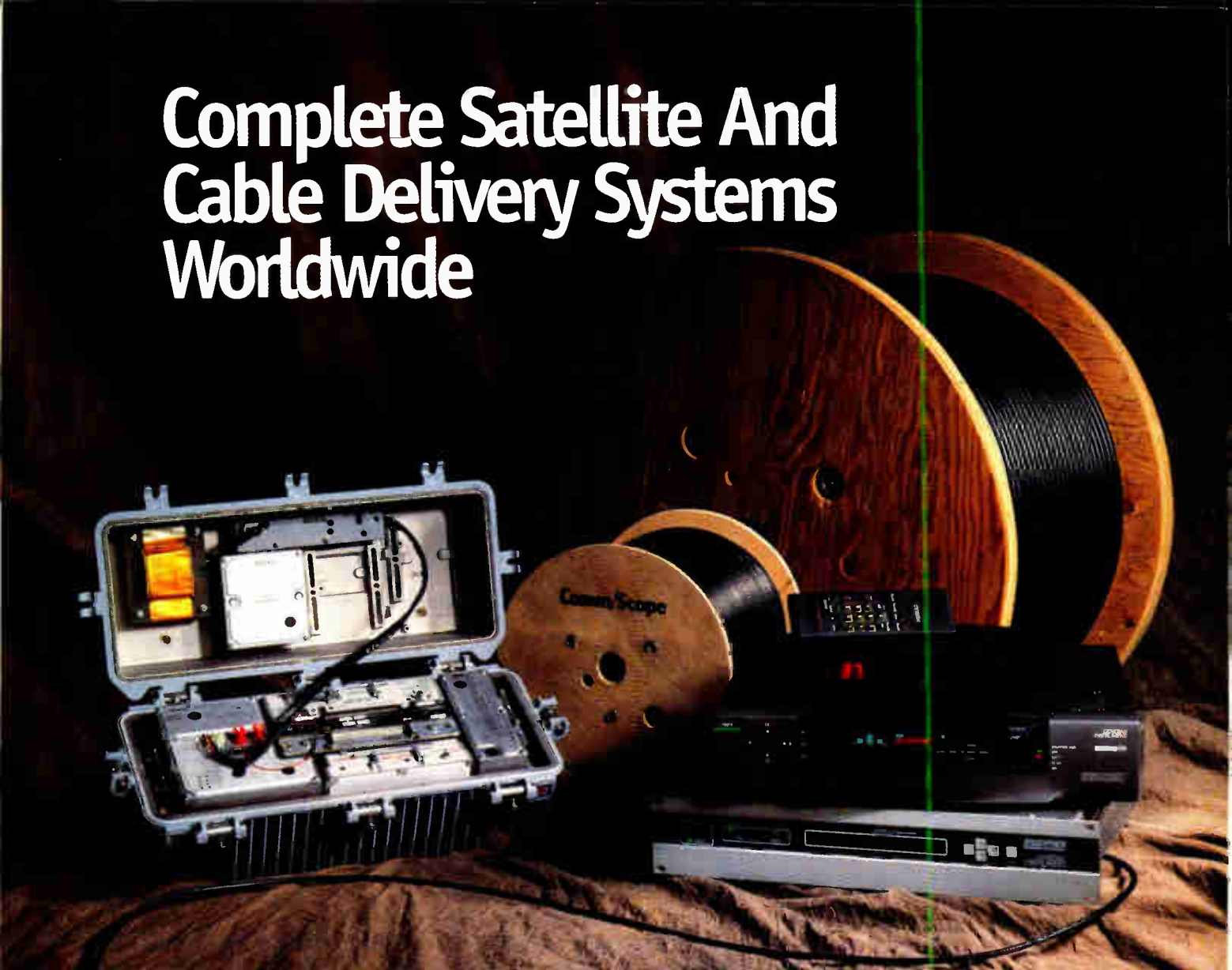

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Reader Service Number 15

MPEG-2 systems specification: Blueprint for network interoperability

By Anthony J. Wasilewski
Senior Staff Engineer, Scientific-Atlanta

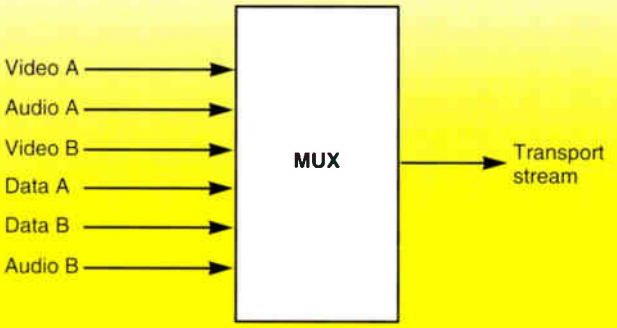
A single, international standard has emerged that promises to unify and focus the digital "revolution" currently underway. This is the MPEG-2 standard. Named for the Moving Picture Experts Group, its work is sanctioned by ISO/IEC as Working Group 11, Subcommittee 29 of JTC1. U.S. delegates are accredited for participation through ANSI.

While MPEG-2 (ISO 13818) is widely known and recognized as a video and audio compression specification, it is perhaps less appreciated in that it also contains a systems "layer." This part of the standard provides a transmission medium independent coding technique to build bit streams containing one or more MPEG programs. This is accomplished through a syntax (formal grammar) and set of semantic rules for the construction of the bit streams that include provisions for synchronization, error resiliency, multiplexing and clock recovery. Each program is composed of one or several elementary streams. An elementary stream is the coded representation of one video, one audio or one data stream that share the common time base of the program of which they are members. Each elementary stream is a succession of access units of the appropriate type (picture, audio frame).

The MPEG-2 systems standard contains two different types of stream descriptions: 1) program stream (PS) and 2) transport stream (TS). Each stream type is optimized for different application domains. Both streams are packet-based and may be considered as transport layer entities in the sense of the ISO network reference model (ISO 7498). The two streams are not strict subsets or supersets of each other but are related by a common structure: the packetized elementary stream (PES). It is possible and reasonable to convert from one stream type to the other in real systems.

The program stream utilizes variable-length packets and is intended for "error-free" environments in which software parsing is supported. The packets are generally relatively large (1K to 2K bytes). Program streams may be used to multiplex together the many components of one program. Relevant applications would include single-program playback from a local digital storage medium (DSM).

Figure 1: MPEG-2 transport stream concept



The transport stream is specifically designed for transmission in "errored" conditions and includes features for enhanced error resiliency and packet loss detection. Transport packets have a fixed and relatively short length (188 bytes). Many programs, each with many components, may be combined in a transport stream. Terrestrial broadcast, CATV/satellite networks and interactive telephony-based services are a few emerging applications of the TS.

A prototypical view of the basic multiplexing concept of an MPEG transport stream is shown in Figure 1.

The packetized elementary stream structure provides a method of packaging subparts of a longer video, audio or data stream and permits the association of time stamps and other indicators with each of these subparts.

The primary mode of data transmission in MPEG broadcast applications will be the MPEG-2 transport stream. This has been confirmed, for example, for U.S. high definition TV (HDTV) by the Grand Alliance of HDTV proponent companies (which also will use MPEG-

Figure 2: Protocol data units in MPEG-2 architecture

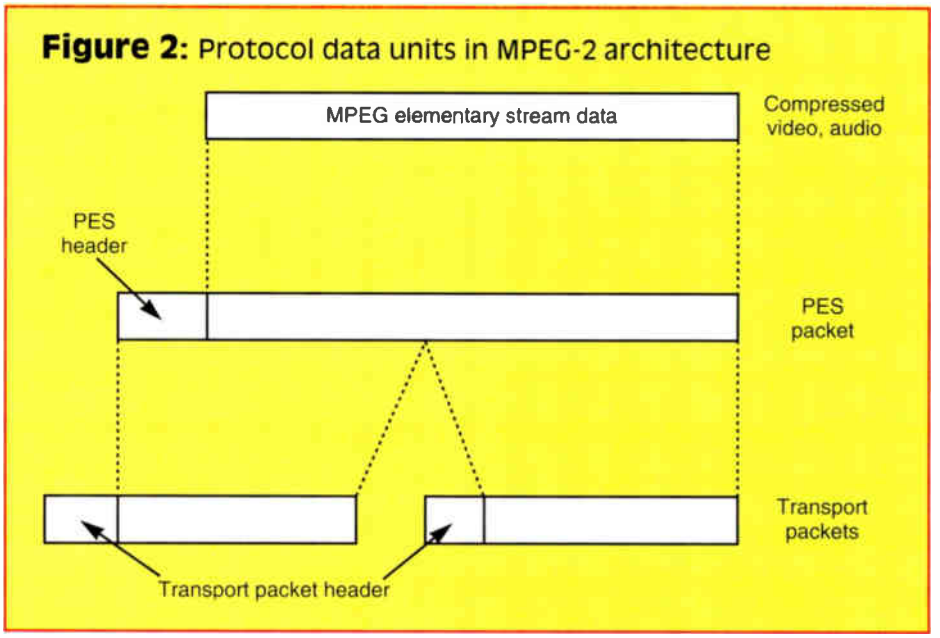


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Figure 4: Prefix format

Transport packet error indicator	Payload unit start indicator	Transport priority	PID	Transport scrambling control	Adaptation field control	Continuity counter
1 bit	1 bit	1 bit	13 bits	2 bits	2 bits	4 bits

by an entity external to the transport, such as a data link processor.

The payload unit start indicator is a 1-bit field that signals that a PES packet header immediately follows the packet prefix or adaptation field, if any. If the packet is a PSI-bearing packet, this bit indicates that a PSI segment begins in the beginning of the payload section.

The transport priority bit allows transport entities to assign higher priority to selected packets. This may be used as a directive to data links for error protection or other special treatment.

Thirteen bits of the prefix is used for a packet ID (PID). The PID identifies the stream that is carried in the associated transport packet. Data from only one elementary stream may be put into packets with common PID values.

The transport scrambling control field is defined as follows:

00 This packet has no encryption
01 User-defined
10 User-defined
11 User-defined

The definition and management of the encryption keys are not specified by MPEG, but are explicitly supported through recognized private data streams and in private areas of the adaptation field. Some suggested uses of the user-defined states are given in the parentheses and are for identifying key parity or mode.

The 2-bit adaptation field control field has three defined states and one reserved by ISO. It indicates whether the associated transport packet payload contains an adaptation field, payload or both.

00 Reserved
11 No adaptation field, payload only
10 Adaptation field only, no payload
11 Adaptation field followed by payload

The continuity counter is a modulo-16 counter that is incremented with each packet sent. It may be used by a decoder to detect packet loss. Also, the sending of duplicate packets is allowed. This is accomplished by not incrementing the continuity counter on consecutive (duplicate) packets. Packets with other PID values may, of course, occur between such "consecutive" packets.

Adaptation field

The adaptation field is a convenience "window" that may be opened in any transport packet. When present, it may carry both MPEG-related and private information of relevance to a given transport stream or the elementary stream carried within a given transport packet. Provisions for clock recovery (such as the program clock reference — PCR) and encryption key management are typical of this information. By placing such information in the adaptation field, it becomes "encapsulated" with its associated data. This is very helpful in remultiplexing and network routing operations.

The PCR is a counter value that represents a "snapshot" of the system time clock (STC) for the associated program at the time the PCR bytes were put into the transport stream. The decoder uses this value to synchronize the decoder system clock with the encoder system clock. The format of the PCR is shown in Figure 5. The lower 9 bits of the PCR is a modulo-300 counter that is incremented at the 27 MHz clock rate. At each modulo-300 "rollover" the count in the upper 33 bits is incremented. The upper 33 bits then represent counts that occur at a 90 kHz rate. This is done so that other time stamps (presentation and decode, discussed later) can be compared using the 90 kHz value.

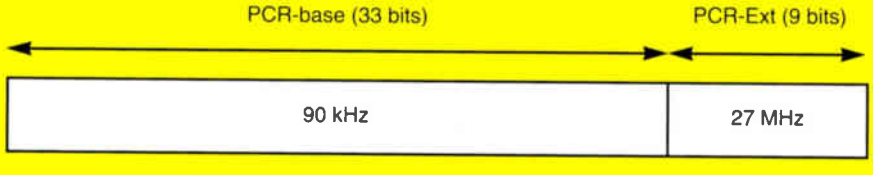
Because every program in an MPEG-2 TS may have its own PCR, programs may be mutliplexed asynchronously. That is, the time bases of the different programs need not be locked together before multiplexing. This has major positive implications for backhaul and rerouting of MPEG data. In particular, TS assembly at any particular network node does not depend on genlocking of video signals either from locally or remotely originated sources.

The PCR field may be modified by multiplexers and is used to accumulate delays that are incurred through various stages of multiplexing. Wherever there exists a possibility of a variable delay (jitter) of a packet, the PCR value must be adjusted to reflect that delay. At the decoder, the PCR is used to initialize and correct the decoder system clock. At the encoder (multiplexer), the PCR is inserted into the stream with a correct value in the context of the overall multiplex.

Synchronization of audio and video (and data) within a program also is accomplished with a time stamp approach. Similar (33-bit) time stamps are inserted into the TS in association with access units of video and audio (PES structure). These presentation time stamps (PTSs) and decode time stamps (DTSs) are used to inform the decoder when to decode and display a picture and when to play an audio segment. The value of the PTSs and DTSs refer to the same clock established by the PCRs.

The adaptation field has a private data section that may be user-defined. The transmission of entitlement control messages (ECMs) must be synchronized with the corresponding ciphertext (encrypted elementary stream). The

Figure 5: Program clock reference (PCR) format



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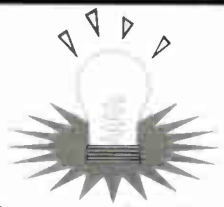

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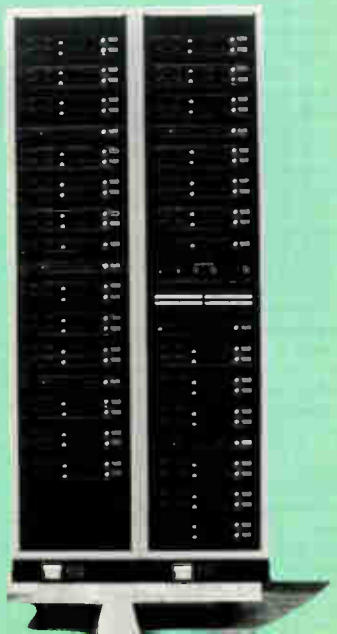

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adaptation field provides a natural and convenient method of achieving this, since the ECMs are encapsulated with the data. This also simplifies remultiplexing and routing operations.

Payload section

The remainder of the transport packet carries either elemental service data (video, audio, text) in PES packets, PSI or private data such as conditional access, network frequencies, etc. Only one type of data is allowed in packets labeled with a common PID. In order to adapt the packet transmission to any data link rate, a "stuffing" packet is defined. This is sent when a data link interface demands packets and there are no valid packets to send. PID value 0x1FFF (8191_{10}) is reserved for null or "stuffing" packets. The contents of the stuff packet is set to all ones.

Program stream compatibility

The transport stream supports interface to and from the PS format. On the encode side, PSs may be demultiplexed and placed into individual elementary streams for transmission purposes. Decoders will be able to construct a PS from multiple elemental streams that have been transported using the TS syntax. Reconstructing PSs on the decode side is supported by using the PES structure to encapsulate the raw service data. This structure contains header information that translates directly into the PS format.

Service data and PES

All MPEG video and audio data must be formatted into a PES and inserted into the payload portion of the TS packet. The PES provides a structure for associating presentation timing information and other factors with elementary stream presentation units.

PES structure

PES packets are of variable and relatively long length. This length is not specified by the MPEG standard but it is normally bounded at 64 kbytes. (Using a length of zero permits an unbounded case for video streams only.) Each PES packet may be protected with an optional CRC. A PES packet starts with a header that has a minimum of 9 bytes of length and structure information. Many optional fields may then follow in the header such as PTSs, DTSs, trick mode fields for fast forward/fast reverse and the like (a PES continuity counter and future PES header extensions).

"One of the advantages of a packet-based transport is the straightforward support of drop/add and insert of asynchronous services. The MPEG TS was designed with this in mind."

When inserting PES packets into transport packets, PES headers must be aligned with transport packets headers. A single PES packet may span many transport packets and the subsections of the PES packet must appear in consecutive transport packets of the same PID value. Note, however, that these transport packets may be freely interleaved with other transport packets of different PID values that carry data from different elementary streams.

Video services

Coded MPEG video streams are placed into PES packets before being inserted into transport streams. Each PES packet contains all or part of a video access unit (i.e., an I, P or B picture in coded form). PTS and DTS data are placed into the PES packet header that encapsulates the associated access unit. The PTS and DTS are in the same units as the PCR-base and reference the same source clock. The PTS instructs the decoder when to display the associated access unit. The DTS indicates when the decoder should decode the access unit. This may be useful when pictures are sent out of presentation order, such as for B-frames.

Some video-related data may be sent in the user data portion of the MPEG video. This includes closed-caption data, pan-scan coordinates, various time codes and video-to-teletext frame reference. The user data section also may include a "generic" VBI (vertical blanking interval) data format. This will support the analog insertion of various VBI data formats (such as Nielsen data) at the decoder.

Audio services

Likewise, MPEG audio services use the PES packet layer that was dis-

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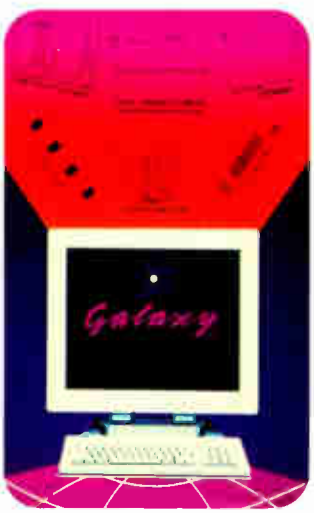

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Table 2: TS structures in MPEG PSI

PSI structure name	Structure type	Reserved PID #	Description
Program association table	MPEG	0	Associates program number with a program map table PID and segment number. Allows specification of the PID of the network table.
Transport stream program map table	MPEG	User-assigned	Specifies the component elementary streams and descriptors for one or more programs.
Network information table	Private	User-assigned	Gives physical network parameters such as FDM frequencies, transponder numbers, etc.
Conditional access table	MPEG	1	Associates one or more (private) EMM streams and other CA data each with a unique PID #.

cussed previously. PTS data should be attached at packets that include audio frame boundaries. A single MPEG-1, Level 2 audio service can provide two channels (e.g., stereo) of audio or a single channel (e.g., mono) of audio.

Utility and other digital data services

Asynchronous serial data can be transmitted using the MPEG-2 TS. This type of data does not rely on "locking" the decoder clock with a clock at the encoder. In order to guarantee that the decoder input buffer will not overflow, the maximum service rate at the encoder must be less than or equal to the data rate used at the decoder. Flow control should be provided at the encoder to ensure that the source is throttled when approaching the limits of the input buffer. The raw asynchronous data is placed into TS packets for transmission. Each transmission packet should always start with a 1-byte count that indicates the number of valid bytes. This allows for partial packets to be flushed by the encoder after a programmable time-out. The decoder will output the data serially at a standard serial baud rate. Note that the baud rate at the decoder and encoder do not have to match. Virtual channel information should include data that indicates the minimum decoder baud rate needed to ensure buffer integrity, but the actual choice of baud rate could be set independently at the decoder.

Synchronous data

Non-MPEG synchronous serial data also can be carried by the MPEG-2 TS. This, however, requires that PCR values be transmitted that are locked to the synchronous rate that is being served at the encoder. Also, at the decoder, the clock that is providing the output rate must be locked to the 27 MHz system clock, which is in turn tied to the incoming PCR values. This method would be used to transmit high-speed synchronous data and telephony standards such as DS1. Like asynchronous data, this data would not have to undergo any preformatting before placed into TS packets.

Text and subtitle services

Text services may be sent using the general format of a command byte followed by the data that corresponds to that command. MPEG considers all such cases as private data. In most cases the length of the message will be variable. Two types of text data transmission may be cited as possible examples with this system. Eight-bit character codes are sent for conformance to world system text (WST) and for other character sets that can be satisfied with 256 codes. Sixteen-bit codes also may be provided to support more diverse character sets and attributes.

Bitmapped graphics, palette control and downloadable fonts also are provided with the text service command set. The data portion of a text command can extend across transport packets by using the private section structure from the PSI specification. Hardware can be configured to filter text data using the general 32-bit "filter" field and/or the page number field. A subtitle command supports PTS information and has a filter field that can be used to select a specific language. This supports the capability of including several languages in one text packet. Unused portions of the packet will be padded out with zeros.

Support for conditional access mechanisms

Scrambling is the MPEG term used to denote the encryption of service data (video, audio). MPEG does not require scrambling nor does it specify which algorithms may be used. As an independent transport layer, it leaves these decisions to the higher layers of the transmission model. Encryption is prohibited, however, in the TS packet header and in nonprivate sections of the adaptation field.

If scrambling is desired in an application however, MPEG provides several explicit support mechanisms. The scrambling control field in the TS packet header, for example, may be used to indicate the encryption mode and identify the key parity of the payload section. The adaptation field may be used to convey the ECMs or keys needed to perform the decryption.

Entitlement management messages

The MPEG standard does not specify the format of entitlement management messages (EMMs) nor even that they be sent at all. It does however provide a method for decoders to be able to identify and demultiplex packets that carry EMMs. EMMs are sent using a predetermined packet ID that will be set at the multiplexer and is known to the decoder through the PSI. (See next section of this article.)

Entitlement control messages

ECMs are the encryption keys and other systemwide information used to control access to individual services. Again, the standard does not require

their presence but rather supports their existence through descriptors and private data areas/PIDs. ECMs may be sent in private data areas of the adaptation field or in transport packets marked as private.

Program specific information

PSI is the total collection of MPEG normative and private information that allows decoders to:

1) Access individual transport streams in networks.
2) Associate elementary streams within those transport streams together as programs.
3) Obtain the location and type of conditional access information that is required to decrypt/descramble elementary streams.
4) Demultiplex, identify and route to the proper decoding circuitry, all packets required for program presentation.
5) Identify additional attributes of MPEG or private data such as language code, windowing parameters, conditional access system, etc.

A mechanism for extension of the definition of programs and elementary streams also is provided: the descriptor.

MPEG has adopted a hierarchical view of systems:

a) A network may have one or more transport streams.
b) A transport stream may contain one or more programs.
c) A program may contain one or more elementary streams.

Each layer of the hierarchy completely encapsulates the ones underneath it. Thus, a program number has significance only within a transport stream. Program numbers may be duplicated in different transport streams in the same network.

Likewise the PID values that identify the elementary streams that comprise a program are meaningful only within the context of a transport stream. Thus, the full range of PID values is available in each TS. Note that this could lead to "PID collisions" when mapping packets from one TS to another. Systems contemplating this should allocate PID values accordingly.

MPEG transport stream PSI structures

There are four recognized TS structures in MPEG PSI, however, the contents of only three of them are specified by MPEG. These structures may be thought of as tables. (See Table 2.)

PSI-bearing transport packets may be freely intermixed with those carrying MPEG data. In practice, they will occur perhaps at 10 or 20 Hz rates for random access channels. For connection-oriented services it is permissible that they occur but once, at the beginning of the session establishment.

It should be noted that the "conditional access table" (lower left in Table 2) supports the identification of one or more conditional access systems. This allows data and control from more than one conditional access system to coexist in the same transport stream.

Extensibility and descriptors

The MPEG TS is designed to be reasonably "future-proofed" through several extensibility mechanisms.

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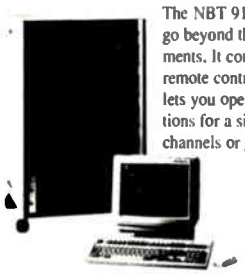

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Figure 6: General MPEG descriptor format

larger fields. These fields may be used by ISO in the future to extend the standard.

Second, descriptions of programs and elementary streams may be extended through the use of descriptors. About a dozen descriptors are predefined by ISO 13818. An additional 192 descriptors are available for user definition. The descriptors all have the general format of Figure 6.

The "tag" is an 8-bit field that identifies each descriptor. The length is also an 8-bit field that specifies the total length of the data portion that follows it.

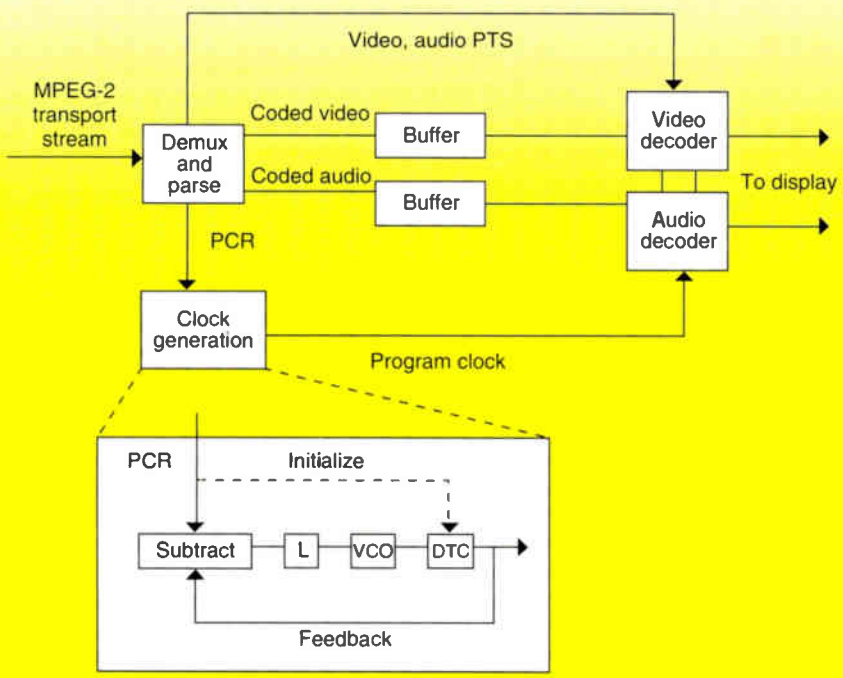
Time base recovery and synchronization

An important function in MPEG decoders is reconstruction of the clock associated with a program. This clock is used to reconstruct, among other things, the proper horizontal scan rate and color subcarrier frequency for the video. Of equal interest is assuring the proper presentation rate of audio and video presentation units. These are the audio sample rate and the picture or frame rate. For most applications, the synchronization of the audio tracks to the video ("lip-syncing") also is required.

MPEG uses a model called the standard target decoder (STD) to provide a rigorous mathematical abstraction of a real decoder. This model is based on a constant end-to-end delay in the delivery of the coded bit streams, that pictures and audio samples are presented exactly once and that a system time clock (STC) exists for each program. The model provides for precise buffer management at the decoder. It should be emphasized that MPEG does not require that the original clock signal that is present at an encoder also be present at the decoder. This is fortunate, since supporting such an end-to-end clock is prohibitive in many networks. Instead, a set of time stamps is utilized in both the PS and TS to convey the instantaneous phase, frequency and value of the STC. In a sense, the STC is coded (digitized) and inserted into the bit stream in a manner analogous to the video/audio coding itself. The STD model is used as the yardstick of valid (compliant) bit streams.

Figure 7 shows a functional view of the method of clock generation and presentation synchronization in an MPEG decoder.

Figure 7: Clock generation and presentation synchronization



The transport stream enters the demultiplexer component that extracts the required MPEG packets based on PID value. It also parses the packet structures to obtain the PCR and PTS time stamps. The PCRs are routed to a clock generation component. The PTSs are sent to the video and audio decoders. If video/audio decoders that can parse the PES structure become available, the PTSs may be sent directly to these decoders through the buffer.

Coded MPEG video and audio (access units) are sent to decoder buffers. The video and audio decoders request data from these buffers, decode it into a format that is then passed to D/A components for conversion to analog display.

The decoder has a local time clock (DTC). This clock, if allowed to free-run, would produce an incorrect time base for program delivery. This is because it is highly unlikely that the frequency of the DTC would be exactly the same as that of the original encoder and that the DTC frequency will be perfectly stable (would not drift). This leads to the prime function of the PCRs. PCR values, sent periodically in the transport stream, are used to correct the DTC clock value.

At the beginning of the decoding of a transport bit stream, the PCR value is used to initialize the counter for the DTC. As the clock runs, the value of this counter is feedback to the subtraction component. The local (feedback) value is then compared with subsequent PCRs as they arrive in the transport stream. Since a PCR when it arrives, represents the correct time base for the program, the difference between it and the local DTC may be used to drive the instantaneous frequency of the VCO and either slow down or speed up the DTC, as appropriate. Note that because of the hybrid nature of the PCR (it has both a 90 kHz and 27 MHz component), a linearizer is used to convert to units in the 27 MHz domain. The output of the VCO is a 27 MHz oscillator signal and is used as the system clock frequency at the decoder.

The reconstruction of the proper STC at the decoder has an additional positive effect: predictable and bounded buffer occupancies. If the local DTC were not somehow locked to the STC, but rather drifted from it at some fixed or variable rate, the result would be

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Reader Service Number 44

the underflow or overflow (depending on the direction and magnitude of the drift) of the video and/or audio buffers. With a compliant MPEG bit stream and a suitable, stable PLL, avoidance of this underflow/overflow may be assured.

Error resiliency mechanisms

While a transport layer is responsible for reliable end-to-end delivery of transmission data, this does not mean that all error-checking and correction must take place in this layer. Usually, these functions are left to the data-link layer since it is a really a channel-coding problem. That is, the forward error correction (FEC) and other error strategies should be chosen to match the channel error characteristics and not the transmission data per se. The transport layer, however, may be called upon to provide error resiliency mechanisms that are appropriate and tailored to the transmission data.

In MPEG-2 TSs, this is accomplished through several avenues:

- *Transport error indicator bit:* As mentioned previously, this transport packet header bit may be set to indicate that an uncorrectable error or errors have occurred in the associated packet. This allows an error detected on one data link to be indicated further down the line in a multihop networking or routing application. Decoders may then use this indicator to trigger the invocation of the appropriate concealment or processing mechanism.
- *Priority bit:* Also found in the packet header, this bit may be used to indicate the relative priority of transport packets. Packets of higher priority may then receive preferential error protection or even be routed to a special transmission medium on the current or a later hop. The MPEG priority bit also may be used to assist in the setting of the ATM cell loss priority (CLP) bit when MPEG transport streams are sent into ATM networks.
- *Continuity counter:* Packet loss may be detected with the 4-bit continuity counter in the packet header. This counter is incremented as each packet of a given PID value is inserted into the TS. Thus, the decoder (or downstream multiplexers) may monitor this value for discontinuities to determine if packet losses have occurred.
- *CRCs:* The transport stream provides cyclic redundancy checks (CRCs) in several areas to assist in the detection of errors within the transport layer. An optional 16-bit CRC may be used over each PES packet. This value is intended for network maintenance such as isolating sources of intermittent errors rather than for use by decoders at network endpoints.

Each of the PSI table structures employs a 32-bit CRC for each of its sections. In this case, the decoder may calculate its own CRC value over the appropriate data and compare it to the transmitted value to determine if errors have occurred.

"It can become a major foundation of interoperability in the 'digital superhighway' since it provides a network- and data link-independent transport layer and a timing model that also is data-independent."

Networking and remultiplexing

One of the advantages of a packet-based transport is the straightforward support of drop/add and insert of asynchronous services. The MPEG TS was designed with this in mind. Amongst other things this allows for distribution of services via high rate multiplexes, such as a SONET OC-3 rate, with later partitioning and rerouting to lower rate transports for, say, a 6 MHz CATV channel. Local insertion of ads and conditional access also are readily supported.

The latter receives explicit support from the splicing point flag and splice countdown that may be included in the bit stream to indicate to the decoder that a splicing point is about to be arrived at. A random access flag also warns the decoder that a discontinuous change in the time base is about to occur.

ATM compatibility

ATM is a very promising technology for the transmission of voice, video and data in LAN/MAN/WAN networks. Some LAN devices are beginning to appear now and early versions of large ATM switches (10 gigabit fabrics) are being deployed in some major interactive network trials currently underway. The MPEG TS was designed to be as compatible with this new technology as possible. This was pursued through the following mechanisms:

- The MPEG TS is a network and data link independent transport, which has excellent affinity to the ATM layered approach.
- The length of the MPEG transport packet was chosen to map evenly into four ATM cell payloads (assuming four additional octets of adaptation layer information).
- The transport priority bit may be used to assist in the setting of the ATM cell loss priority bit (CLP). Current ATM specifications do not adequately address the transmission of variable bit rate (VBR) video in the general case in which an end-to-end network clock is unavailable. This problem is addressed by MPEG TSs. Liaisons between the ISO MPEG group and the ITU-TS (formerly CCITT) and with the ATM Forum have started a dialog to work through this issue and the general mapping of MPEG onto ATM networks.

Conclusion

MPEG-2 (ISO 13818) is a multifaceted standard for the coding of digital compressed video and audio and for their multiplexing, storage and transmission. The systems part is comprised of program stream and transport stream definitions, each of which are expressed as a set of syntax and semantics. The program stream is optimized for use in "error-free" environments where software parsing is common, such as digital storage media. The transport stream is optimized for use in "error-prone" environments such as broadcast, CATV, satellite and telephony networks. While one is not a strict subset or superset of the other, conversion is possible and is facilitated by the common packetized elementary stream (PES) structure.

The MPEG-2 systems specification provides support for clock recovery, synchronization, buffer management, private data and conditional access. It can become a major foundation of interoperability in the "digital superhighway" since it provides a network- and data link-independent transport layer and a timing model that also is data-independent. **CT**

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Reader Service Number 32

Powering: How we did it, how it will be done

By Marty de Alminana
International Sales Engineer, Power Guard Inc.

In the beginning there was television but only the privileged few owned a TV set. Soon there were TV sets in every home. Everyone in the city was happy. But beyond the city all that was seen was the dreaded ghost.

"I can sell you an antenna for the entire town, Mr. Rural Dweller." As a result, the community antenna TV system was born.

Ah, but the viewer was not satisfied. "We want more!" More they got and more and more. And the city dweller also was not satisfied. "We want more too!" they said. Soon 24-hour movies arrived.

You know the rest of the story. This race to provide more and more also meant the need for more power. This was to become the hew and cry of the system designer as he attempted to push more and more signals down the cable.

The ferro

Back in the beginning, life was much simpler. The ferro or AC supply, as it is most commonly know, was the all-in-all for powering the system. Since the actives to be powered were dispersed around the service area, individual powering of each device was impractical. We had a two-conductor cable interconnecting the devices we wished to power anyway, why not use it? The power inserter was born. The AC supply has served our industry well. It is rugged, simple, reliable and inexpensive. We have used it for the previous reasons but primarily for a reason not generally mentioned. It is a good regulator for the most part. We rely on its ability to regulate the 60 VAC under varying conditions of line voltage and output loading. Since we have essentially a constant power load, it performs rather well.

The standby

With the ever-increasing sophistication of the viewing public and with pressures mounting from city councils during the refranchising process, system reliability was at issue. Previously, if there was a picture, there were happy customers. Not so in our new world of video. The traditional tree-and-branch system architecture obviously had an ever-increasing potential for disaster as one traced your way back toward the headend. More and more plant would be affected by a simple loss of power at a supply close to the point of signal origination. The standby was born.

"It is obvious that we need to consider the powering question at the outset rather than relegating it to the last decision as we have done in the past."

In its early days, it was a rather simple straightforward device capable of delivering an AC powering signal to the plant actives for a period of time during the loss of utility power (hopefully in excess of the outage). The problem was that the operator generally did not know when the unit was operating in the standby mode. This led to the delaying of the inevitable, the dreaded outage! Standbys have functioned well as bandages for the short-term outage. The natural response for the extended outage was to ask for more time. So more batteries were employed. Lighter loads were placed on the supplies. More supplies were installed because of the reduced individual loads. But still on Super Bowl Sunday the dreaded outage would occur (caused by some careless driver "parking" his automobile on the utility poll feeding our supply).

"Status monitoring will fix our problem," we said. We renamed it "network management." As we move into the future, we must know what our network is doing at all times. We no longer have the luxury of assuming that since we have three 100 amp/hour batteries in our slick standby power supply that all is well. The standby (when properly applied) will improve system reliability, but we must remember that since it is more complex than our old faithful ferro, it is a point of maintenance. Since it is active, it should be monitored like all of the other actives in the system.

Limitations of current technology

If we go back far enough we can remember the 30 VAC powering technique. But all too soon the system being required to deliver more was so power hungry that 30 VAC was not able to push the power through the cable. (The obvious result of loop resistance.) The answer was 60 VAC. This was generally still considered low voltage for the sake of the various regulatory bodies and would allow for almost twice the amount of powering from one location. The future had arrived but not for long.

In the race to outdo ourselves (to provide more as an answer to the cry from our customers for more, more, more) quickly led us into the same dead end as before. We are again voltage-limited in traditional systems. We have placed more and more actives in the field that are themselves more complex and power hungry. There seems to be no end in sight. The challenge is formidable.

It also presents a challenge to the passive manufacturers as well. We continue to pass power but with ever increasing bandwidths — not an easy or inexpensive task. We should face the fact that to operate a network of the future, we will be required to do a

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Powering the superhighway

How will we power the information superhighway? This is the question of the day. Everything must be rethought. The overall system design. How deep do we take the fiber? What are the type and quality of services to be provided? Will the local regulatory bodies place previously nonapplicable requirements on the system if it becomes an essential services pipeline?

With the merging of two industries, telco and CATV, the past activities in the powering arena do not necessarily apply. The telephone industry has historically operated a centralized power plant. In the central office (CO) there were numerous banks of batteries constantly on charge with an additional engine-driven generator to cover even the rare extended outage. This was acceptable until the telco industry started providing enhanced services. It has gone to a distributed style of powering with the placement of hubs in neighborhoods that house fiber to copper mux/demux equipment. This was dictated by the very situation with which we, the CATV industry, are dealing. We can't power over fiber. The telephone industry liked centralized power since it only had to have one power company connection and the batteries could be properly treated to enhance service life.

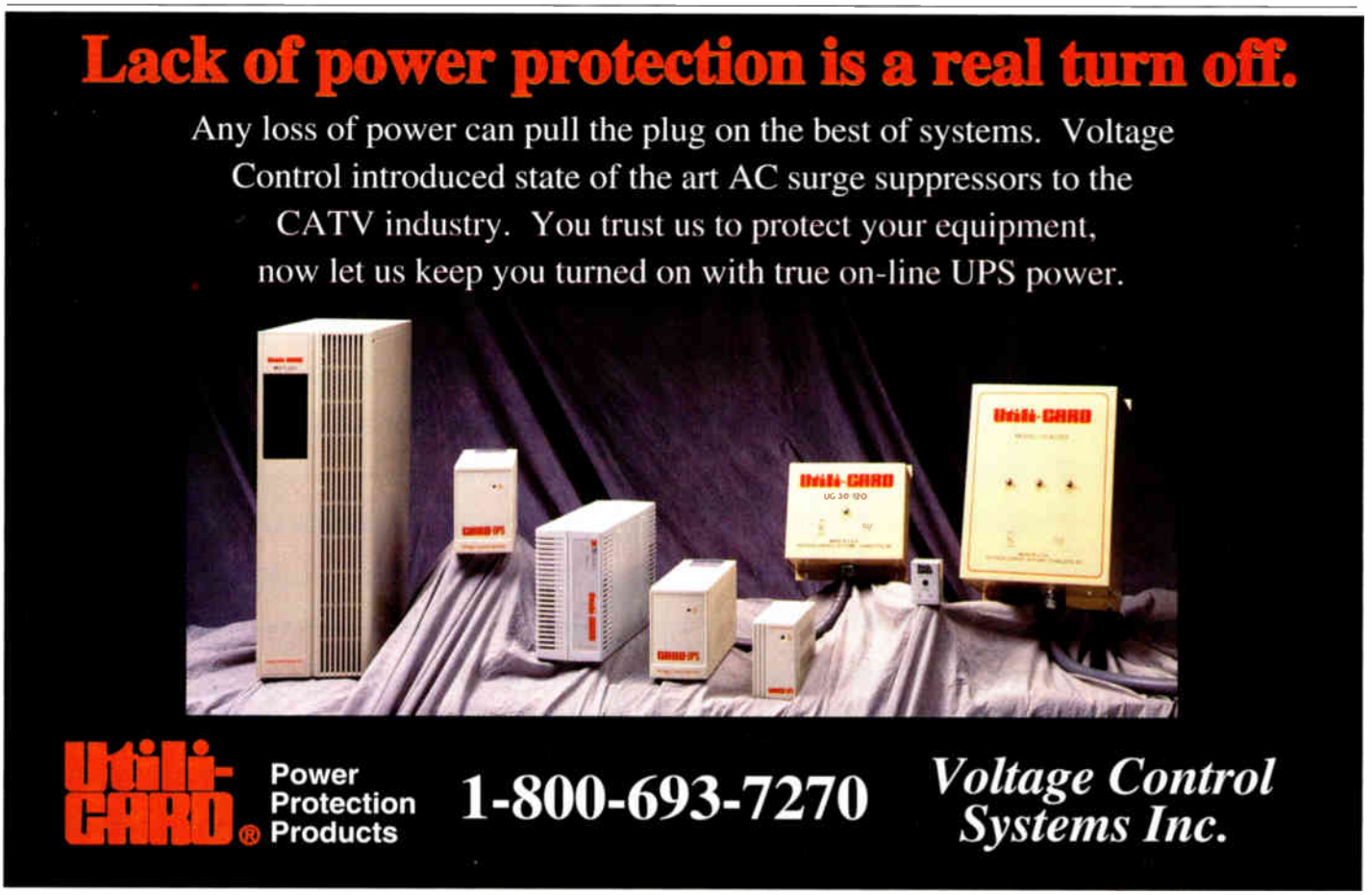
The CATV industry has always utilized distributed power: power supplies placed every so many miles; batteries spread out over the system in standby equipment; and multiple power company connections. We have learned to cope with the situation even though it has not been a perfect world.

So which topology will win out? It most likely will be distributed power. This is because the fact that to deliver the amount of power required to operate the networks of tomorrow with the centralized approach would require lethal operating voltages. This would not be practical. We may see a hybrid approach on a small scale, neighborhood by neighborhood, to achieve some interesting results.

As previously mentioned, some operators have considered very high operating voltages in a centralized power scheme as a means by which to push the power through the cable, regulatory issues aside. Some have considered placing a shadow power conductor along with the signal delivery cable, be it fiber or coax, to segregate this activity. Some telcos have considered using their copper plant for part of the power delivery mechanism (not unlike what they have done all along). There is no one answer yet as we have had in the past. The pool of ideas is being stirred by the creative thinkers of our industry. The number of well thought out options made available from the various power equipment vendors will no doubt make these questions more tolerable.

Watts the question!

As we see, all bets are off when it comes to traditional powering approaches. The whole process must now revolve around a new term for



Reader Response Number 49

our industry as it applies to powering. We need to start thinking in terms of watts. If we start with watts, we can divide the system into wattage areas. This allows us the ability to decide operating voltages, conductor sizes and amount of battery plant needed (all in a manner previous methods did not allow).

Take for example a typical 500-mile plant. At an estimated 3.4 miles of plant for each power supply and with a typical loading average of 9 amps, the total wattage consumed all day, every day, 365 days a year will be 79,411 watts. This is the way you should discuss your power consumption issues with your local power company. You may find the discussion to go much easier if you take this approach.

If we take our loading up only 0.5 amp, 30 watts, per supply what effect will that have? That is an additional 4,410 watts. At an average cost for power of 6 cents per kilowatt hour, the previous 79,411 watts would cost $41,150 per year. Our increased load results in an added cost of $2,286. We can see by these examples that even a small added load on our systems will forever mean added operating cost. That cost, of course, will never cease to increase.

In discussions with various manufacturers of terminal devices that provide telephone service over the cable, the power consumption of the devices range from 6 to 9 watts. Let's assume that we provide 50% of our previous example service area with this option. If we assume 100 homes per mile of plant, that means that we would be providing 2,500 pieces of additional equipment that will need power. The consensus of opinion at this point is that the operator will be responsible for the powering of this device since that stage has been set by the telco tradition.

With 2,500 added devices with a demand of 6 watts minimum, that translates into a total of 15,000 watts or nearly a 20% increase in power required. This is power that we must plan for at the beginning. We must consider this impact up front as we design and allow for this potential expansion. Expected penetration figures must be brought into the equation in a way in which they never have before. We have been able to deliver signal to a port at a given cost over time. That day is rapidly going by the wayside. Our power demands will become as dynamic as our customer base. After all, power is power.

It is obvious that we need to consider the powering question at the outset rather than relegating it to the last decision as we have done in the past. We have to design a powering scheme and plant first. Only then can we overlay any one of several signal delivery systems. There are some very interesting methods of delivering service being discussed in today's market. However, when it comes to discussing how to power those methods, one is generally met with blank stares. It is the opinion of this writer that the real challenge is in "powering" the network, not necessarily "operating" it.

There are new and exciting developments looming on the horizon. The question is which ones will steer the market? The answer will affect the way we build our systems to achieve the revenue and reliability we require. **CT**

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Reader Response Number 50

When is a UPS not a UPS?

By Jud Williams
Owner, Performance Cable TV Products

Cable TV is taking on an entirely new perspective because of the rapid growth of fiber optics and the opportunities this technology offers. The old claim that fiber was too costly has surely fallen by the wayside. In fact, a cable system can't afford not to take advantage of this fantastic medium. Many cable plants are evolving into hybrid systems since both fiber and coaxial technology are being used. Basically, it results in mixing the old with the new. Presently, fiber-to-the-node is a popular architecture as well as the use of fiber to eliminate multiple headends.

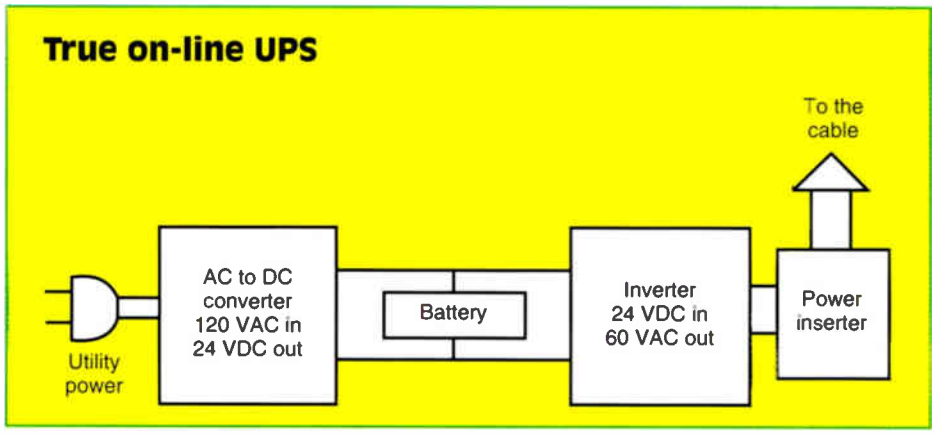
The purpose of this article is to examine how power supplies fit into fiber technology and to discuss some of the pitfalls that may be encountered in the future.

The power supplies I will be discussing are the ones that produce the nominal 60 VAC that powers the cable plant. We should all know that cable TV operates on 60 V RMS (root mean square) rather than 120 V, mainly because of safety reasons. This 120 VAC can be lethal so it is stepped down to a safer 60 V by use of a ferroresonant transformer. The ferroresonant was selected (wisely I might add) because it effectively regulates, conditions and suppresses, giving the cable system a nice clean, noise-free voltage to operate from. By the way, a modern ferroresonant transformer does not normally produce a quasi square wave as is often suggested, particularly when operating from the 120 V utility. It actually approaches a sine wave except when there is no load on it.

Standby inverters

Backup and standby power supplies (the proper name is "inverter") do in fact generate square waves, so a cable system is actually subjected to two different wave shapes. The two most popular square wave producing standby power supply configurations are the multivibrator and the driven types.

The multivibrator is by far the most efficient and operates on the principle of two opposing pairs of power transistors alternately turning on in such a way that they draw current through one-half of the primary of a transformer winding, then switching to the other half so that a square wave is produced on the secondary of the transformer. Various pulse-generating circuits assure that the multivibrator continues to oscillate. These inverters generally operate from 24 VDC.



A second type of inverter uses a pulse-forming circuit often located on a logic board to drive the output transistors so that they turn on and off in unison. This also results in a square waveform. Since this is a less efficient type of inverter, it is usually powered by 36 VDC. Some versions of this configuration operate through a ferroresonant transformer that consumes some additional power but results in tighter regulation.

UPSs

The power supplies described thus far are strictly "standby inverters." There is yet another type of power supply that is used as a backup, particularly when digital information is involved. As you can imagine, digital signals can be quite sensitive to spikes and noise when introduced into their signal path. This so-called "digital intrusion" can be quite destructive to a chain of binary pulses. For this reason, the computer world uses the uninterruptible power supply, commonly called a UPS.

As the name infers, the power supply produces continuous clean power even if the utility power line goes on and off, or fluctuates, producing surges, sags, transients and noise. A true on-line UPS has no transfer relay as do standby power supplies because regardless of the speed of the transfer, there is always the possibility of relay bounce. In fact, all relays bounce upon closure because of the length and springiness of their armatures. Also, with continued use, relay contacts tend to become contaminated by erosion and oxidation so that their effectiveness and reliability is compromised over time.

"A true on-line UPS has no transfer relay as do standby power supplies because regardless of the speed of the transfer, there is always the possibility of relay bounce."

The consequence of a bouncing relay contact is the possibility of generating inductive spikes that may become a form of digital intrusion. Because the cable shares its conductor with both signal and power, it is easy to see how one may affect the other particularly when digital information is present.

It is fair to say though that when playing the numbers game of probability, such an occurrence may not be an issue with present state-of-the-art cable TV. But looking into the future when interactive cable is widespread, the problems may be different.

As a guard against such an eventuality there is a type of UPS that operates on a double conversion basis. Simply stated, the configuration func-

(Continued on page 98)

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Reader Service Number 40

The road to ATV: A progress report

CableLabs has had an office at the Advanced Television Test Center in Alexandria, VA, since early 1990. CableLabs is committed to testing all proposed high definition TV (HDTV) systems in a cable TV environment. The author of this article is CableLabs director of advanced TV testing at the ATTC facility. What follows is a review of the history and present status of the search for an advanced TV (ATV) standard.

By Brian James
Director of Advanced Television Testing
Cable Television Laboratories

ATV refers to any system for distributing video and audio programming that results in improved quality when compared to NTSC (National Television System Committee). An ATV system could be a marginal improvement to the existing NTSC service or could be a completely new system with much higher quality, different aspect ratio and scanning parameters, and improved audio quality.

HDTV is a subset of ATV and refers to a system capable of delivering a much improved quality picture. The general goal of a high definition signal is to provide about twice the horizontal and vertical resolution of NTSC receivers, and improved audio quality. The picture and sound quality should approach those of a 35mm film presentation.

The role of the FCC

The Federal Communications Commission began the process of selecting an ATV system with the appointment of the Advisory Committee on Advanced Television Service under the chairmanship of Richard Wiley. Three subcommittees (Planning, System and Implementation) were charged with developing necessary attributes for the ATV system, testing the proposed systems to determine whether they met the requirements, and developing scenarios for the introduction of ATV. Interested parties were asked to submit proposals for ATV systems. Over 20 proposals for systems or partial systems were submitted in response to the initial request. The proposals were reviewed, some accepted for further development (precertified), while others were rejected. All of the proposals utilized some form of analog transmission.

The development of ATV systems was pushing the state-of-the-art in technology. In order to allow proposals incorporating new (possibly superior) technology, June 1, 1990, was set as the date by which a system had to be precertified to be considered for testing. Just before the June 1 deadline, General Instrument Corp.'s VideoCipher Division submitted a proposal for an ATV system using a digital transmission system. The other proponents were given an opportunity to rethink their proposals to determine if they wanted to convert to digital transmission technique. Three of the proponents modified their proposals to include digital transmission techniques.

Test procedures

The test procedures developed by the committee called for general objective tests, terrestrial and cable specific transmission tests, plus subjective tests. Two laboratories were formed to perform some portions of the tests with CableLabs to perform the cable-specific portions. One laboratory, the Advanced Television Test Center (ATTC), was created to perform the objective and terrestrial portion of the tests plus collect expert viewer observations and commentary. ATTC was sponsored by broadcasting companies and industry organizations including Capital Cities/ABC, CBS, NBC, PBS, Association of Independent Television Stations, Association for Maximum Service Television, Electronics Industries Association and National Association of Broadcasters. CableLabs entered into a contract with the ATTC to perform the cable portion of the tests at the same location as the terrestrial tests.

The other laboratory, the Advanced Television Evaluation Laboratory, located just outside Ottawa, Ontario, was created to perform the subjective evaluations of high definition video. It was sponsored by the Department of Communications, Communications Research Centre, Tektronix Canada, Canadian Broadcasting Corp., Leitch International, Rogers Engineering, Telesat Canada and Advanced Broadcasting Systems of Canada.

Systems to be tested

Five ATV systems were accepted, tested and evaluated for consideration as the U.S. ATV standard.

1) NHK, which developed the original 1,125-line high definition studio system, proposed an analog transmission 1,125-line, interlaced system.

The four digital transmission systems, in the order in which they were tested, were:

2) The American Television Alliance (General Instrument and MIT) DigiCipher system, which used a 32 QAM mode to transport a 1,050-line, interlaced signal.

3) The Zenith/AT&T Digital Spectrum Compatible-HDTV (DSC-HDTV) system used a 2/4 VSB modulation technique to transport a 787/788-line, progressively scanned signal.

4) The Advanced Television Research Consortium (NBC, North American Philips, David Sarnoff Research Center, Thomson Consumer Electronics and Compression Labs) Advanced Digital-HDTV (AD-HDTV) system used two separate 32 QAM channels to transport a 1,050-line, interlaced signal.

5) The American Television Alliance Channel Compatible DigiCipher (CCDC) system used a 32 QAM mode to transport a 787/788-line, progressively scanned signal.

The aspect ratio of all systems was 16:9 and the channel bandwidth was 6 MHz.

The system testing began on July 12, 1991, and was completed on Nov. 12, 1992. Reports of tests were prepared by the testing laboratories, then reviewed and analyzed by System Subcommittee/Working Party 4 (SS/WP-4), the working party on system

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standards that reports to the FCC Advisory Committee.

Final report

SS/WP-4 was responsible for the review of the test results and the drafting of the final report of the Advisory Committee. Some members at the meetings expressed concern that attendance at the meetings was open to everyone. This admitted the possibility that various interests could fill a meeting with their representatives and make it difficult to obtain a decision based only on technical merit. To address this concern, a "Special Panel" was appointed by the Advisory Committee to review the results of the laboratories, to consider contributions and analysis of the various working parties, and to determine ability of proponent systems to meet requirements of the selection criteria and to prepare a report for the Advisory Committee. The Technical Subgroup of the Special Panel was formed to review proposed improvements to the ATV systems to determine if the improvements were feasible and desirable. These improvements would be considered in the recommendation for the final report.

The panel met on Feb. 8-11, 1993, to review the data and prepare the report. It determined that the four digital systems exhibited substantial transmission performance over the Narrow-MUSE (NHK) transmission system and further determined that the Narrow-MUSE system would not prove to be a suitable terrestrial broadcasting ATV system for the United States. The panel recommended that the Narrow-MUSE system be dropped from consideration due to its poor performance in the terrestrial transmission tests.

The panel determined that there were no significant cost differences among the proposed systems. All systems had proposed improvements to their transmission systems and the panel found that incorporation of the improvements in time for field testing could lead to improved spectrum utilization and increased robustness beyond that found during the first tests. The all-digital approach was expected to provide excellent quality pictures and audio once the proposed improvements were incorporated, and was determined to be desirable for extensibility and interoperability. The panel further recommended that the four digital systems be retested after the improvements approved by its Technical Subgroup were incorporated.

"The final decision, while it may not happen until some time in 1995, will be well worth the effort and delays."

The Grand Alliance

The Advisory Committee met on Feb. 24, 1993, and adopted the report and recommendations of the Special Panel. The retests were scheduled to begin in the spring of 1993. The chairman of the Advisory Committee, Richard Wiley, urged the proponents to join together in a "Grand Alliance" that would combine the best technical aspects of each system into one optimal system. A side benefit of this approach would be the elimination of potential lawsuits by the losing proponents. On May 24, 1993, the Advisory Committee produced a press release announcing the formation of a Grand Alliance of the entities sponsoring the four remaining digital ATC systems. The entities (AT&T, the David Sarnoff Research Center, General Instrument, Massachusetts Institute of Technology, North American Philips, Thomson Consumer Electronics and Zenith Electronics) had reached a business and technical agreement to produce a merged system proposal. The ATVA progressive system, which was the first improved system to be tested, had arrived at the test center but the tests had not yet started. The testing was put on hold pending development of the alliance system. The Special Panel Technical Subgroup was charged with reviewing the alliance proposal and certifying the proposed system.

The Grand Alliance members presented their proposed system to the Technical Subgroup in June 1993. This system appeared to include all of the original proposals with specific subsystems to be decided in the future. The highlights of the proposed system included flexible picture formats with header/descriptor approach allowing both progressive and interlaced raster forms including square pixels for the progressive format and rectangular pixels for the interlaced format.

The video compression would have substantial commonality with MPEG-2, but with additional elements that represent innovative contributions from each of the previous systems. A system would use a packetized, prioritized, data format to provide flexibility of services and extensibility.

Areas of the Grand Alliance system needing to be finalized included the audio system and the transmission system. The audio system was to be selected from three proposals: The Dolby AC-3 system; multichannel MUSICAM; and MIT-AC audio systems. The transmission system is to be one of QAM, spectrally shaped QAM, 6 VSB (with trellis code) or 4 VSB.

The Technical Subgroup of the Advisory Committee met in August to review the alliance's progress in determining the specific subsystems to be used in the final system and to set tentative dates for decisions on various parts of the system. Rather than approve all aspects of the system, it was decided that (as the alliance determined which subsystem it wanted to adopt) the Technical Subgroup would review the decision process and either approve the proposal or recommend an alternative. That procedure would allow the individual development of the various subgroups as they were approved rather than waiting for all subgroups to be specified. The dates for the final decisions were: audio system Aug. 31, scanning formats Sept. 14, compression system Sept. 30, and transmission system Nov. 30. The transmission system was to be tested at the ATTC in January and the tests of the complete system were to begin in June 1994. Field tests would follow the laboratory tests and the final reports of all tests was to be completed by the end of the year.

Possible delays

The Technical Subgroup met on Oct. 21 to review the progress of the Grand Alliance and to consider approving its decisions. The alliance announced that the Dolby AC-3 audio system was adopted. At the encouragement of the subgroup, the al-

(Continued on page 98)

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DirecTv: Creating a digital entertainment system

The following is updated from an article that ran in the October 1993 issue of "Via Satellite" and is by a freelance writer based in Roswell, GA.

By Karen JP Howes

When Hughes Communications Inc.'s DirecTv launched an HS 601 satellite into the 101°W orbital slot this past Dec. 17 for its direct broadcast satellite (DBS) service, something new was coming to fruition: a digital, satellite-based entertainment system that many feel can give cable TV a run for the money.

DirecTv will command 11 transponders on DBS 1; Hubbard Broadcasting's United States Satellite Broadcasting, which is marketing its own DBS service, owns the other five. A second spacecraft, scheduled for launch in the middle of this year, will be owned by DirecTv. The Hughes subsidiary will operate both birds.

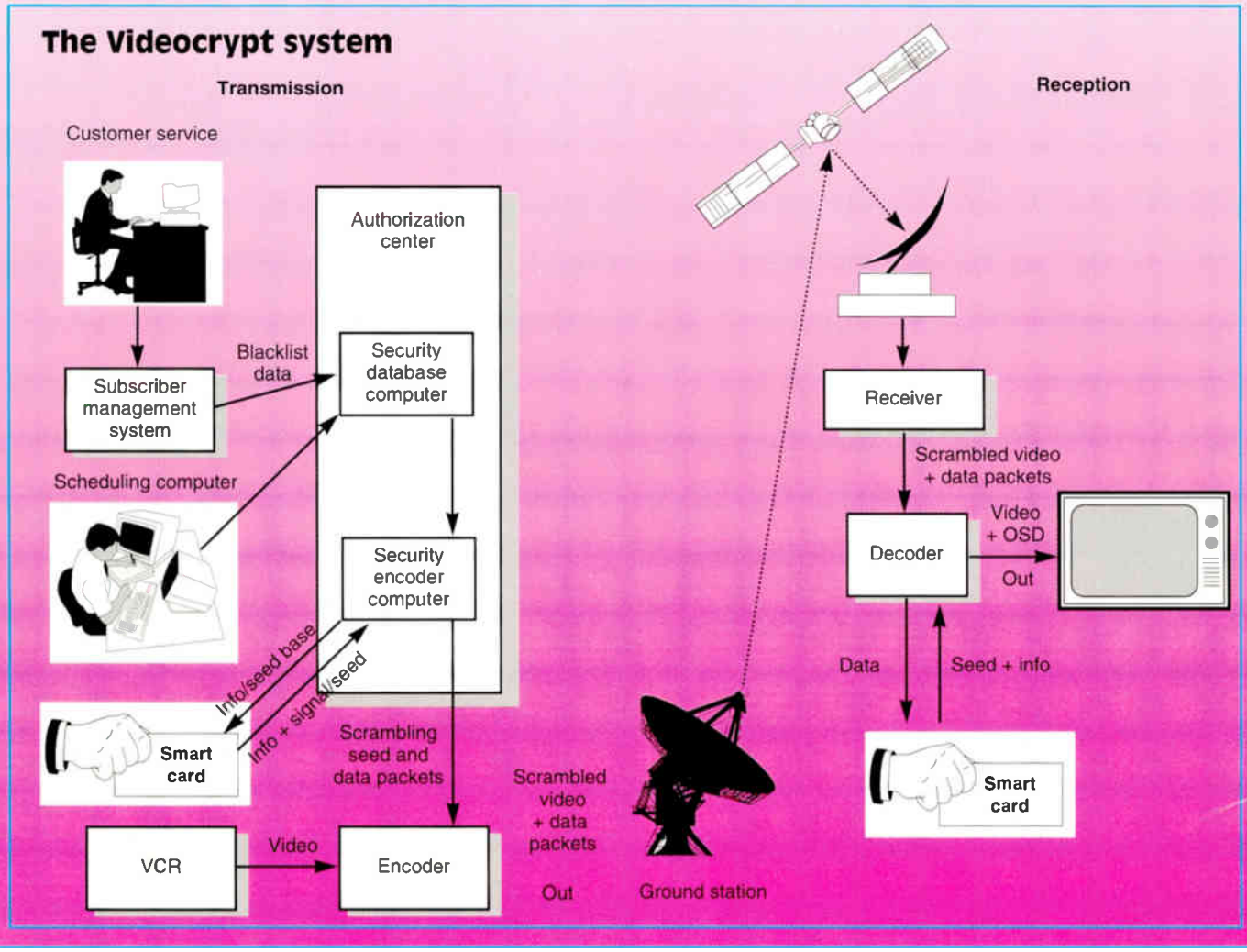
With one satellite up and the other being readied for launch, and a variety of programmers agreeing to be on its service, DirecTv is getting ready to sell the concept of DBS to U.S. viewers on a widescale basis.

The digital satellite system

The Digital Satellite System receiver, developed by Thomson/RCA, is only one aspect of the digital technolo-

Videocrypt's conditional access system

The DSS receiver manufactured by Thomson Consumer Electronics for DirecTv incorporates a Videocrypt decoder within each unit. Videocrypt is the conditional access system developed by News Datacom and used in numerous subscription TV venues throughout the world. While Videocrypt is characterized as a conventional decoder, all of its proprietary authorization secrets do not exist within the decoder itself. The addressability, tiering and billing features



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gy employed in the DirecTv project. This receiver is expected to be one of the most powerful products in the consumer electronics industry.

Chips inside the RCA unit have 10 times the power of a personal computer. The RCA box will be able to generate a sophisticated electronic program guide, deliver CD-quality audio and laserdisc-quality video, process complex authorization and security control data, store pay-per-view (PPV) selections and viewing habits, receive and send data through the telephone line, communicate with a VCR, provide forward error correction, receive and decompress information sent via satellite, convert from digital to analog, and even provide the local time. The receiver also will be able to produce a crystal-clear, 16:9 aspect-ratio picture on

are housed within individual smart cards. It is these smart cards that provide the personalized authorization functions and mark the only point through which pirates could circumvent the security of the system.

To the credit of News Datacom, should a break in the system occur, it is less costly and much less cumbersome to replace a $10 smart card than a $250 decoder. Another benefit of removing the secrets from the box is that every decoder is identical and capable of being manufactured by any manufacturer as is every other mass marketed consumer electronics product. There can be multiple and competing vendors supplying the decoder without incurring any risk of compromise. Only News Datacom provides the smart card, however.

Note the accompanying figure on page 56. The Videocrypt encoder is based on a cut and rotate method of scrambling. According to Dr. Dov Rubin, technical director for the Israel-based News Datacom, the encoder selects lines at random points within the TV picture at the exact moment of transmission. The lines are reversed and broadcast so the picture is unintelligible. The specific location of the encoder's cut points is proprietary and critical to the security of the unit. As such, the Videocrypt system employs "special techniques" to disguise the cut points.

The location of the cut points is fed into the system through the security encoder computer by way of a card reader and smart card. This PC also accepts input from the security data base computer that acts as an interface to the subscriber management system and the program scheduling system.

The security encoder computer generates packets of data that combine program identification and scheduling information with a random number. The packets of data are fed to the smart card, which processes the information through a secret algorithm to produce a seed for a pseudo random bit sequencer (PRBS). This process produces a string of 8-bit numbers, which determine the cut point for each line. The packets of information fed to the card also are transmitted over the air. There are no secrets in this information. The decoder extracts these data packets and feeds them to the smart card in the decoder, which contains the same algorithms as the smart card in the encoder. The same seed is therefore produced and a similar PRBS reproduces the same cut points, allowing the decoder to cut the lines in the same place as the encoder and reconstitute the picture.

According to News Datacom, the data transmitted over-the-air is not secret and changes every few seconds. It is the combination of the data and the information in the cards that provides the decoding information. As a result and unlike other encryption systems, no keys are transmitted over the air in the clear. Imperative to the security of the system is that the starting number is "hidden" from view.

In essence, the Videocrypt smart card is an active security device. It is not something that passively holds keys. The purpose of the Videocrypt smart card is intrinsically tied to the process of authorization. Therefore when the smart card is changed and replaced by a programmer for any reason, including a break in the security of the system, the entire decryption/authorization process may be redesigned and reissued without affecting the utilization of the decoder.

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Reader Response Number 54

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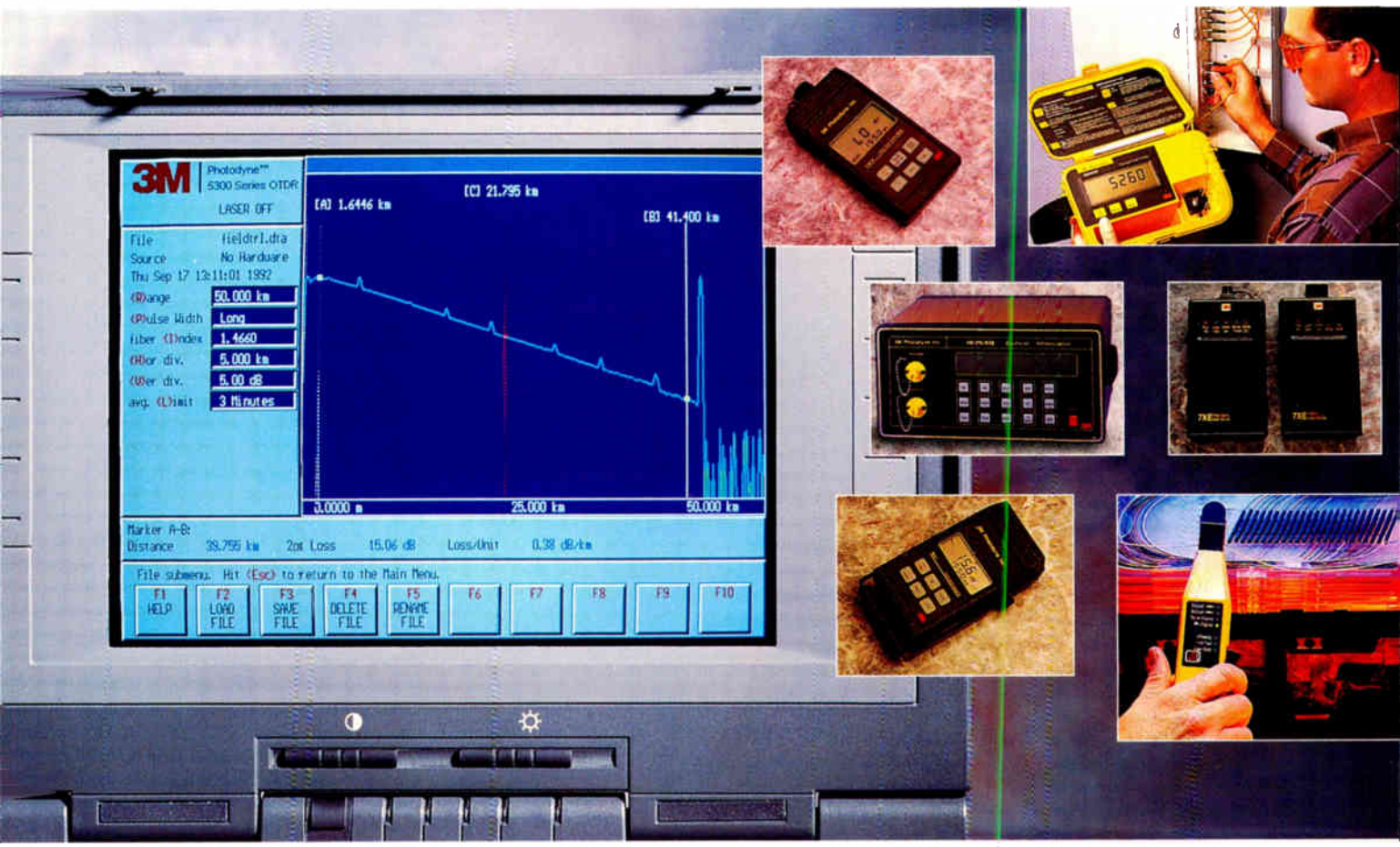

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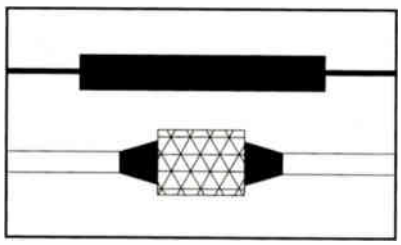

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"With the launch of DirecTv, the United States is being further immersed in the digital world. Consumers will be able to purchase DSS equipment at the same outlets where telephones and TV sets are sold."

an RCA or Philips widescreen TV set.

In fact, everything about the in-home DSS receiver is unique. It is high definition TV (HDTV)-upgradeable, and its price is relatively low compared to the $325 that a satellite receiver manufacturer has to pay for an analog decoder module used in a typical TVRO system.

The broadcast center

Activated, operated, monitored and controlled by bitstreams, DirecTv will be more than the first high-powered U.S. DBS TV service. One key aspect of DirecTv's infrastructure is the 55,000 square foot operations center in Castle Rock, CO. The $100 million to $120 million facility is designed to transmit 150 channels of programming to 16 transponders on each of the two DBS birds to be collocated at 101°W.

Sony is providing 300 digital dubbing machines, 50 digital robotic playback systems, various signal routing peripherals, and a broadcast automation and media management system that automatically loads and unloads tapes, inserts advertisements, routes signals throughout the center, and tracks the tapes housed in DirecTv's media library.

By using automation, DirecTv has been able to cut its personnel requirements by 75%. According to David Baylor, vice president of operations for DirecTv, the company would have needed a staff of 600 to catalog, monitor and play all of the programming needed to fill 150 channels. With state-of-the-art equipment, Baylor continues, DirecTv will only have to hire 150 people to cover three shifts, 24 hours a day, seven days a week.

The DBS satellite

The DBS 1 and 2 satellites being used for DirecTv carry 120 watt transponders, capable of being doubled to 240 watts for future high-ratio compression applications. Switching to a 240 watt power level allows the use of smaller receive antennas or the transmission of compressed HDTV. By comparison, HCI's Galaxy IV and Galaxy VII spacecrafts carry 50 watt transponders; Primestar, which beams entertainment programming to viewers via GE Americom's Satcom K1, uses 45 watt transponders.

Hughes Space and Communications customized the HS 601 for DirecTv's direct-to-home (DTH) application. Shaped reflector technology and custom-designed traveling wave tubes were developed, so receive antennas

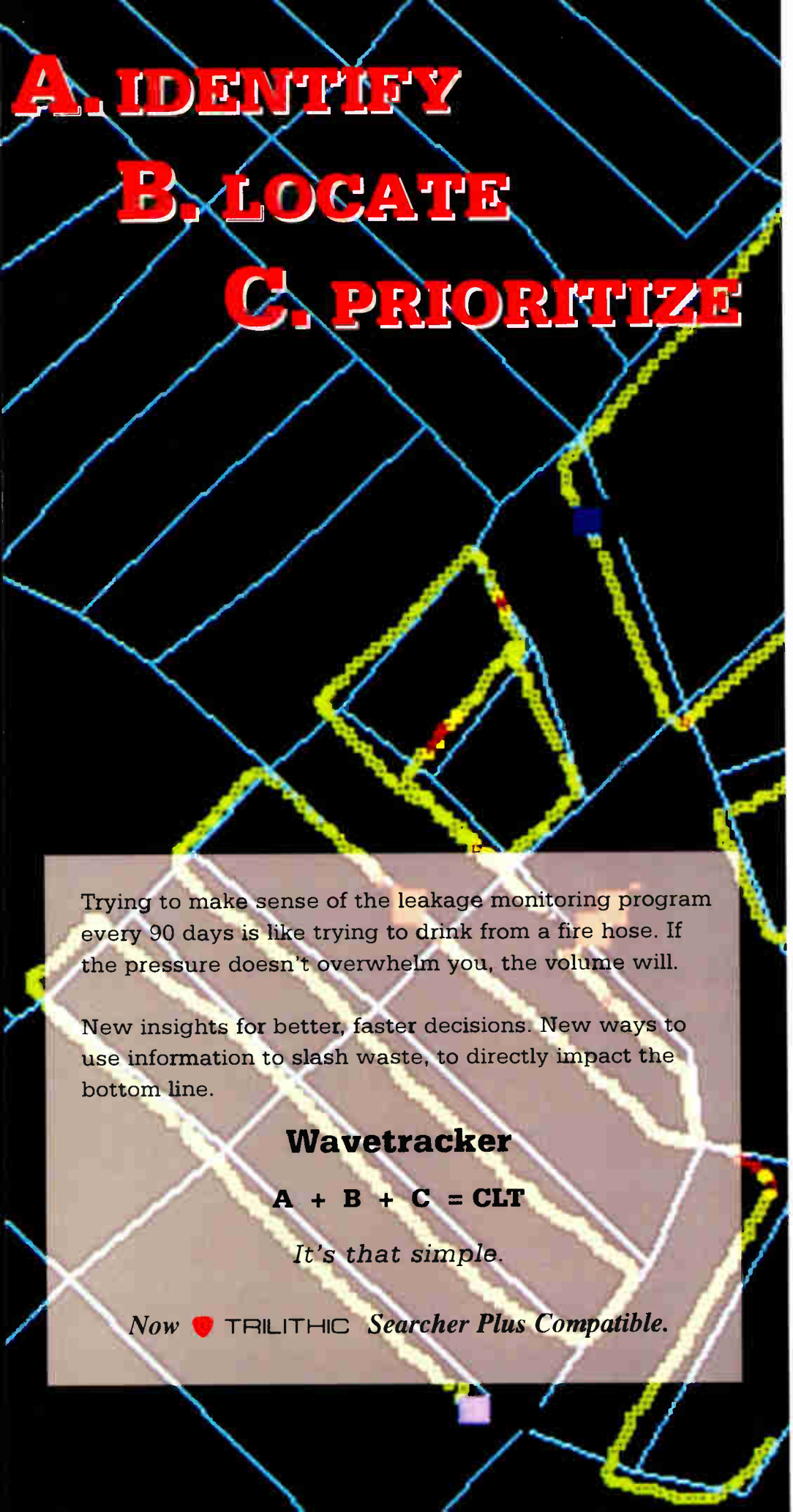
Tempo to buy DBS satellites from Space Systems/Loral

Space Systems/Loral was awarded a contract for over $400 million from Tempo, a subsidiary of Tele-Communications Inc., to build two high-powered direct-to-home (DTH) broadcast TV satellites.

Under the terms of the Tempo contract, which results from a restructured arrangement between Space Systems/Loral and Tempo, SS/L will deliver the two satellites in orbit in June and October 1996. SS/L will provide for risk management and the procurement of launch services.

The satellites will provide DTH TV service to customers in the United States. The spacecrafts will be designed to use digitized and compressed video signals to provide a tenfold increase in the number of channels.

Each Tempo satellite will carry 32 high-powered 107 watt transponders, switchable to 16 transponders at 200 watts. The bus design is based on SS/L's FS 1300 platform, used for the Superbird, NStar and Intelsat 7 series of communications satellites.



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DirecTv at a glance

Two DBS birds collocated at 101°W will provide Hughes Communication Inc.'s DirecTv and Hubbard Broadcasting's USSB with a total of 200 programming channels. HCI will take 11 transponders (or 50-60 channels) on the satellite that was launched Dec. 17, 1993, onboard an Ariane rocket, leaving USSB with five transponders. On the second satellite, scheduled for a mid-year launch by Arianespace, DirecTv will acquire 100 channels. DirecTv's 150-channel lineup consists of the following categories of programming:

- *Cable networks*: Up to 40 channels will be devoted to premium and basic cable networks. Programmers that have signed on with DirecTv include The Cartoon Network, CNN, CNN International, Courtroom Television Network, Country Music Television, The Family Channel, The Golf Channel, Headline News, The Learning Channel, The Nashville Network, Playboy TV, The Sci-Fi Channel, TBS SuperStation, The Travel Channel, Turner Classic Movies, Turner Network Television, USA Network and The Weather Channel.
- *Movies:* Pay-per-view movies will comprise 50-60 channels, with charges ranging from $1-$4. Popular hits will be broadcast every 30 minutes. Viewers will be able to purchase a film on impulse by selecting a title from the on-screen program guide or from a preview channel showing trailers of the movie. Hollywood studios that have signed agreements with DirecTv include Columbia/TriStar, Paramount Pictures, Sony Pictures Entertainment, Turner/MGM and Universal Studios.
- *Sports*: Sporting events will fill up to 30 channels. However, at press time, DirecTv had not signed agreements with any programmer or producer for this genre.
- *Special interest*: This category, which will include cultural, international and educational programs, will fill the remaining 30-40 channels.
- *New programming services*: Newsworld International and Northstar.

could be a uniform 18 inches. "In our original model," says Tom Bracken, DirecTv spokesman, "the size of the dish would have varied depending on where a customer lived."

The birds carry 32 traveling wave tubes that are paired and connected to electronic power conditioners (16 are used as backups). The output signal is circularly polarized and beamed to the earth through a single feedhorn for each shaped reflector. With the shaped reflectors, the satellite can boost power to the southeast and other regions where rain fade would typically require a larger antenna. Unlike the intelligent beam-forming networks onboard military satellites, however, the power levels for DBS 1 and 2 are set during construction and cannot be redirected in orbit. Hughes is using circular polarization to allow more efficient reuse of the frequencies and easier in-home installation for consumers. With circular polarization, the tuning of the receiving dish does not have to be as precise.

The programming

With the launch of DirecTv, the United States is being further immersed in the digital world. Consumers will be able to purchase DSS equipment at the same outlets where telephones and TV sets are sold. Yet while the sophistication and affordable cost of the technology is crucial to the success of DirecTv, the project's viability has rested on the support of a handful of TV programmers and Hollywood studios.

For that reason, five years ago DirecTv would not have succeeded. The political atmosphere was not conducive to the creation of a TV subscription service designed to compete with U.S. cable system operators. Hughes began its quest to develop a DBS business in 1985. "We started when we were first given a DBS slot," Bracken reminisces,

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"but we could not put the business together. It was not until 1990 that it began to make sense."

"The technology wasn't available," explains Jim Ramo, senior vice president for DirecTv. "The ability to provide strong competition to cable was not there. The ability to have government step in was not there. In short, the capability for the business was not there."

So, following a failed DBS venture, dubbed Sky Cable, DirecTv was formed as a Hughes-owned subsidiary. Sky Cable's partners had been NBC, Rupert Murdoch's News Corp. Ltd. and Continental Cablevision.

The challenges appeared formidable. DirecTv had to develop a DBS service that would compete with the entrenched cable system operators and buy cable programming. The company had to design a digital transmission and receive system. Satellite earth stations had to be mass marketed as a consumer electronics product. Everywhere, the company faced skepticism and prejudice that resulted from a string of failed DBS ventures, while building a business from scratch.

DirecTv executives called on programmers who they learned were not initially interested in DBS. "Even last year (1992)," Bracken remembers, "some of the programmers didn't return our telephone calls."

But today, he continues, the atmosphere is different: "We won't have room for every cable channel that wants to be on DirecTv."

The program access rules established by the Federal Communications Commission in conjunction with the 1992 Cable Act may have helped DBS operators negotiate rates in parity with those offered to the cable industry. Pre-Cable Act rates charged to MMDS and TVRO program distributors, for instance, were 500-1,000% higher, according to some sources.

Since then, DirecTv has been able to convince a wide range of programmers to sign distribution agreements. A unique aspect of DirecTv's strategy in filling its programming channels was to attract small programmers first. When other companies tried to penetrate the cable network industry with new products or services, they initially targeted the largest programmers. DirecTv executives, on the other hand, believed that a viable business could be built, even if big names like Time Warner and Turner were not part of the original line up.

"Having overcome two significant hurdles — developing a digital, satellite-based distribution system and signing on programmers — DirecTv faces perhaps its biggest obstacle to success: selling the concept of DBS to the public."

After making a pact with the NRTC, in which the rural cooperative promised to pay DirecTv $250 million for the exclusive rights to sell 20 cable programming channels in non-suburban areas, DirecTv had to sign on programmers quickly. "We had a list of 35 (services) to work from," says Bracken. "We decided which ones we could do a deal with faster."

With the need to move as quickly as possible, DirecTv mounted a major marketing effort aimed at programmers. "There's been a lot of education," says Bracken. "First, we had to get the programmers to understand a new national distribution system. Then we came on top of it with a new technology." But the tutorials paid off, and the contracts began to come in. On Jan. 7, 1993, The Disney Channel became the first programmer to join the DBS venture. DirecTv was able to meet its 20-channel goal in order to honor its part of the deal with the NRTC. However, since the NRTC only paid the DBS provider $125 million (instead of the promised $250 million), the original agreement between the two was amended so that the NRTC had exclusive rights to sell the 20 cable basics to rural territories covering a total of 6 million homes.

Having overcome two significant hurdles — developing a digital, satellite-based distribution system and signing on programmers — DirecTv faces perhaps its biggest obstacle to success: selling the concept of DBS to the public. "Now we have to integrate all the pieces," says Ramo. "We have to successfully market the service. That's a big challenge." **CT**

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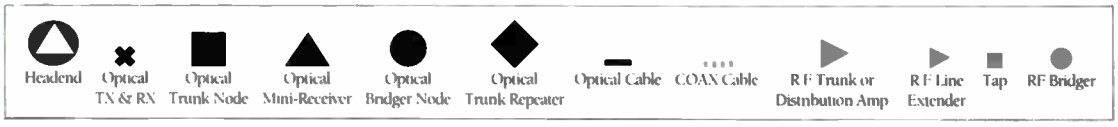

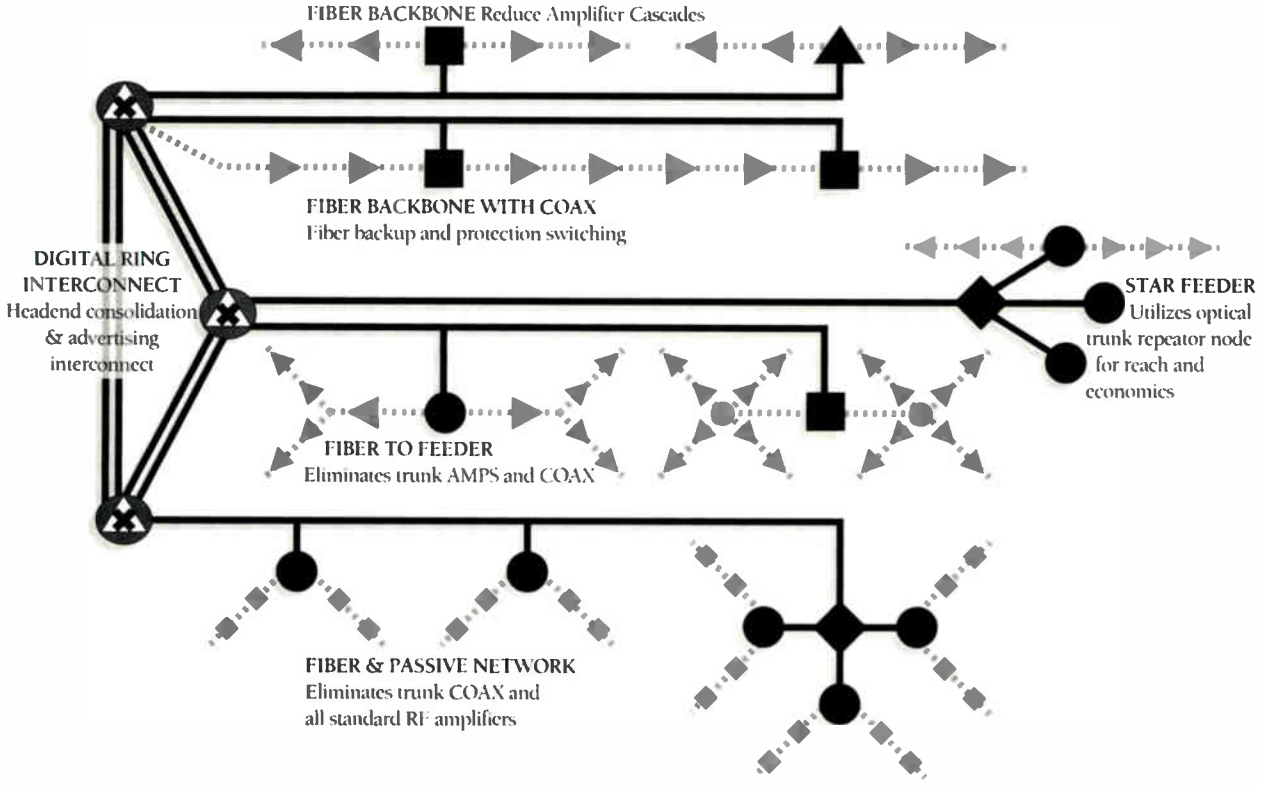

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From *Communications Technology* magazine Western Show Wrap-up Edition

New Drop Amps From Pico

Pico Products Inc. announced production of a new line of low-noise drop amplifiers (LNDA-10 and LNDA-20) designed to assist in meeting CFR Section 76.605 requirements. Available in either 10 or 20 dB gain, these broadband amplifiers provide continuous amplification from 50 MHz to over 1 GHz.

According to Pico Products, the low-noise and high-output capability of the amplifier makes it perfect for improving the signal level and quality to long drops. The high-performance surface-mount circuitry, packaged in a sealed trap enclosure providing -130 dB RF shielding and protection from the elements, is said to ensure long-term performance and overall cost-effectiveness. Over the 1 GHz bandwidth, the amplifier's flatness is ±0.5 dB, while maintaining a 4 dB noise figure.

Both versions of the amplifier contain an internal DC block allowing for direct connection to an antenna or CATV drop tap ports. Included is a power inserter for providing in-line voltage to the remotely placed amplifier while allowing only the RF signals to pass to the subscriber's TV set. **Reader service #208**

Belden Unveils Fiber Trunk Cables

Belden Wire & Cable Co. displayed new fiber-optic trunk cables. They are available in armored and all-dielectric versions and meet Bellcore (TR-NWT-000020) and REA (PE-90) specifications. They are said to be ideal for use from headends to fiber nodes.

The Belden multifiber per tube design consists of four to 240 single-mode fibers contained in loose, gel-filled, color-coded buffer tubes. The fiber tubes are cabled around a dielectric central strength member and the interstices are gel-filled to impede water penetration. In the armored version, the buffered tubes are surrounded by a layer of aramid yarn. An inner polyethylene jacket with ripcords is featured on both versions.

The reverse oscillating lay (ROL) stranding provides easier mid-span access. The tubes are color-coded to aid identification and matching of tubes and fibers. **Reader service #203**

Powerful Auto Redundant Transmitter New From Hughes AML

Hughes AML showed its new line of auto redundant transmitter systems. This new product line incorporates an intelligent control system that constantly monitors transmission quality and takes corrective action without any required input from the system operator. In addition to protecting the integrity of the signal delivery, the system will notify the operator by means of a flexible alarm system. The ARTS product line is available in four different models including the most powerful CARS band transmitter system available in the market, according to the company.

The ARTS system allows for remote control of your transmitters via a built-in RS-232 port or manual activation of the redundancy capability. The ARTS system is available immediately and can be retrofitted on existing Hughes indoor broadband systems. **Reader service #207**

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Hotel PPV A New Profitable Frontier

Great Lakes Data Systems has developed an economical in-room entertainment system, Touch Tone Theater, that utilizes satellite, computer and digital voice technologies to allow hotels, motels and other private properties previously considered too small to offer premium in-room entertainment to guests.

A common problem for hotel PPV operators has been the "unintentional purchase." Some properties report refunding an average of 30% of all movies charged because the ordering instructions were unclear, a wrong button was pushed, or a child placed an order. The company says guest requested credits can be virtually eliminated with this technology.

TTT uses automated ordering technology, without confusing set-top boxes. Guests place orders using their in-room touch tone telephones. They are greeted by prerecorded human speech, not a computer voice. A unique personal identification number (PIN) also can be required to confirm each purchase.

The system is compatible with any video source, and can coexist with free-to-guest TV services. Present cable TV, satellite or off-air service need not to be disrupted.

PPV event promotion is simplified with an integrated character generator. A program schedule can be loaded from a disk file directly into the TTT system. Once loaded, event information can be automatically sent to an optional barker channel to promote upcoming events and provide ordering information.

Confirmed guest orders are printed at a logging computer, usually located at the front desk. Charges are then added to the guest's room bill. Purchase information including room number, time, date, program title and cost are all available as soon as the order is placed.

The system is compatible with equipment from a number of addressable manufacturers. GLDS billing software has addressable interfaces for Scientific-Atlanta, Pioneer and Tocom, and can provide TTT interfaces for all major makes of addressable equipment.

TTT runs on DOS and Novell Netware platforms, and comes with two-line ARU capacity. Four-, eight-, and 12-line expansions are available for larger properties. **Reader service #206**

SCTE Unveils Newest Publication

The Society of Cable Television Engineers unveiled its newest publication. The quarterly newsletter, *Interface*, has been written as an informational piece for the cable industry's senior management. Recent developments between the cable TV industry and telephone companies have confirmed the need for increased technical training in both sectors. *Interface* will focus on informing systems managers, operations managers and company CEOs of the myriad of training opportunities offered within the industry.

Also, *Interface* will spotlight successful "Careers in Cable" and feature in-depth interviews with industry leaders. **Reader service #204**

Alpha Shows New UPS, Powers Telephony From Cable Network

Alpha Technologies introduced the PM4808 Power MUX, a 60 VAC/48 VDC multiplexing power supply. The unit facilitates the remote powering of 48 VDC telephony equipment from cable TV networks. The unit rectifies and conditions 60 VAC power from a cable trunk to provide high-quality 48 VDC, 4 amp output. Designed for optimum reliability, it is equipped with redundant AC input to further ensure the integrity of the DC being supplied to the telephony equipment.

The unit provides status information concerning the condition of the AC input as well as the DC output of the unit. These signals also can be cabled into a remote status monitoring system, allowing the system manager access to vital information.

In the event that more backup time is required for the telephony equipment than can be supplied by either cable trunk power supply, the unit can be connected to a small standby battery pack. The DC output also can be tailored to properly maintain the battery pack over a wide operating temperature range. It is designed to meet UL, CSA and VDE safety standards.

Also, the company announced the addition of a 7 amp version to its XP Series uninterruptible power supply. The single ferroresonant design provides fully regu-

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lated output voltage, battery backup, surge and short circuit protection, plus complete line conditioning under all modes of operation and loading. The modular design allows the unit to be easily configured for 7, 10 or 15 amp operation. The inverter and charger electronics are located on a removable module that can be replaced or upgraded without interruption to the cable plant. **Reader service #201 (PM4808), Reader service #200 (XP UPS)**

Power Guard Powers Up With New Power Supply

Power Guard showed its new minus 48 V modular power supply system with high-power capability and wide operating temperature range. The power supply is in a 19-inch rack-mount configuration. Modular construction allows configuration for simple, redundant, or high power systems, either with or without battery support.

A pluggable wiring harness permits ease of installation and replacement. The wide temperature range (-40 to +60° C) accommodates installation environments and the temperature probe option tailors the battery charger output for extended battery life. **Reader service #202**

Superior's Cheetah Fully Automates Compliance Testing

Superior Electronics added both the In-Channel Frequency Response Measurement and Cheetah Compliance Software program (CCSW) to the Cheetah product line of fully automated test equipment.

In-Channel Frequency Response will be available in the Distortion Measurement package, which already includes CTB, CSO, C/N and hum. This is a fully automated remotely programmable testing method that allows multiple channels to be selected for scheduled remote measurements simultaneously at multiple test points. The CCSW allows calculated values to be combined with system measurements in a "push-button" pass/fail reporting format that is utilized for compliance documentation. Live demonstrations are being provided at the company's booth. **Reader service #199**

New From Standard: RF Distribution Concept, Broadband Modulator

Standard Communications Satellite Broadband Products Division revealed its answer to the new demands of the information highway of the future with the new Stratum series.

Because of the cable industry shift from traditional tree-and-branch design to the more advanced redundant fiber ring architecture, dictated by optical digital signal distribution, the eventual need for transition back to analog has blazed a trail for the introduction of a new series of distribution products. This transition node will require a new concept and approach to video distribution.

Stratum consists of an integrated 19-inch modular rack system only 7 inches tall. Capable of containing eight vertically mounted slide-in modulators and one power supply, this configuration will permit up to 80 VSB-AM TV channels to be integrated into a single EIA 6-foot rack. The video transportation system of the future will require the flexibility and redundancy to ensure system performance in the regional hubs or master headends that can potentially supply signals to several hundred thousand subscribers.

As well, Standard Communications Satellite Broadband Products Division introduced its new breed of conventional frequency agile modulators with the TVM550, a PLL synthesized broadband modulator. Designed to be integrated into the most demanding CATV distribution systems of the future, the universal design of the TVM550 will allow rechannelization of master headends without replacing equipment.

The TVM550 core is designed around a unique, broadband RF circuit that is an ultra-stable and artifact-free synthesizer engineered by Standard Communications to eliminate the need for post-filtering. This advanced unit is the next generation of Standard-produced frequency agile modulators, which are said to break the bandwidth barrier while producing re-broadcast quality video and spurious-free RF performance.

Due to the dynamic bandwidth

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expansion within the cable industry, the TVM550 allows operators to fulfill the maximum amount of analog channels delivered on their systems. With the installation of the OAP890 heterodyne processor the TVM550 becomes a frequency agile processor that allows cable operators any channel in and any channel out capability.

The TVM550 also is available with a BTSC/MTS stereo generator that eliminates external wiring between components. Without the need for dual equipment alignment and setup procedures, the cohesive TVM550 permits reduction of rack space, AC power requirements, and heat while permitting for future system expansion. **Reader service #198 (Stratum), #197 (TVM550)**

Debut: Pioneer's Digital Laserdisc Player, Alpha Vision

Pioneer previewed digital equipment for pay-per-view (PPV), near video-on-demand (NVOD) and video-on-demand (VOD) services. Pioneer New Media Technologies, Cable and Broadcast Systems Group exhibited a model of its new four-headed digital laserdisc player and Alpha Vision, a CD-sized compressed system, as well as demonstrating real-time decompression using its VLSI CD1100 Series chip set.

Pioneer reports it is the first to introduce a digital laserdisc player with four independent heads. The laserdisc player is capable of both analog and digital output. The player serves as a PPV transmission system for satellite delivery or localized video playback. In addition, this unit can be used as an archival source for video servers.

The company's one-sided digital laser discs offer 135 minutes of playback time. They are recorded in digital video compression format, currently MPEG-1++, at a rate of 4.8 Mbps. Pioneer's VLSI CD1100 Series chip set makes the decoding possible.

With the help of Pioneer's Alpha Vision, images are compressed and stored allowing optimal quality, large storage capacity and durability for digital applications. Sixty minutes worth of video is contained on a 5-inch (CD-sized) disc inside a 500-disc changer. Through real-time decoding, the full 60-minute image is reproduced at a horizontal resolution of 460 lines.

In addition to showing the digital laser disc player and Alpha Vision, Pioneer featured an operating decompression demonstration. The CD1100 chip set was used to show real-time decompression from multiple compression rates. The technology is MPEG-1++ with high-quality CCIR 601 resolution. **Reader service #196**

S-A Showcases New Fiber Architecture, Optical Receiver

Scientific-Atlanta Inc. featured its new fiber-to-the-serving area (FSA) Mini-Star architecture and fiber-optic receiver. The Mini-Star architecture and Model 6920 fiber receiver allow fiber deployment even deeper into the cable system, providing more cost-effective and reliable delivery of new interactive services for added revenue, according to the company.

Mini-Star is an evolution of the company's FSA star architecture that moves fiber even closer to the home. Mini-Star allows the local system to begin with 2,000-home fiber serving areas and then migrate to smaller 500-home pockets when new interactive or narrowcast services are launched. Alternatively, a system may choose to begin with 500-home serving areas and then migrate to 125-home pockets later.

This rebuild architecture utilizes express coaxial cable to divide the larger 2,000- or 500-home serving areas into four smaller 500- or 125-home pockets. The company's 750 MHz System Amplifier II (SAII) is located at all express amplifier positions that serve as star

Toner Introduces New Enclosures

Toner Cable Equipment featured Hennessey outdoor enclosures for headend or fiber node applications. Environmentally controlled aluminum outdoor enclosures provide safe, clean, cost-effective alternatives for mounting any electronic equipment in either streetside or rooftop applications, according to the company. Each unit can be custom made to your specific needs or you can choose one of many styles already available. **Reader service #205**

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points for the smaller pockets. These high level multi-output SAIIs then feed the subscriber taps. As smaller serving areas become necessary, fiber may easily migrate to the next Mini-Star express amplifier location. The 750 MHz SAII is then converted to an integrated fiber receiver and amplifier by replacing the lid with a new lid containing the company's optical receiver. This upgradability with no resplicing make the 750 MHz receiver and amplifier a very cost-effective package.

According to the company, the Mini-Star architecture improves network reliability through 30% lower active device counts and subscriber tap placement downstream of amplifier paths. The 750 MHz SAII is available in single, dual and triple configurations. The 750 MHz forward intermediate terminating trunk (FITT)/bridger module drops into a slimline trunk housing to provide a 300 to 750 MHz upgrade path. The 750 MHz line extender and 750 MHz taps and passives also are available.

The Model 6920 fiber receiver features: 1.5 GHz bandwidth platform; simplified bandwidth expansion using the reversible signal flow feature of the SA II; provides platform for advanced system monitoring, reverse video and wave division multiplexing; and dual fiber cable inputs to accommodate RF switching of redundant fiber routes.

Also introduced were 1 GHz taps and passives to accommodate future bandwidth requirements. The new taps and passives are backwards-compatible, are said to have excellent insertion loss specifications and also feature S-A's surge resistant circuitry. **Reader service #194 (Mini-Star), #193 (receiver)**

Telecorp Announces New Payment Processor

Telecorp Systems Inc. introduced its new payment processor software that was designed to increase the efficiency of a cable operator's nonpay collections program. The payment processor software package is sold in conjunction with the System 9000 predictive dialer. It automates the collections process, allowing cable operators more control over their collections efforts. The system is the first predictive dialer to offer a cable-specific collections package, according to the company. It automates the steps of making collections calls, thereby increasing collector productivity up to 300%.

The payment processor keeps track of payments received on a daily basis, allowing the predictive dialer to call only those customers who meet the collection manager's criteria. It also tracks all promises to pay and automatically calls back those customers when payments are not received on time. The payment processor reports provide detailed collection information such as promises to pay by collector and which promises resulted in payments received. Unsolicited payments also are tracked separately, allowing collection managers to assess the effectiveness of individual collectors.

The predictive dialer provides outbound call processing for proactive telemarketing, collections and retention. It eliminates the manual steps of making phone calls by automatically dialing phone numbers. It then screens out busies, no answers and disconnected numbers, connecting only answered calls to telemarketers and collectors. Each call is synchronized with an immediate screen display of the customer's information needed to complete the call. **Reader service #195**

Northern Telecom Expands Magellan Broadband Portfolio

The latest addition to the Magellan portfolio of network switching systems, the Magellan Concorde, was announced by Northern Telecom. It will be available on a limited basis during the first half of 1995.

The Magellan Concorde is a 40 gigabit per second backbone ATM network switch that will deliver a wide range of multimedia applications from video to image and data transfer. The product is targeted toward cable, telecommunications and video carriers and provides them with a smooth evolutionary path for network upgrades.

The unit, which is scalable up to 80 gigabits per second and down to 10 gigabits per second, will serve as a network backbone switch capable of delivering multimedia traffic across broadband communication networks reliably and cost-effectively, according to the company. It is said to be designed for flexibility and operational simplicity. It is capable of delivering video, data and voice traffic originating from multiple network sources and operators, and converging on a high-capacity carrier backbone network.

The unit supports standard open inter-

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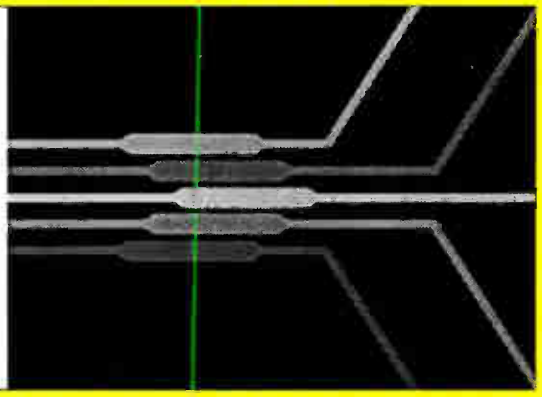

faces including SONET, SDH, CCITT and ATM forum specifications and will allow interworking with other Northern Telecom and third-party products. As with the other members of the Magellan product portfolio, Magellan Concorde incorporates a standard-based traffic and services management capability through Northern Telecom's multiple priority system (MPS). MPS optimizes traffic efficiency based on customer-defined requirements and priorities for specific network applications. It allows network providers to offer flexible pricing for different types, grades and packages of service.

The product joins the Magellan Passport enterprise network switch, announced last March, and the Magellan Gateway network access switch. The Magellan Gateway and Passport products are being deployed in networks today. The company is publicly demonstrating for the first time its Magellan Gateway ATM switch here at the show. **Reader service #191**

General Instrument Rolls Out New Broadband Telco Architecture

General Instrument's Broadband Communications Division unveiled the Broadband Telecommunications Architecture (BTA). According to the company, operators can use this architecture to build an economical system today that can — with only minor modular upgrades — become tomorrow's state-of-the-art interactive system.

The plant is built to 750 MHz using, at the start, mini-bridgers or broadband telecommunications amplifiers. Both products can then be upgraded with modules as node size and service areas change.

According to the company, the architecture is flexible enough to migrate down to 125 homes in a dedicated return and 1,000 homes per transmitter.

Through various modular upgrades the system can support reduced node size and add services such as video-on-demand, telephony, interactivity, data services and other options that might become available. **Reader service #192**

Headend Electronics Center Of Pico Macom Display

Pico Macom Inc. introduced its CATV series line of headend electronics. This line includes the PR-3200 commercial satellite receiver, which is a frequency agile, 70 MHz, phase lock loop receiver. Its companion, the PR-3200 IRD, has been licensed by General Instrument Corp. to meet all VideoCipher RS performance requirements. Both receivers are C-/Ku-band compatible.

The CATV series also includes the M-600 audio and video modulator. The M-600 is a SAW filtered, IF loop through, Chs. 2-62 modulator that is said to provide high stability and superior picture and sound quality, and was specifically designed for adjacent channel headend use.

Also included in the series is the SP-600 heterodyne signal processor, a high gain (70 dB), SAW filtered, low noise, stable signal processor.

Pico Macom also is including as a part of the CATV series the newly designed PDA-1000 1 GHz, broadband distribution amplifier designed to meet the future needs of all SMATV, CATV, TVRO and MMDS systems. **Reader service #178**

New Riser-Bond TDR Has Computer Interface

The new Model 1205 time domain reflectometer was displayed by Riser-Bond Instruments. The unit is low-cost, compact, multi-purpose cable fault locator, designed for field testing all types of metallic paired cables.

The Model 1205 features an RS-232 serial output port for computer interface that allows stored waveforms to be downloaded to a PC for post-storage evaluation and analysis. An exclusive feature of Model 1205 is the automatic and manual dual cursor operation that allows measurement between any two points on the waveform. It will automatically calculate and display return loss measurements and distance to the fault. The 1205 has a large hyper-twist liquid crystal display that provides detailed information of the instrument settings and cable conditions.

The product is designed for field use and is rugged, compact, lightweight and features high precision accuracy. **Reader service #177**

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New Amp, Probe At Sencore

Sencore introduced two accessories designed for its line of signal networks. The RFA275 is a low-noise amplifier that can be used to increase the signal level at drop locations in order to make the FCC required C/N measurement requirements. The RFP274 is an RF probe that can be used to measure signal levels at any passive or active device through any 5/8-inch seizure screw port.

Typical drop levels are 0 to +10 dBmV, which is not enough signal level to make the required C/N measurements to the new 40 dB FCC specification, according to the company. The RFA275 provides an additional 20 dB of gain, raising the signal level and system noise to a level that can be measured with a signal level meter. The unit is powered directly from the SL750s accessory jack.

When troubleshooting the distribution plant, service technicians often need to measure the signal level at a splitter or tap. This has been a difficult operation or only a guestimate using homemade probes or a piece of cable. The RFP274 provides a high impedance probe that can be screwed into a 5/8-inch seizure screw port on most amplifiers and passives. Being high impedance, the probe has virtually no effect on the cable being tested, but provides accurate signal level measurements to better than ±0.5 dB. The probe provides 20 dB of isolation and can be used with any signal level meter or other test equipment. **Reader service #174 (RFA275), #173 (RFP274)**

S-A Heralds Telephony-Over-Cable System

Scientific-Atlanta introduced a system of telephone service delivery products that will enable switched telephone, video, data and interactive TV services to be delivered over broadband cable TV networks. The dual telephone/CATV capabilities will be provided by new cable headend and residential products to be integrated into the company's fiber-to-the-serving area (FSA) hybrid fiber/coaxial broadband system architecture.

The new CoAccess system is designed to be compatible with today's public switched telephone networks, providing a single network for video and telephony services that makes efficient use of the cable TV spectrum. In the product design, telephone services are integrated in a multiline, expandable architecture that requires no additional in-home wiring or equipment, enabling broadband network operators to integrate telephony-over-cable capabilities at a low cost of service.

The technology contained in the CoAccess network is provided by a residential interface unit installed outside the home and includes the broadband telephone signals carried over the network to be terminated at the end of the CATV cable drop and pass through the building as standard two-wire telephone signals. Customers would see virtually no change in the way their video or telephone service operates.

A functional prototype of the CoAccess equipment was on display, but initial shipments of the product in commercial quantities are not expected to begin until the first half of 1994.

The CoAccess headend interface unit is designed to provide the interface to the RF broadband network. It is intended to perform all the functionality for multiplexing and demultiplexing of the digital signals, the interface to a Class 5 switch or other switching device, system and diagnostic functions, and the interface to the operations and provisioning controller.

The CoAccess residential unit is designed to interface the broadband network to the end user's existing telephone equipment. It is intended to provide the subscriber loop functions, analog/digital conversions, RF interface to the broadband network, and performs the multiplexing and demultiplexing of the digital signals.

System benefits include: single network for video and telephony; efficient use of cable spectrum; multiline, expandable; no in-home equipment; no customer power requirement; low cost of service. **Reader service #169**

Cable AML Adds New Transmitters, Repeaters

Cable AML displayed CARS band (12.7 to 13.25 GHz) dual redundant broadband high-power transmitters and repeaters. Designed for maximum hardware redundancy, Cable AML's series "D" (for dual) transmitters and repeaters incorporate manual or remote input switching between dual transmitters as

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Siecor Unveils Optical Power Meter

Siecor Corp. introduced the OM-105F optical power meter specifically designed for applications requiring high-performance optical power measuring. This power meter is a full-wavelength range unit calibrated at the three predominant wavelengths: 850, 1,300 and 1,550 nm. The unit measures optical power through fibers, checks end electronics, and measures power loss through a length of fiber or an installed system.

Offering ±5% accuracy, the unit can be used in demanding precision applications such as cable TV, telephony and others where tenths of a dB are critical, even at temperature extremes, and accurate field measurements made on very high-powered lasers that transmit on a range of +20 to -60 dBm are required.

This compact, lightweight unit was designed with the user in mind. Its features and performance make it well-suited for private premises installation, testing and maintenance, as well as field public network use. It features one-touch selection of relative or absolute power level, a bright backlit LCD, autoranging and an audible tone for quick, easy acceptance checks. **Reader service #163**

Electroline Unveils Amplifier For Upgrades

Operators can now use a new low-noise amplifier to upgrade feeder plant bandwidths without moving line extenders or adding power supplies, according to Electroline Equipment. The new family of distribution amplifiers will be particularly helpful when operators upgrade from 300 MHz or 750 MHz.

Conventionally, an LE or DA requires high input level, on the order of 15-20 dBmV, for example, and also generates a high level output, on the order of 45-50 dBmV, for example. The new Electroline DAs, on the other hand, are designed to work at far lower input levels (as low as 0 dBmV or -6 dBmV, for example) and produce output high enough to feed the tap network at adequate levels. That means an operator conceivably could upgrade a feeder network from 300 MHz to 550 MHz or 750 MHz without adding more power supplies or respacing line extenders.

The unit also could be used as a preamplifier, a gain stage immediately prior to an existing LE, to compensate for the higher signal loss of an extended bandwidth network. They could be used more efficiently within a large apartment building, where a more expensive distribution amplifier might be used.

The new DA features a compact form factor, measuring 4.25" x 3.5" x 1.25". **Reader service #160**

AM Communications Announces Test Generator

AM Communications displayed its 9031 modulator test generator, which is now in full production. The unit is a remote controlled headend device that provides test video signals for measuring a modulator's in-channel flatness. The unit can operate in either a wideband noise mode or a swept carrier mode. The 9031 has output connectors to drive up to eight modulators simultaneously. The video output of the device can be turned on and off automatically under software control so that field measurements of channel flatness can be completely automated. **Reader service #166**

Pico Macom Looks To Future MDU Needs

Pico Macom provided information about its new apartment amplifier designed to meet the future needs of all SMATV, CATV, TVRO and MMDS systems. The PDA-1000 is a low-noise linear distribution amplifier that provides high output with low distortion and noise figures across the 45-1,000 MHz forward bandwidth. The PDA-1000 has a built-in passive return path from 5-30 MHz, and there is an optional plug-in return amplifier module that provides an additional 17 dB gain for the return path signals.

The unit is powered by an internal switchable power supply that can be used in all international power systems. Switchable plug-in power cords are ordered with the amplifiers. The PDA-1000 has been designed for all distribution systems, including large adjacent channel cable TV systems. Built-in slope and tilt controls allow for easy equalization of system signals. The amplifier will maintain a flat response for the entire bandwidth of ±0.75 dB. **Reader service #164**

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General Instrument Unveils 750 MHz Laser Modules

General Instrument introduced its new family of Starblazer 750 MHz laser modules that are built around the 500-channel laser the company introduced last year. A total of 10 products are planned for this family, including five hybrid analog/digital models that load to 550 MHz analog and 750 MHz digital, and five all-analog units to 750 MHz.

The new modules offer variety and flexibility to cable operators wanting to perform such tasks as point-to-point applications, long distance networking and splitting, according to the company.

Also introduced were products that are complementary to these new lasers. The AM 750-ATH transmitter housing, which holds up to two laser modules, has a reduced input level of 15 dBmV input level and is backward compatible with existing lasers. The AM-750ATH's "plug-and-play" features maximize carrier-to-noise and distortion performance while easing operational setup time.

The company also unveiled its 750 MHz fiber mini-bridger (Model AM-MBR/750D-H), offering expanded bandwidth, return path video return and three high level outputs for distribution needs. This product is well suited for cost-effective and flexible fiber/coax networks such as the broadband telecommunications architecture (BTA) and will be a key element in the company's downsizing efforts. **Reader service #159 (laser modules), #158 (housing), #157 (mini-bridger)**

ComSonics Intros Fiber Test Devices For Today, Tomorrow

The new Video Window from ComSonics is said to be a versatile, highly accurate digital video multimeter suitable for meeting today's requirements and preparing the cable industry for the coming 1995 FCC requirements.

Video Window is a hand-held device weighing only 1.7 pounds, yet is said to be a powerhouse of video measuring. With the new instrument, the technician will be able to set up, match and calibrate all his video equipment, and do so in either NTSC and PAL formats. Three major tests include differential gain, differential phase and chromance-to-luminance delay.

All test results, viewable on Video Window's alphanumeric backlit screen can be conducted with repeatable accuracy. It is available with an optional printer/PC interface to assist with in-depth study and analysis at office, lab or headend.

A single-mode modulated laser light source is suitable for multiple system applications. It is designed to inject light into fiber-optic cable. This laser light source is available in two versions — a 1.310 nm model and a 1.550 nm model. And for versatility it can function on NiCad batteries. When it is combined with either the ComSonics optical power meters or FiberLite for WindowLite PLUS, it can be used for end-to-end loss testing of fiber links.

The company also introduced its line of fiber-optic power meters as part of the new generation of test equipment. The meters are rugged, hand-held units that measure the power of light traveling in optical fiber. Test results appear on an easy-to-read LCD. The meters, which make an excellent companion piece for a ComSonics light source, are offered in two styles: A variable meter offering a three-button style that has user-selectable wavelengths — 850, 1,310 and 1,550 nm. ComSonics says it is excellent at obtain-

Hughes Exhibits Streetcrosser

Hughes is exhibiting the new Streetcrosser, specifically designed and manufactured to interconnect noncontiguous properties and increase subscriber count. The Streetcrosser system transmits high-quality signals over short distances to cross streets, freeways, rivers, streams or ravines.

Designed for short haul microwave requirements, the system has the availability to transmit 72 analog or hundreds of digital signals over distances of up to 3,200 feet. With the availability of four compact models, the Streetcrosser is a very cost-effective system for educational or corporate signal trunking and distribution applications, according to the company. **Reader service #162**

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ing end-to-end loss results, cable acceptance testing, and is well suited for CATV applications. Its measurement range is +20 to -40 dBm it and can be used during splicing and connectorization. The dual power meter measures at 1.310 and 1.550 nm and is controlled by a two-way switch. It is said to be a hard-working diagnostic tool when used during connectorization and other fiber-optic service activities.

FiberLite, the company's latest addition of test equipment, incorporates the convenience of modularity. The quick connect/disconnect feature allows attachment to the host WindowLite PLUS, permitting the user a choice of test functions: the signal level meter functions or fiber-optic power meter function. While attached, FiberLite relies on the WindowLite PLUS for its computing power and power display.

Through its built-in photo detector, the FiberLite module allows the technician to accurately measure the absolute power of optical light traveling through the system. User options are selectable and controlled through the use of the softkey pads on the face of the WindowLite PLUS.

The back reflection laser light source can measure the optical return loss in fiber cable. Using their company's power meter, a technician need only connect the back reflection laser light source to the system under test, read the meter and subtract two numbers to evaluate a system. Optical power output of the unit is -10 dBM minimum and -7 dBm typical.

The GeoSNIFFER employs what the company says is the latest in cable system leakage detection technology. It will survey an entire system for leakage trouble spots while the field technicians roam the plant, accomplishing their normal installation and repair duties.

GeoSNIFFER is based on global positioning system technology. It is mounted in the technician's vehicle, which also is equipped with a GPS antenna. A GPS receiver records positional data as the technician moves about the system. Then, at the end of the day, collected data can be downloaded into any PC equipped with mapping software. **Reader service #153 (Video Window), #152 (power meters), #151, #150 (FiberLite), #149 (GeoSNIFFER)**

Automate Your Headend With S-A And Superior

Scientific-Atlanta Headend Division and Superior Electronics Group have joined forces to provide a highly advanced method of automation for cable TV headends. By combining the features of S-A's Headend Managert and SEG's Cheetah headend monitor, the result is a computerized monitoring system that can automatically detect and backup malfunctioning CATV channels without the need for any human intervention at the headend. Neither system loses any of the features already offered by each company's product with the combined benefits being a highly advanced automation tool for the headend operator.

Headend channel redundancy provides one (or more) backup networks that can automatically replace defective channels with redundant equipment and instantly restore the lost channels to their original backup position. Headend Manager provides channel redundancy and backup 24 hours per day. The Cheetah headend monitor provides frequency and level measurements on both visual and aural carriers.

Dual package provides a constantly scanning monitoring system that will automatically detect and replace a defective or marginal channel without the immediate need to roll a truck or provide around-the-clock personnel on site.

Headend status monitoring provides a method of scanning equipment and signal requirements that come together to make the combined headend output. Abnormalities in picture quality would be reported to the headend operator via remote computer interface.

The product provides status monitoring of S-A hardware equipped with the status monitoring and control bus interface (SMC).

Dual package offers the on-site and remote operator a more complete picture of trouble (both cause and solution), thereby providing options previously unavailable without being on site with extensive test equipment. Estimated commercial availability of this combined product is April 1994. **Reader service #147**

Power Guard Shares The Secret To A Longer Life

Power Guard showed its newly designed standby power supply with a unique battery compartment designed to extend battery life. The supply measures 9"W x 11"D x 56"H, and is mounted on an underground vault that contains the

batteries. This configuration allows for much cooler battery temperatures thus increasing battery life substantially, according to the company. The supply uses the same modules that are utilized in other Power Guard power supplies.

The system has a built-in breaker box that comes prewired from the factory, and access is gained by way of a hinged vault top that swings open. The pedestal housing attaches to the lid of the vault and remains stationary. **Reader service #161**

Cabil Corp. Offers New PPV Solution

Cabil Corp. offerred a proprietary pay-per-view order-taking, billing and support service for hotel applications that allows cable TV systems to use standard addressable converters to provide Playboy TV and other PPV programming in nonregulated hotels, motels and resorts within cable franchise areas. The service, which features direct credit card billing for PPV purchases, requires no special capital equipment or investment by the cable system, other than their preferred brand of converter. The Cabil Corp. system is compatible with: Jerrold, Scientific-Atlanta, Pioneer and other major manufacturers' addressable systems.

In each addressable system, Cabil Corp. will install a local computer control unit at the system office or headend, at no cost to the operator, where it is directly ported to the system's existing addressable controller. Cabil Corp. thereafter provides all support and delivery services automatically, including order-taking, credit card processing, PPV delivery instructions to the system controller, and confirmation of PPV order acceptance.

The entire order process typically takes 35 to 45 seconds, and PPV revenues are then directly deposited to the cable operator's bank account within a few days. For its turnkey services, and the use of its computer system, Cabil Corp. receives a transaction fee, which also covers all credit card processing charges, fees, assessments and other bank and service charges. **Reader service #156**

Virtual Recorder Makes Digital Spot Insertion Affordable

ASC Audio Video Corp. says it has devised the ideal method for economically automating spot insertion. The new Virtual Recorder is the first digital, direct replacement for videotape recorders and laser disk machines. Hundreds of commercial spots can be loaded onto a single VR and accessed instantly.

Compared to conventional VTRs, the VR offers numerous advantages for spot insertion. Because the VR is random access, spots can be instantly retrieved in any order — a big improvement over the real-time process required to reorder spots on videotape. While VTRs were often required for a typical two-minute break (four 30-second spots) one Virtual Recorder can now handle the entire job. Furthermore, the completely electronic VR requires much less maintenance than electro-mechanical videotape machines. **Reader service #148**

ALS Enhancer DV6000 Digital Regional Networking System

American Lightwave Systems announced two enhancements to its high-speed digital regional networking system, the DV6000. The first is a new video carrier encoder/decoder card pair that allows RF scrambled signals to be encoded and transmitted from a master headend to multiple remote headends.

The DV6000 can now carry every major video format currently in use or proposed by the CATV industry. This capability is provided by the DV-6101-CE carrier encoder and DV-6102-CD carrier decoder cards. Each card carries one video and one audio IF carrier channel. The video IF input and output frequencies are 45.75 MHz. Thirty-two channels of scrambled video can be transported on one fiber using two optical wavelengths.

The second announcement in the DV6000 family was a compact, modular frequency agile VSB/AM modulator that can be combined with the DV6000 to create a complete remote headend. The ALM1000 VSB/AM modulator provides high performance in a compact package. Eight modulators can fit into 7 inches of vertical rack space. **Reader service #145 (DV6000), #144 (modulator)**

Digital Future Heats Up At Zenith

The race to develop technology for the 500-channel digital future heated up as Zenith Electronics Corp. expanded the capability of digital cable systems to 1,000 or more channels. →

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Zenith previewed its new digital cable decoder system planned for introduction next year, a decoder expected to be the first to combine world-class digital video compression and 16-level vestigial sideband (16-VSB) digital transmission technologies.

Using MPEG digital video compression technology, the new Zenith decoder will be able to receive as many as 23 movies or nine live video programs (such as sports events), in each 6 MHz channel. The 16-VSB transmission technology, developed as part of Zenith's high definition TV (HDTV) research, also will send two digital HDTV signals on a single 6 MHz analog cable channel. **Reader service #146**

EMI To Offer Info Net Access Through Cable

EMI Communications Corp. announced plans to provide an information service to cable operators that will give subscribers cost-effective computer access to information networks via their cable. According to Gil Korta, vice president of marketing, the company is currently negotiating test agreements to launch pilot projects in early 1994. It is expecting to offer nationwide system availability in early 1995.

Through EMI's information system, cable subs will be able to connect direct through their cable box to Internet, the world's largest computer network, as well as government offices, universities and library systems. The company also will help cable operators integrate system-specific local information like school events, bus schedules and local news, weather and sports into the network.

Working in conjunction with a cable operator, the company will provide system integration support to add voice and data capability in existing cable plant structures. Through a technology called Fast Packet Switching, EMI can minimize the number of dedicated lines needed for network support thus decreasing the cost of the service.

The company will provide necessary equipment to cable systems as well as assist them in the design, installation, management and maintenance of the information network. Korta said that the cost of the service to the cable subscriber will be below current network access fees and will be assigned on a system by system basis. **Reader service #142**

Standard Announces New Upgrade Option For Agile

Standard Communications SATCOM Division introduced a new upgrade option for its Agile Omni. Deemed the Omni Global VU (Model CAM830), this new access control module is designed to bridge the gap between the cumbersome multiple menu-driven receivers and simple rotating analog knob receivers for the MT830 Series.

The Omni Global VU upgrade option allows simple menu, front panel control and access to reprogramming of all of the Omni's functions. As an added benefit, a host of new expanded features is available in both manual and remote control operations.

The upgrade is compatible with all Agile Omni Broadcast and International Broadcast receivers (MT830/830I). The module is designed to be field-retrofitted in existing Omni Broadcast installations or installed as a factory-ordered accessory.

The Omni Global VU permits an unlimited number of user-definable satellite formats (memory space permitting), complete control of all three audio subcarrier demodulators and control of international video formats (PAL, SECAM and NTSC). The front panel of the new module replaces the CAD800C and CAD800B front panels. Control is provided by the CAM830. RS422 and RS232C protocols are supported without external adapters. **Reader service #141**

Ipitek Pushes Power Of Fiber Optics

Ipitek announced a new line of CATV laser transmitters for use in its FiberTrunk system. The new laser transmitters have optical output power of up to 1 mW with a transmission bandwidth of 900 MHz.

The high optical output power and wide bandwidth of these transmitters allow transport of up to 100 video channels over an optical line budget in excess of 15 dB.

Ipitek also introduced a 10-bit digital video multichannel codec. The IM-TRAN system delivers short-haul RS 2500 video at any distance with one to 20 channels per fiber. **Reader service #155 (transmitters), #154 (codec)**

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General Instrument Provides LinX To Interactivity

General Instrument unveiled its Jerrold LinX module, the connection to drive cable's interactive programming, and the CompuVerter, into which it will be placed. In addition, it will demonstrate a variety of potential services that can be driven by LinX.

The first CompuVerters will be extensions of GI's existing analog addressable product lines. When the LinX module is inserted into these units, they will assume CompuVerter status. Later next year, the company will provide this same module for the DigiCable digital compression units, offering still more services via digital compression and LinX strength.

GI also demonstrated new headend products designed to help cable operators keep pace with the rapidly evolving technology environment. The Jerrold Commander 6 modulator (Model C6M-II) is the most highly advanced headend modulator available today, according to the company, now with capabilities of signal processing up to 1 GHz. **Reader service #140 (module), #139 (headend products)**

DROPAmp Production Run Increased

Electroline Equipment Inc. displayed its new DROPAmp subscriber amplifier, featuring an exceptionally low 3 dB noise figure, which is used to boost signal levels for homes with numerous outlets, multiple TV sets, VCRs and other devices connected to the drop or for situations where an extra-long drop is encountered. The unit provides 15 dB output and 23 dBmV output per channel for 155 channels, and as many as four separate in-home cables can be connected to it.

DROPAmp can be powered either from inside the customer's home, using a plug-in adapter, or from the drop. It also offers an optional signal return path with the addition of one filter, and comes in a zinc die-cast housing. DROPAmp offers 60 dB CSO and -60 dB cross-mod. Output across all 50 channels is flat. The amplifier comes in four versions, featuring one, two, three or four outputs. It measures 4.5" x 3.5" x 1.25", including the F-connector ports. **Reader service #136**

Demodulator System Unveiled At Tektronix

In response to customer demand for cable-specific demodulation gear economical enough to place in multiple locations, Tektronix rolled out its DS12000 demodulator system. The system delivers tunable downconversion plus measurement-quality synchronous demodulation at about half the price of products made for broadcast applications, according to the company.

The DS1200 demodulator system consists of two instruments. The TDC5 tunable down converter provides coverage of all frequencies from 47 MHz to 860 MHz. A unique gain control system automatically evaluates incoming signals to determine the ideal compromise between optimal signal-to-noise intermodulation distortion. The TDMS TV demodulator supports numerous RF and baseband measurements, including the four-key FCC tests. **Reader service #180**

EON Unveils New Consumer On-Screen Graphics For Interactive TV

After seven years of research and development, EON Corp. (formerly known as TV Answer) unveiled the on-screen graphics package that consumers will see with its interactive TV service.

EON featured its new, full-color graphics design in product demonstrations. The graphics were included in EON's demonstration of its home version of QB1 and the TV quiz show, Jeopardy.

EON plans to introduce its interactive TV nationally in mid-1994. The timetables for the roll-out will be determined in part by the FCC, which must issue licenses for Interactive Video and Data Services (IVDS) before EON's technology can be introduced locally. **Reader service #143**

Porta Organizes Fiber Tangle

Porta Systems announced an array of products designed specifically for the needs of the cable TV industry. These new products, as well as Porta's existing CATV product line, provide a complete passive network that is modular, easy to install and allows for logical future upgrades, the company says.

The new products include the Horizontal Unirack, the CSM-192 and RSM-298. The Horizontal Unirack is 3.47" (h) x 16.5" (w) x 12" (d) and can be mounted in either a 19- or 23-inch rack. Each Unirack is capable of handling four Porta-6-pack modules. Each of these modules is capable of holding splitters with up to six output ports. The input lead can be supplied with a Porta connector to mate with the transmitter's connector adapter or with protected jacketing for routing to an area for fusion splicing. The unit is supplied with a hinged front cover for added protection. **Reader service #135**

Harmonic Lightwaves Demos New Fiber Transmitter

Harmonic Lightwaves introduced the PWPLink DFB transmitter for use in short links, local distributor and high density newscasting applications. The PWPLink complements the company's product line, which includes the YAGLink system and the NMS 500 network management system. Up to five DFB modules can be accommodated within a compact 5-1/4" high rack-mount housing. The HLT-4000 series housing also incorporates a convenient alphanumeric display allowing simplified setup and local monitoring. Performance for the PWPLink ranges from 9 dB to 13 dB optical budgets providing an end-of-line C/N of +51 with CTB of -67 dBc and CSO of 63 dBc. Availability is scheduled for the first quarter 1994. **Reader service #137**

Cable AML Offers New Test Equipment Package

Cable AML showed an integrated low-cost test equipment package. The WR75TK was designed to allow CARS band (12.7 to 13.25 GHz) users to verify transmitter, receiver and system performance and to perform on-site diagnostics and troubleshooting. The test equipment package also facilitates compliance with FCC verification requirements by providing frequency and power measurement capabilities. **Reader service #138**

Channelmatic Intros Audio Level Control Module

Channelmatic Inc. demonstrated its new audio level control (ALC-3001) module. This control module incorporates state-of-the-art circuitry to provide high-performance automatic signal level control while additionally improving the overall sound quality.

Featuring 10 DIP switch selectable attach and recovery time periods, the ALC can be custom configured to match the audio characteristics of different network programming. The company says the unit is economically priced and compact in size, offering 24 channels of audio control that require only two rack units of physical space at a cost of about $300 per channel. The modular design of the rack frame also incorporates an automatic bypass relay when a module is removed. **Reader service #135**

Amplifying With Viewsonics

Viewsonics announced a line of miniature broadband amplifiers with a frequency range of 45 MHz to 1 GHz.

The single output 10 dB gain mini amp uses the company's traditional small pattern two-way splitter housing. The two-output 10 dB gain mini amp uses the 3/4-way splitter housing. The four-output 10 dB gain and the single output 20 dB gain mini amps are housed in a slightly larger version. Ports are parallel to the mounting surface on all models.

All amps can be either standard power type or power insertion and come with the patent pending plug-in adapter. This adapter utilizes F-connected power feeding and is available in 110 and 220 V versions. **Reader service #134**

INTERNATIONAL CABLE Magazine

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BACK TO BASICS

The training and educational supplement to Communications Technology magazine.

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The ins and outs of the time domain reflectometer. By Riser-Bonds Walter "Duff" Campbell.

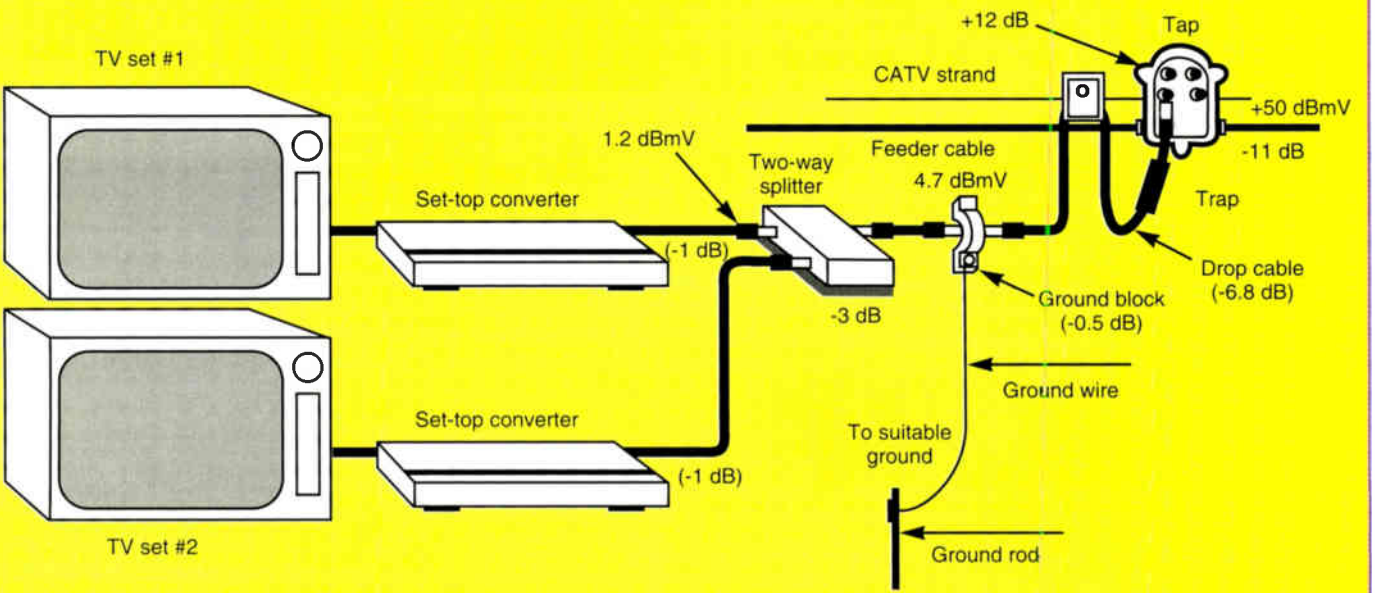
SLM troubleshooting 88

Jack Webb of Sencore offers a hands-on introduction to the use of signal level meters in drop operation.

Table 3: Troubleshooting guide

Picture problems	Cause	Action/solution
Snow (all channels)		
Low signal levels	Open in drop	Use meter to troubleshoot the drop. Loose connector, dielectric left on center conductor or short center conductor.
	Short in drop	Use meter to troubleshoot the drop. Look for fasteners through cable.
	Bad cable	Use meter to troubleshoot the drop. Look for low levels or lost signal in the cable.
	Bad traps	Measure signal level through traps. Measure at high, low, mid and adjacent channels.
	Bad splitters	Measure signal levels through splitter. Terminate all unused legs.
	Bad balun	Replace balun.
	Bad connector	Use meter to troubleshoot the drop. Fix/replace connector.
	Bad tap	Use RF probe to measure signal levels low at tap port, but good at tap RF input. (Use same value.)
	Bad converter	Check AC power. Swap converter or troubleshoot with test TV set.
	System problem	Signals measure low back to tap, or noise is confirmed with test TV monitor at the tap. Notify supervisor.
	Bad TV set	Signal levels are measured good through the drop and confirmed with a test TV monitor. Also, check input connection to TV set, A/B switch, video game adapter, and VCR connections. Eliminate all to verify TV operation.
Intermittent snow	Open in drop	Use meter to troubleshoot the drop. Loose connector, dielectric left on center conductor or short center conductor.
	Short in drop	Use meter to troubleshoot the drop. Look for fasteners through cable.
	Bad connector	Use meter to troubleshoot the drop. Fix/replace connector.
Snow (low channels)	Open in drop	Use meter to troubleshoot the drop. Loose connector, dielectric left on center conductor or short center conductor. Levels will be good at high channels and low at low channels.
	Bad splitters	Measure signal levels through splitter. Terminate all unused legs.
	Bad balun	Replace balun. Balun may be for lower bandwidth system.
Snow (high channels)	Bad cable	Use meter to troubleshoot the drop. Look for water ingress in cable. Frequency response of cable is worse than expected.
	Bad splitters	Measure signal levels through splitter. Terminate all legs. Splitter may be for lower bandwidth system.
	Bad balun	Measure signal levels through balun. Loss 3 dB per balun. Balun may be for lower bandwidth system.
Ghosting	Ingress	Test at tap with test TV monitor, or check drop for loose connector, damaged cable, broken ground, bad balun or "creative customer wiring."
	Direct pickup	If good with a converter, but not with cable-ready set, problem is TV set. Must use a converter. If bad at the tap, notify your supervisor.
Co-channel	Ingress	Test at tap with test TV monitor, or check drop for loose connector, damaged cable, broken ground, bad balun or "creative customer wiring."
	Direct pickup	If good with a converter, but not with cable-ready set, problem is TV set. Must use a converter. If bad at the tap, notify your supervisor. If bad at the tap, notify your supervisor.
White Flash ~1/3 line	Test signal	Normal when using high level sweep system. Explain that this is a test signal used to maintain the system.
Vertical line	FM interference	Test at tap with test TV monitor, or check drop for loose connector, damaged cable, broken ground, bad balun or "creative customer wiring."
	Direct pickup	If good with a converter, but not with cable-ready set, problem is direct pickup (TV set). Must use a converter. If not good with converter or bad at the tap, notify your supervisor.
Horizontal bar(s)	System problem	Measure hum with the meter. If greater than 3% report it to your supervisor. If measured < 3% and visible test converter output/IF convert output is OK, TV set may have a problem.
	Bad TV set	Measure hum at converter output, if <3%, TV set may have a problem.
Windshield wiper		Test signal levels with meter. Use RF probe to measure signal levels. If low at tap port, but good at tap RF input, change tap plate to proper value.
	Bad converter	If levels are OK, check converter output with test TV set. If OK, TV set is defective. If not, test without converter or replace the converter.
	Bad TV set	Test converter output with test TV, if OK, TV set may have a problem. (Try reducing input to TV set with in-line pad.)
	System problem	Test the drop with the test TV set, if X-mod is present, it is a system problem; report it to your supervisor.
Herring bone		Test signal levels with meter. Use RF probe to measure signal levels. If low at tap port, but good at tap RF input, change tap plate to proper value.
	Bad converter	If levels are OK, check converter output with test TV set. If OK, TV set is defective. If not OK, test without converter or replace the converter.
	Bad TV set	Test converter output with test TV set, if OK, TV set may have a problem. Adjust fine tuning control or turn on AFT.
	System problem	Test the drop with the test TV set, if herringbone is present, it is a system problem; report it to your supervisor.
Vertical roll		Test signal levels with meter. Use RF probe to measure signal levels. If low at tap port, but good at tap RF input, change tap plate to proper value.
	Bad converter	If levels are OK, check converter output with test TV set. If OK, TV set may have a problem. If not, test without converter or replace the converter.
	Bad TV set	Test converter output with test TV set. If OK, TV set may have a problem. Never adjust customer's TV set.
	System problem	Test the drop with the test TV set, if vertical roll is present, it is a system problem; report it to your supervisor.
Diagonal tearing		Test signal levels with meter. Use RF probe to measure signal levels. If low at tap port, but good at tap RF input, change tap plate to proper value.
	Bad converter	If levels are OK, check converter output with test TV set. If OK, TV set may have a problem. If not, test without converter or replace the converter.
	Bad TV set	Test converter output with test TV set. If OK, TV set may have a problem.
	System problem	Test the drop with the test TV set. If tearing is present, it is a system problem; report it to your supervisor.
Sparkles (single channel)	Over modulation	Test with test TV set. If OK, TV set is defective, otherwise notify your supervisor (headend or system problem).
Contrast/brightness (single channel)	Mod level	Test with test TV set. If OK, TV set may have a problem. Otherwise notify your supervisor (headend or system problem).

Figure 7: Typical installation levels



your levels are significantly different than those predicted, then there may be a fault in the installation. To locate this fault we will use the signal level meter to troubleshoot our installation, starting back through the drop.

Divide and conquer. Move back to the ground block output to check levels and if the levels are good the problem is between the ground block and the wall plate. If not, move to the cable at the input of the ground block. Keep dividing the problem area into half until you get down to the one faulty component. Don't forget our assumptions and loss estimates as you go through the drop components so that you can predict a good signal level reading. If you are using a splitter to provide second outlets, be sure that both legs are terminated by a TV, converter or terminator. An open leg will cause standing waves and erroneous readings on the other leg. (See Figure 7.)

If you have had a problem troubleshooting an installation be sure to double check all of your connections for proper tightness, tags and weather boots, etc. It is very easy to forget these items once you have solved the major fault. For other helpful hints in troubleshooting the drop see Table 3.

Finish the job

Now that you are sure the signal level to the customer is correct you should double check the operation of the TV set(s), the converter and/or the traps, if used. Operate the TV set on all channels viewing the picture quality and listening to the audio, especially those channels adjacent to trapped channels. A faulty trap will not only insufficiently block the trapped channel, but also may trap part of the adjacent channel. You can use your signal level meter to measure the level of the adjacent video and audio carriers. The FCC requires the audio carriers to be 13 to 17 dB down from their respective video carrier. System transmission of the audio carrier should have little effect on this ratio. A problem is usually caused by a faulty trap.

For help in identifying problems in picture quality such as hum, co-channel, X-mod, C/N, ingress, etc., refer to other reference materials for photos and descriptions.

Don't forget to check the remote control for the converter and the power on/power off operation. The least little problem will mean a second truck roll and an unhappy customer. Be sure. Do it right the first time. Proper use of a signal level meter will help you make more installations and more importantly make them all good installations.

It has always been a good practice to equip your service and installation personnel with a fully capable signal level meter, but now with the new focus on customer service, it is more important than ever. **BTB**

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Reader Service Number 61

Making the ups and downs in your life a little safer

By Ralph Haimowitz
Director of Training
Society of Cable Television Engineers

It should not come as a surprise to anyone that the greatest number of accidents in the field are happening on ladders. Improper climbing habits, unsafe footwear and a lack of proper training in handling and using ladders are primary causes (along with just plain carelessness).

Occasionally, a new product comes along that can improve safety in the use of certain equipment. Recently I found out about three items from Independent Technologies Inc. that seem to work well with ladders.

The first two products are called Safe-Tie and Sky Hook. First, let's take a look at the Safe-Tie.

The Safe-Tie was introduced as a ladder safety product in 1986 and there are currently two versions of this product on the market. Model ITC-6003 (Figure 1) secures a ladder to a utility pole or superstructure before climbing and is the most commonly used because it is the quickest and easiest to use. The ITC-6003 has two quick release buckles for rapid setup and take-down. The ITC-6004 (Figure 2) does the same operation as the ITC-6003 except it uses straps around the ladder rail rather than hooks. Key benefits of using the Safe-Tie are:

Figure 1: ITC-6003 Safe-tie

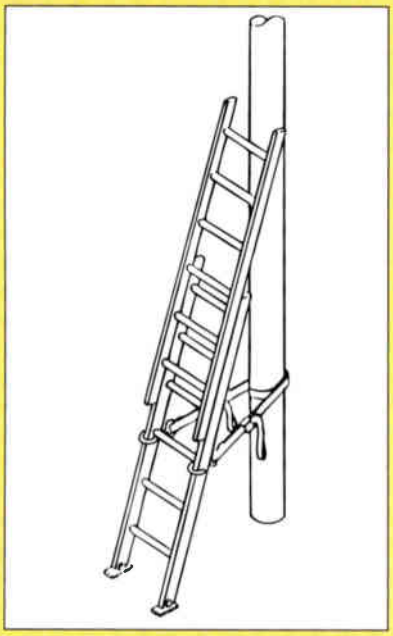


Figure 2: ITC-6004 Safe-Tie

1) Hooks around ladder rails that eliminate the unnecessary loops and ties through the ladder.

2) Buckle-operated unit with spring-loaded buckles that allow for quick disconnect within seconds.

3) Nylon webbing and stitching makes it rated stronger than rope or canvas webbing and is far less susceptible to mildew and rot. Tie systems are rated at 1,500 pounds, which exceeds ladder specifications.

4) International orange color draws the attention of pedestrians to take precaution when near the ladder use location.

5) No special additional equipment or ladder modification is needed to use the product.

6) Most important of all, it reduces the potential for ladder accidents substantially.

The second product is called Sky Hook (Figures 3 and 4) and can either be used as a top-tie for ladders to poles, pipes, pillars, superstructures, etc., or as a strand-tie when working mid-span on cable plant. Sky Hook eliminates twisting of the tie-down unit. It stabilizes itself with weight shifts and may be used with or without strand hooks. It will prevent lateral slide of the ladder on the strand — something that makes it invaluable for the safety of the technician. It allows for increased working reach and will ride out wind, weight

Figure 3: Sky Hook as a top-tie

Figure 4: Sky Hook as a strand-tie

"Improper climbing habits, unsafe footwear and lack of proper training in handling and using ladders are primary causes (of accidents)."

and tension sag. Ease of application is a big plus for this item.

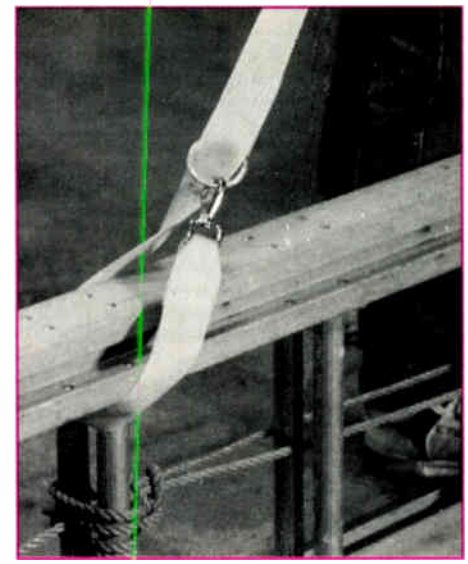
Gordon Baldwin of Times Mirror Cable in California said the Safe-Tie and Sky Hook have proven excellent for their technicians' use with ladders. He feels the products are "the equivalent of safety belts for ladders and excellent for CATV use, particularly when the application is side loading for tools and equipment that needs to be pulled up or lowered down a pole."

The third item is called Ladder Tote and was specially designed to carry ladders that are used throughout the cable industry over long distances, over rough terrain, when footing is poor due to ice, snow, mud, leaves, etc., in congested business or residential areas, or for the smaller, slight-of-build technician. Ladder Tote lightens the load, eases lifting, improves balance and maneuvering, and helps reduce the risks of falling, muscle strain, back pain, fatigue and reduces lost time accidents. Ladder

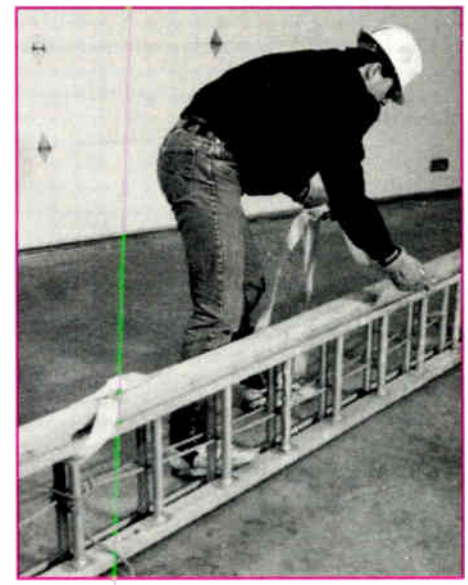
1) Ladder Tote by Independent Technologies in use.

2) Center yourself and the Ladder Tote beside the upright ladder. The adjustable buckle should be on the front end (direction of movement).

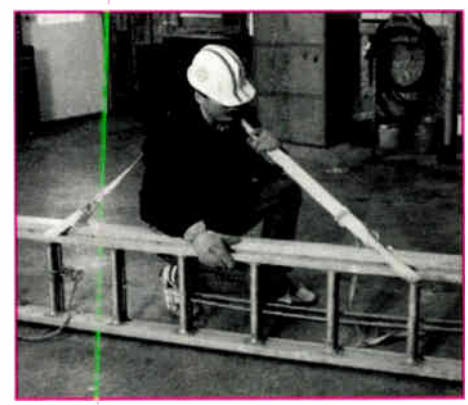
3) Loop one end of the Ladder Tote around the ladder rail and the third rung from the center position.



4) The built-in snap and ring secure Ladder Tote to the ladder.



5) Secure the other end of the Ladder Tote to the ladder rail three rungs from the center position in the opposite direction.



6) The technician places Ladder Tote over his shoulder (away from the ladder).

"The greatest number of accidents in the field are happening on ladders."

Tote was tested by technicians at High Country Cable, a system of Booth American in Boone, NC, and it was found to live up to the manufacturer's claims. (See the accompany series of photos starting on page 95 to see how the product is used.)

This article is not intended as an endorsement of a specific products by the Society of Cable Television Engineers. The sole purpose of this article is to provide information regarding safety material available to help protect the safety, health and welfare of cable system employees who climb ladders in the performance of their jobs.

For additional information on these products call Independent Technologies Inc. at (402) 496-4700. **CT**

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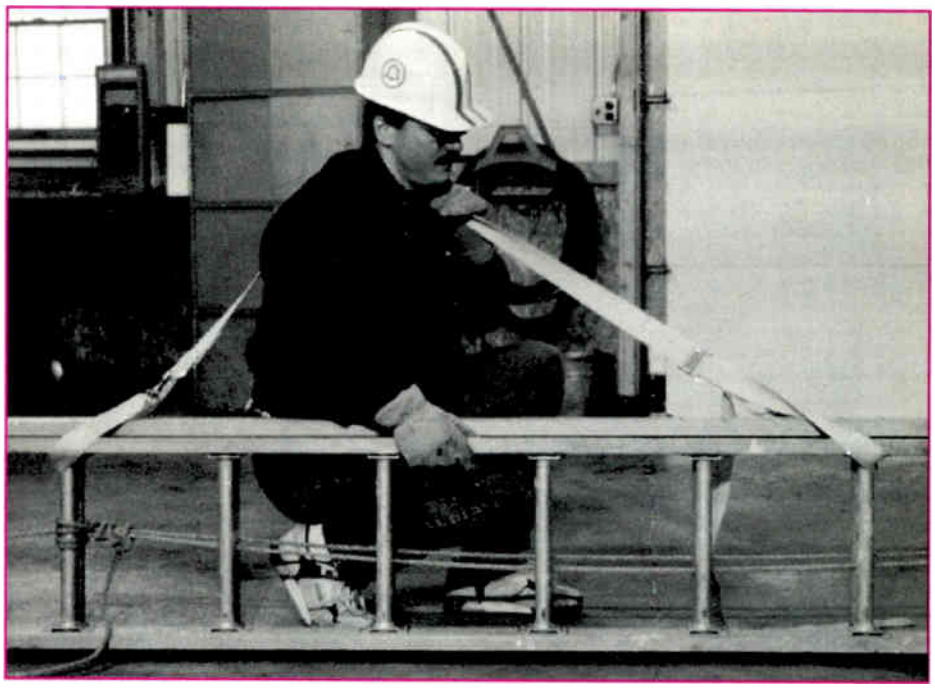
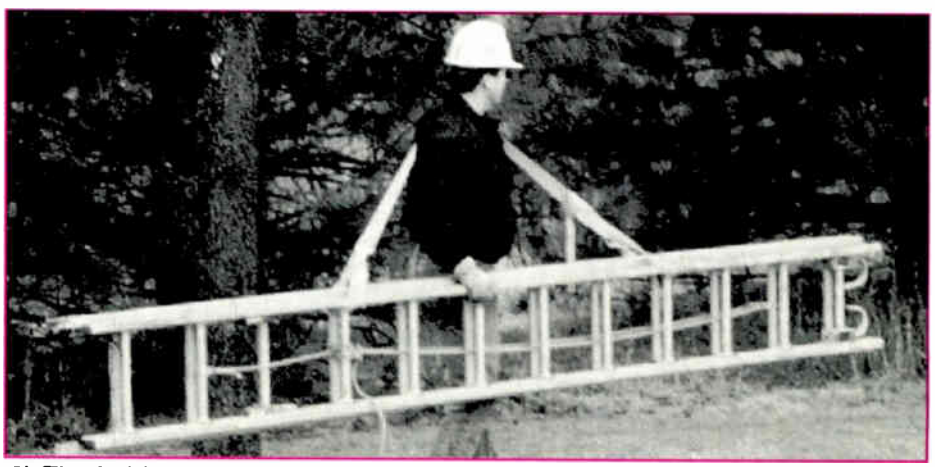


7) Now the tech adjusts the Ladder Tote buckle removing slack until the ladder can be lifted and carried about hip-high.

8) The shoulder pad may have to be adjusted to a comfortable position also.



9) The ladder can now be easily carried and maneuvered in uneven terrain or congested areas.

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15	41	67	93	119	145	171	197	223	249	275	301
16	42	88	94	120	146	172	198	224	250	276	302
17	43	69	95	121	147	173	199	225	251	277	303
18	44	70	96	122	148	174	200	226	252	278	304
19	45	71	97	123	149	175	201	227	253	279	305
20	46	72	98	124	150	176	202	228	254	280	306
21	47	73	99	125	151	177	203	229	255	281	307
22	48	74	100	126	152	178	204	230	256	282	308
23	49	75	101	127	153	179	205	231	257	283	309
24	50	76	102	128	154	180	206	232	258	284	310
25	51	77	103	129	155	181	207	233	259	285	311
26	52	78	104	130	156	182	208	234	260	286	312

A. Are you a member of the SCTE (Society of Cable Television Engineers)?

01. ___ yes
02. ___ no

B. Please check the category that best describes your firm's primary business (check only 1):

Cable TV Systems Operations
03. ___ Independent Cable TV Syst.
04. ___ MSO (two or more Cable TV Systems)
05. ___ Cable TV Contractor
06. ___ Cable TV Program Network
07. ___ SMATV or DBS Operator
08. ___ MDS, STV or LPTV Operator
09. ___ Microwave or Telephone Comp.
10. ___ Commercial TV Broadcaster
11. ___ Cable TV Component Manufacturer
12. ___ Other (please specify)_____

C. Please check the category that best describes your job title:

13. ___ Corporate Management
14. ___ Management
15. ___ Programming

Technical/Engineering
16. ___ Vice President
17. ___ Director
18. ___ Manager
19. ___ Engineer
20. ___ Technician
21. ___ Installer
22. ___ Sales/Marketing
23. ___ Other (please specify)_____

D. In the next 12 months, what cable equipment do you plan to buy?

24. ___ Amplifiers
25. ___ Antennas
26. ___ CATV Passive Equipment including Coaxial Cable
27. ___ Cable Tools
28. ___ CAD Software, Mapping
29. ___ Commercial Insertion/ Character Generator
30. ___ Compression/Digital Equip.
31. ___ Computer Equipment
32. ___ Connectors
33. ___ Converters
34. ___ Controllers
35. ___ Fleet Management
36. ___ Headend Equipment
37. ___ Interactive Software
38. ___ Lightning Protection
39. ___ Vaults/Pedestals
40. ___ MMDS Transmission Equipment
41. ___ Microwave Equipment
42. ___ Receivers and Modulators
43. ___ Safety Equipment
44. ___ Satellite Equipment
45. ___ Splitters
46. ___ Subscriber/Addressable Security Equipment/Remotes
47. ___ Telephone/PCS Equipment
48. ___ Power Supplies. (Batteries, etc.)
49. ___ VideoCiphers
50. ___ Video Servers

E. What is your annual cable equipment expenditures?

51. ___ up to $50,000
52. ___ $50,001 to $100,000
53. ___ $100,001 to $250,000
54. ___ over $250,000

F. In the next 12 months, what fiber-optic equipment do you plan to buy?

55. ___ Fiber-Optic Amplifiers
56. ___ Fiber-Optic Connectors
57. ___ Fiber-Optic Couplers/Splitters
58. ___ Fiber-Optic Splicers
59. ___ Fiber-Optic Transmitter/Receiver
60. ___ Fiber-Optic Patchcords/ Pigtails
61. ___ Fiber-Optic Components
62. ___ Fiber-Optic Cable
63. ___ Fiber-Optic Closures & Cabinets

G. What is your annual fiber-optic equipment expenditures?

64. ___ up to $50,000
65. ___ $50,001 to $100,000
66. ___ $100,001 to $250,000
67. ___ over $250,000

H. In the next 12 months, what cable test & measurement equipment do you plan to buy?

68. ___ Audio Test Equipment
69. ___ Cable Fault Locators
70. ___ Fiber Optics Test Equipment
71. ___ Leakage Detection
72. ___ OTDRs
73. ___ Oscillators
74. ___ Power Meter
75. ___ Service Monitors
76. ___ Signal Level Meters
77. ___ Spectrum Analyzers
78. ___ Status Monitoring
79. ___ System Bench Sweep
80. ___ TDRs
81. ___ Video Test Equipment

I. What is your annual cable test & measurement equipment expenditures?

82. ___ up to $50,000
83. ___ $50,001 to $100,000
84. ___ $100,001 to $250,000
85. ___ over $250,000

J. In the next 12 months, what cable services do you plan to buy?

86. ___ Consulting/Brokerage Services
87. ___ Contracting Services (Construction/Installation)
88. ___ Repair Services
89. ___ Technical Services/ Eng. Design
90. ___ Training Services

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L. Do you plan to rebuild/ upgrade your system in:

95. ___ 1 year
96. ___ more than 2 years

M. How many miles of plant are you upgrading/ rebuilding?

97. ___ up to10 miles
98. ___ 11-30 miles
99. ___ 31 miles or more

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Road to ATV

(Continued from page 54)

liance agreed to a 1,080 active line interlaced presentation with the development of a transition path to 1,080 active line progressive display. The 787/788-line progressive display was retained. The alliance agreed to incorporate "B" frames in the system so it would be MPEG-2 compatible. The spectrum-shaped QAM transmission system was withdrawn from consideration. The Technical Subgroup approved the recommendations of the Grand Alliance and passed the recommendation to the full Advisory Committee for approval. The adoption of full MPEG-2 compliance impacts the schedule and results in the complete system tests being delayed until October 1994. Field tests would follow with final reports in early 1995. The proposed transmission systems will be tested at the test center in January 1994. The Transmission Experts Group of the Technical Subgroup is continuing to investigate coded orthoganal frequency division multiplex (COFDM) transmission. If COFDM proves to be superior to the proposed alliance transmission systems, there could be a further delay while the alliance modifies its system to work with COFDM.

Other potential delays in rolling out a complete system include the following: The transmission system selected needs to be capable of transporting two ATV signals within 6 MHz on a cable system; VCRs must be designed to enable the recording and playback of the ATV signal; and an encryption system has to be developed and incorporated into the design to allow cable operators to secure the signal.

Conclusion

The process of developing an ATV system and adopting a national standard has moved a long way from the appointment of the Advisory Committee in 1987 with significant developments in technology during that period. The development and implementation of the new technologies — while slowing down the process — will result in a superior system. The final decision, while it may not happen until some time in 1995, will be well worth the effort and delays. **CT**

UPS

(Continued from page 50)

tions in an AC-to-DC-to-AC format as shown in the accompanying figure on page 50. It acts like an ordinary inverter operating from a pair of batteries to produce AC, but also has an AC-to-DC converter (better known as a DC power supply) attached to the battery terminals supplying the current necessary to operate the inverter and keep the batteries charged.

When a power failure occurs, the inverter section doesn't even know anything has happened. It just keeps humming merrily along from the current supplied by the batteries that have been floating fully charged across the inverter input. Because there are no relays in this configuration, it is the only type that may properly be called a true on-line UPS.

The trade-off for this type of power supply is less efficiency — something in the order of 20% below a transfer type of standby inverter. But the advantages of complete isolation from the power line and no possibility of transfer glitches surely makes this type of power supply a viable option for critical locations. **CT**

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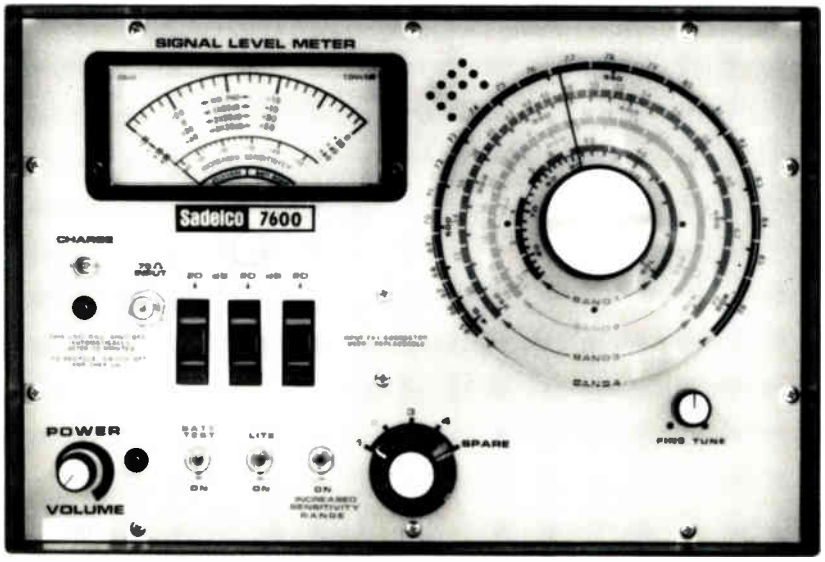

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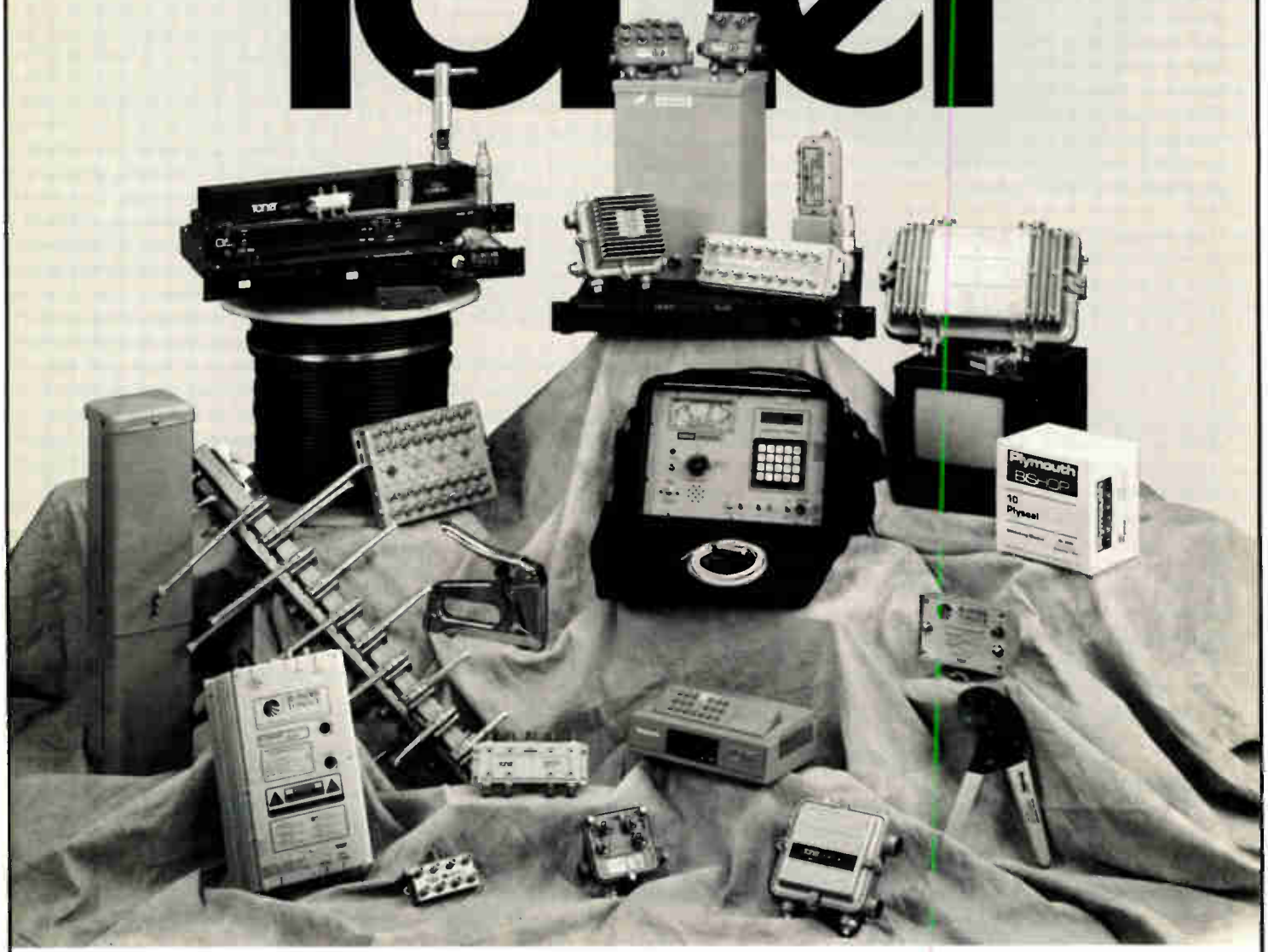

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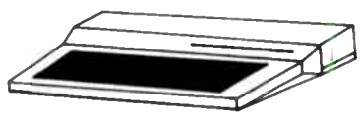

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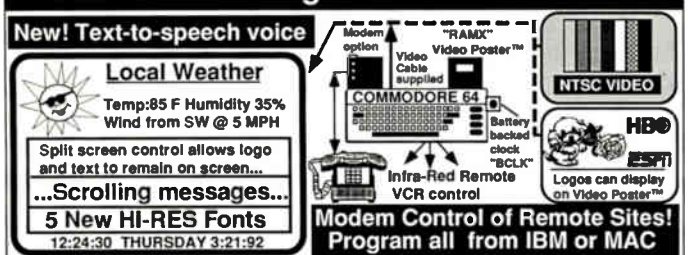

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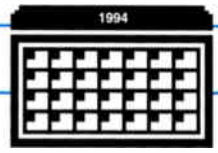

February

14-17: Siecor fiber-optic training course, fiber-optic installation, splicing, maintenance and restoration for cable TV applications, Hickory, NC. Contact (800) SIECOR1.

15-16: Scientific-Atlanta technical training session, 8600 System operation and maintenance (System Manager 10), Atlanta. Contact Bill Brobst, (404) 903-6306.

16-17: SCTE Northern California Vendor's Day, Holiday Inn, Fairfield, CA. Contact Steve Allen, (916) 783-7495

17: SCTE Lake Michigan Chapter seminar, BCT/E certification exams to be administered, Morley, MI. Contact Karen Briggs, (616) 941-3783.

18: SCTE Central New York Meeting Group seminar, Installer certification exams to be administered, Mount Vernon, NY. Contact Vincent Cupples, (315) 452-0709.

18: Hewlett-Packard CATV measurements course, Pittsburgh. Contact (800) 472-5277.

19: SCTE Cactus Chapter seminar, Installer and BCT/E certification exams to be administered, Tucson Cablevision, Tucson, AZ. Contact Harold Mackey, (602) 352-5860, ext. 135.

22: SCTE Desert Chapter seminar, BCT/E and Installer certification exams to be administered, Palm Desert, CA. Contact Greg Williams, (619) 340-1312, ext. 277.

23: SCTE Michiana Chapter seminar. Contact Russ Stickney, (219) 259-8015.

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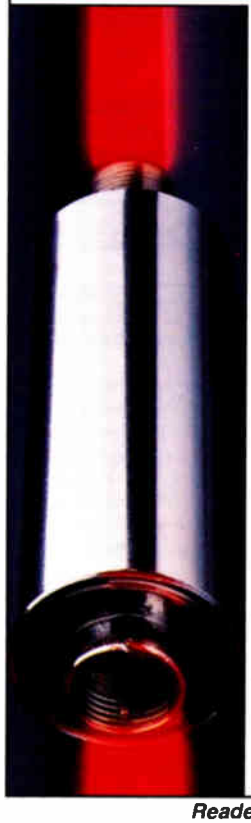

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Planning ahead

April 10-12: CAB, New York. Contact (212) 751-7770.
May 2-5: SuperComm/ICC '94, New Orleans. Contact (312) 782-8597.
May 22-25: The National Show, New Orleans. Contact (202) 775-3669.
June 15-18: SCTE Cable-Tec Expo, St. Louis. Contact (215) 363-6888.

23: SCTE Smokey Mountain Chapter seminar, improving system performance, Days Inn, Kingsport, TN. Contact Roy Tester, (615) 878-5502.
22-24: OFC '94, San Jose, CA. Contact (202) 223-8130.
23: SCTE Smokey Mountain Chapter seminar, improving system performance, Days Inn, Kingsport, TN. Contact Roy Tester, (615) 878-5502.
23-25: The Texas Show, San Antonio Convention Center, San Antonio. Contact Texas Cable TV Association, (512) 474-2082.
23-25: Texas Show '94 Technical Sessions, San Antonio, TX. Contact SCTE national headquarters, (610) 363-6888.
24: Hewlett-Packard CATV Measurements Course, Burlington, MA. Contact (800) 472-5277.
24-25: Scientific-Atlanta technical training session, design consideration and sweep and balance, Atlanta. Contact Bill Brobst, (404) 903-6306.

March

1: Hewlett-Packard CATV measurements course, Paramus, NJ. Contact (800) 472-5277.
1-2: SCTE Upper Valley Chapter seminar, telephony and broadband, Holiday Inn, White River Junction, VT. Contact Chip Winchell, (315) 682-1446.

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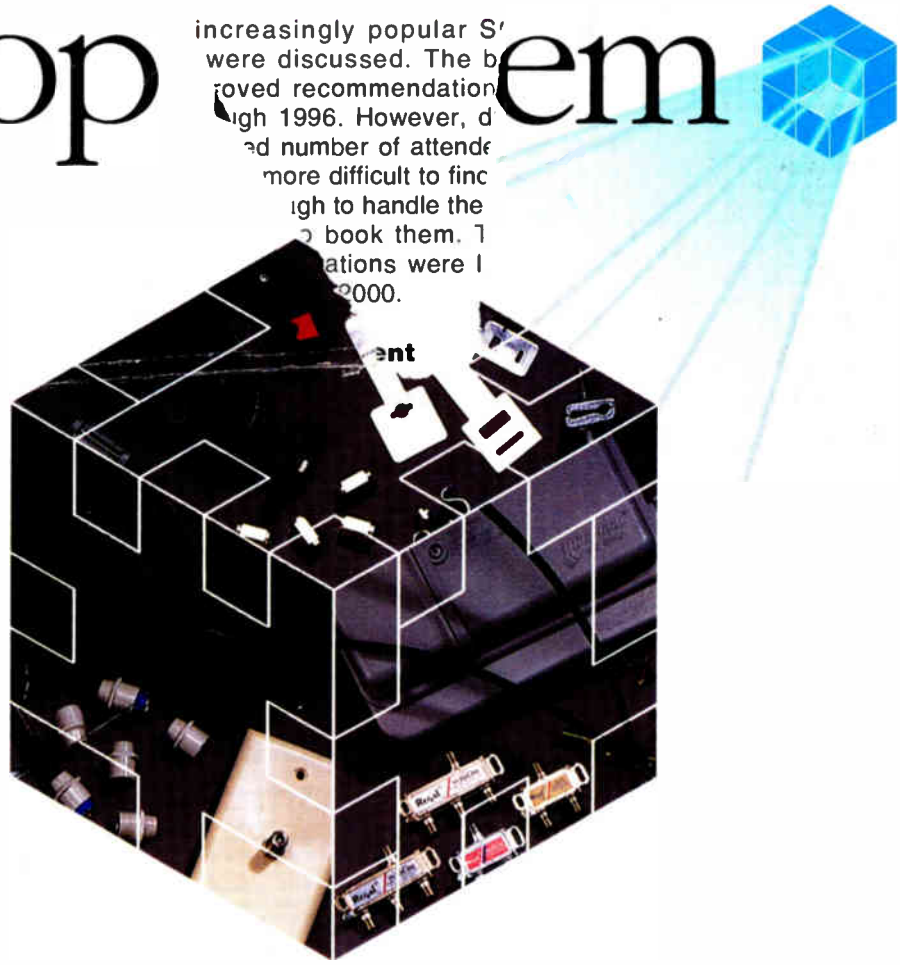

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