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COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

Cable-Tec Expo registration

Analog smoothing VS. transitions digital

Luff's back with "Future Watch"

Enhanced services — Part 2

April 1995

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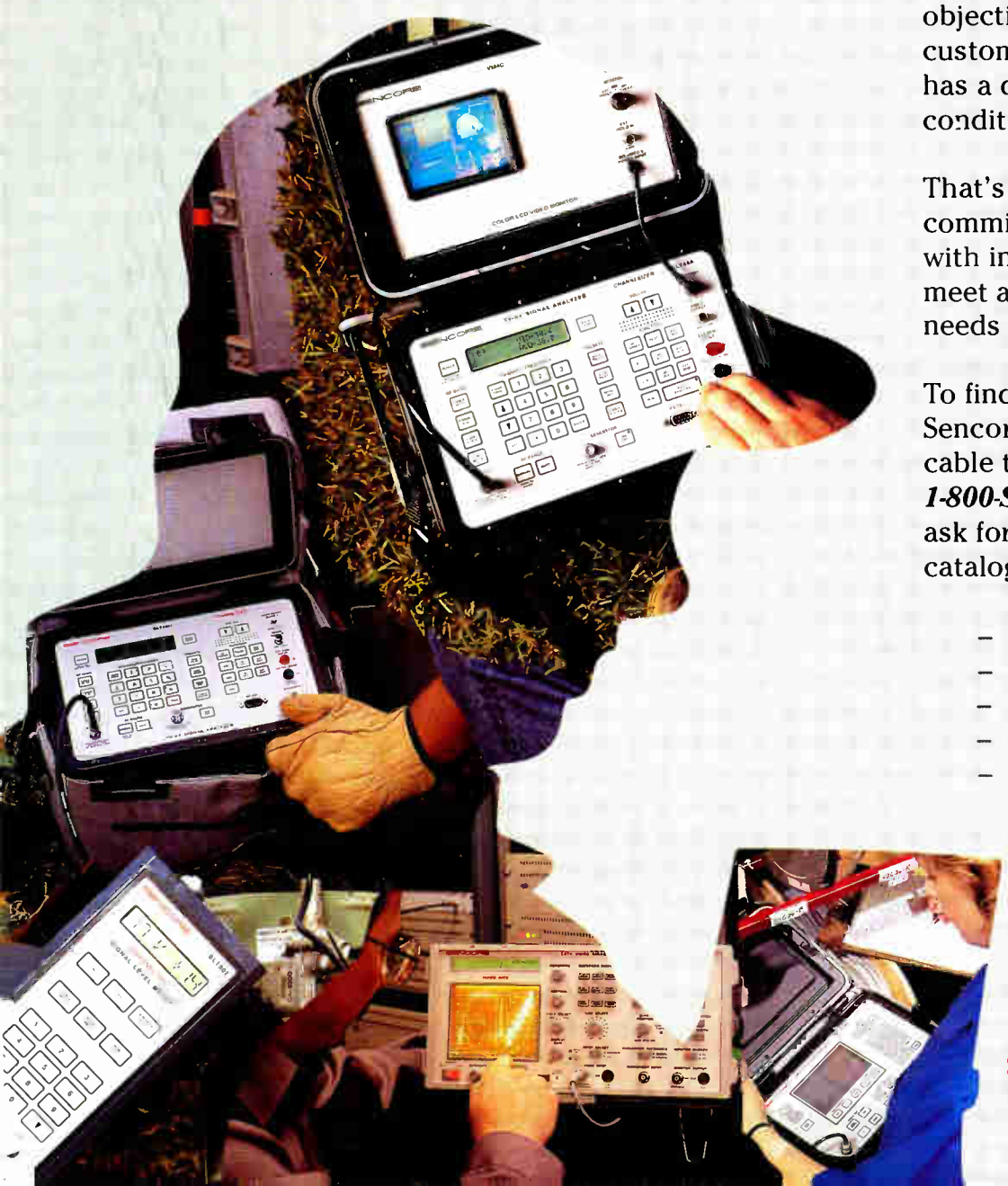

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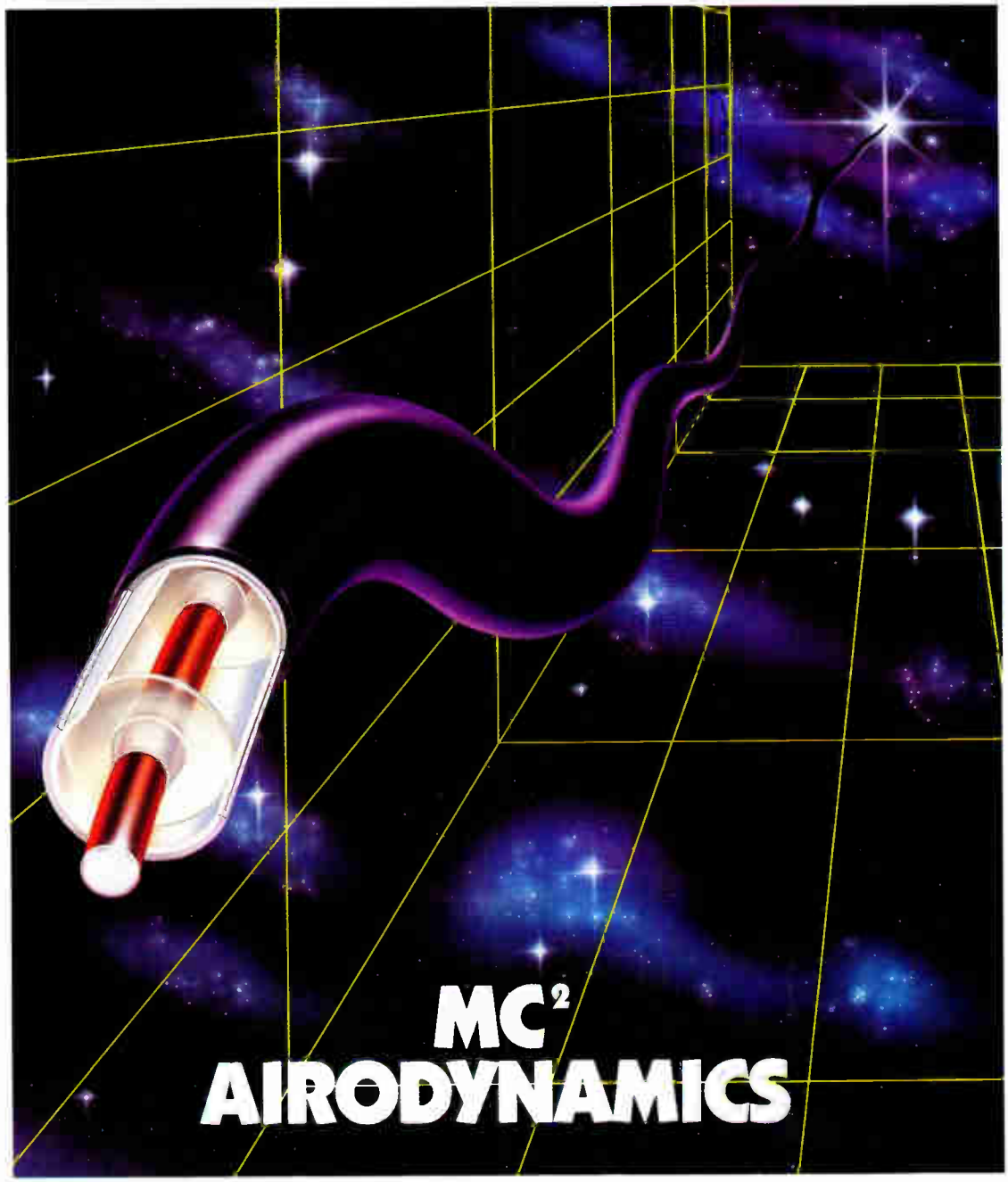

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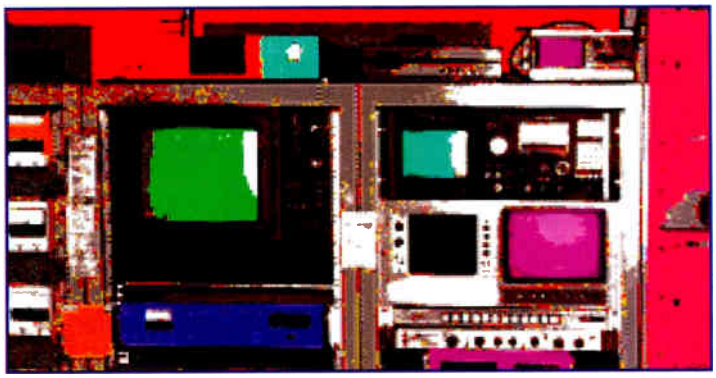
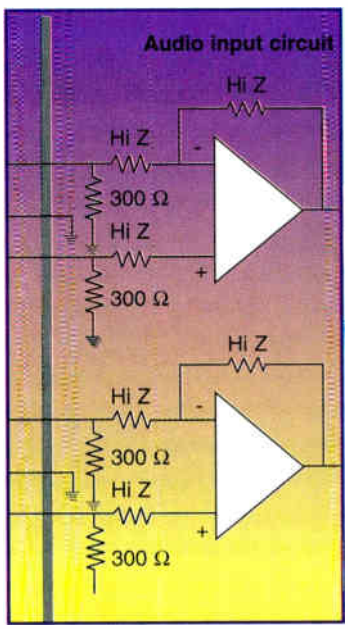
CONTENTS APRIL 1995

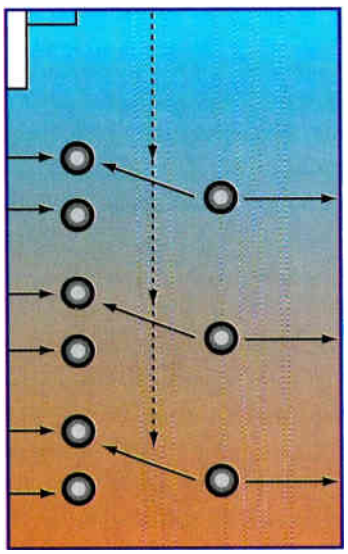
Departments



Management Portfolio 22



Back to Basics 78



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Riser Bond INSTRUMENTS

EDITOR'S LETTER

DirecTv update: Taking it seriously

It's been about six months since I installed DirecTv at my home. During that time I've had a chance to get a pretty good idea about what our competition is up to. Quite frankly, the news is not good. And by now, no doubt, you've seen some of their TV and print advertisements. Not bad for a first year ad budget of $40 million.

First of all, reliability has been far better than I expected. The closest thing to an outage I've seen happened one night during one of those wet, sticky snowstorms. I stayed up until almost midnight switching between the signal strength meter in the setup menu and the pictures themselves, and running upstairs to look out the window and see how much snow was piling up in the 18-inch Ku-band dish. (It uses an offset feed, so the dish surface is nearly vertical.)

The signal strength meter indicated a level that suggested the service was operating very close to threshold. This was evident in the pictures because freeze frames and tiling were happening fairly often. But the service never went out! In contrast, the local cable company lost a handful of channels, likely because of snow buildup in one of its C-band dishes.

It remains to be seen how DirecTv holds up through Colorado's spring/summer thunderstorm season, but I suspect it won't be as bad as originally anticipated.

Picture quality has visibly improved. (It was already pretty good.) Digital artifacts occur much less often than even a few months ago. It appeared as if the compression algorithms had been tweaked a bit, which I confirmed through a satellite industry contact.

Lack of the ability to receive local programming has not been an issue, at least in Denver. The DirecTv receiver has an external TV antenna jack and built-in A/B switch so that the user can switch between DirecTv and a rooftop antenna. Viewers in other markets may not have the over-the-air reception quality that is available in Denver, but lack of "local content" is not always going to be an argument we can use against the service.

The pay-per-view and near-video-on-demand interface is nothing short of outstanding. No calls to customer service representatives, no ARU or ANI. Simply order the desired selection from a very user-friendly on-screen menu. Movies are generally $2.99 each. (The first one each month is only 49 cents because DirecTv includes a $2.50-off coupon with each monthly statement.) By the way, the upstream path is via the telephone line.

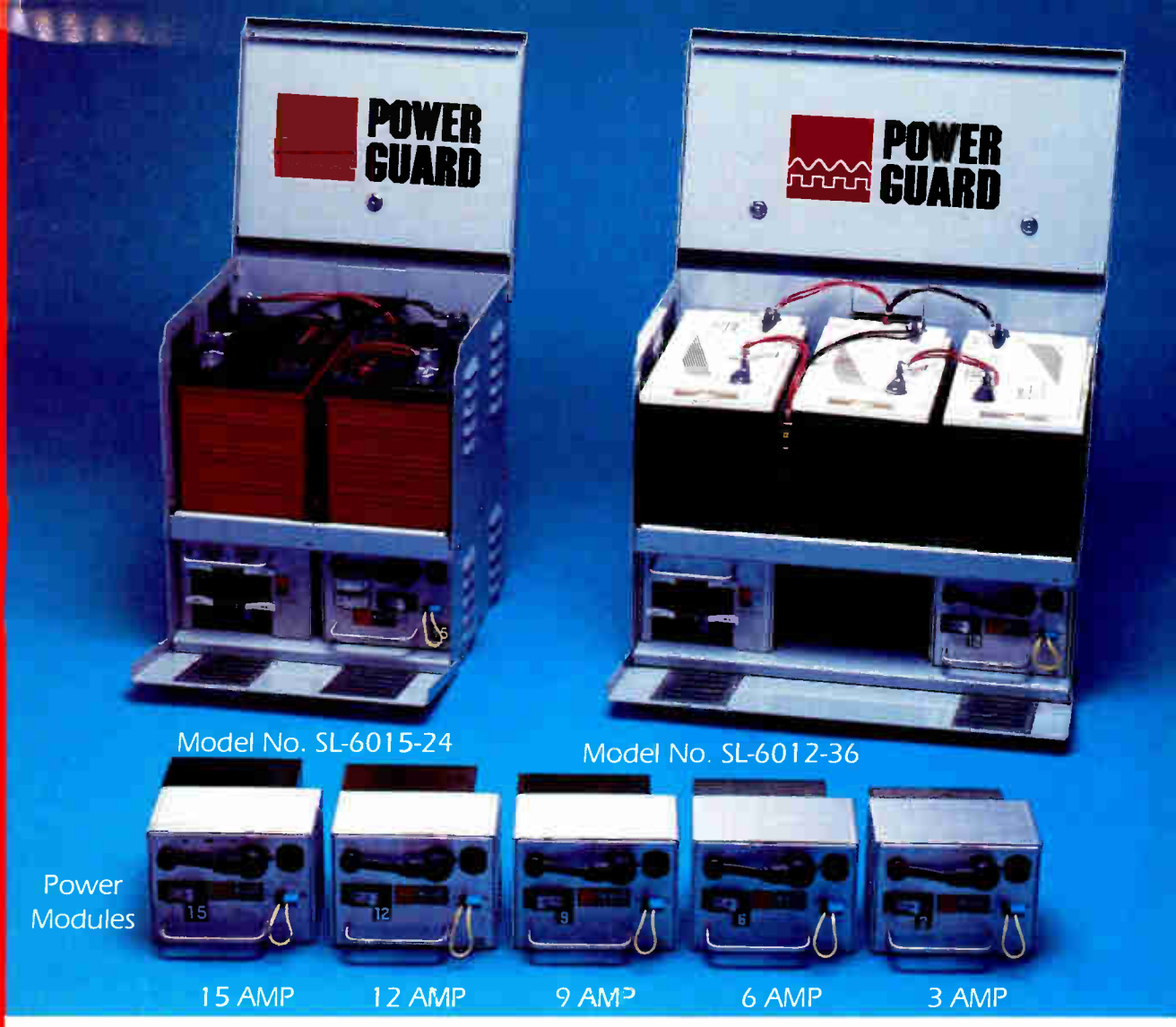
About the time you read this, Sony and others are supposed to begin manufacturing receivers and dishes. You can bet the equipment prices will probably drop, making it even easier for people to afford the cost of signing up for this service.

And in case you didn't hear about it before, a study published around the time of the last Western Show indicated a major reason people were subscribing to DirecTv is because of "superior technical quality." Ouch! And they're reportedly signing up 110,000 new customers per month.

Folks, we had better take these guys *very* seriously.

Ronald J. Hranac
Senior Technical Editor

Power by Design



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Return on investment.

Reader Service Number 13

Decoder meltdown is nation's largest

On Feb. 24, the largest meltdown of illicit cable decoder devices took place in Los Angeles, the culmination of a two-and-a-half year crime fighting effort spearheaded by Continental Cablevision, the Los Angeles Cable Operators Association and the Los Angeles Police Department.

The recovery of the illegal decoders allowed Continental Cablevision to file criminal and civil charges against several cable pirates. As a result, Continental was awarded $2.75 million as part of a judgment against one of the nation's largest suppliers of pirate cable decoders.

The destroyed decoders represent equipment seized by the LAPD in several major raids in June and October 1992, the largest of which netted approximately 70,000 black boxes from the nation's largest wholesale supplier. The street value of the boxes exceeds $20 million; lost revenue to cable operators from use of the 70,000 decoders would have exceeded $200 million.

Ameritech selects S-A interactivity

Ameritech selected Scientific-Atlanta Inc. to provide advanced analog and digital home communications terminals and other systems for its video dial tone network.

The digital terminals will feature real-time graphics/video compositing and video transport, robust graphics, full interactivity and decompression capabilities based upon MPEG global standards. These will be managed by the PowerTV operating system, developed by PowerTV Inc., a majority-owned subsidiary of Scientific-Atlanta.

The digital home terminals will allow Ameritech to provide video-on-demand, games, education, shopping and many other interactive services. The company began building the two-way video network in early February and expects it to be operational in some Midwestern communities in the fourth quarter of this year.

In other news, S-A and Siemens Public Communications Network Group agreed to enter into a joint venture for development and worldwide marketing of telephony-over-cable products. The announcement marks the next step toward implementing the IMMXpress interactive multimedia network architecture.

Dissatisfied: Cable subscribers

A recent survey conducted by *Consumer Reports* magazine portrays cable TV subscribers as one of the most dissatisfied service user groups. Over 25% of the 19,000 surveyed said they were dissatisfied with their service and complained that it did not offer a channel they wanted. Eighty percent said they received more than the basic cable package at an average additional cost of $15 per month. Forty percent said their total bill increased in 1994.

Likewise, a poll of 4,000 households conducted by Odyssey, a market research firm in San Francisco, said 55% of cable TV homes would switch to comparable services delivered by telephone or satellite companies. Only 39% rated their cable provider as "very good." The study also found that cable penetration has slipped to 62.8% from 64.5% in 1993.

Texas Show tech sessions

SCTE sponsored three timely technical sessions at this year's Texas Show, held Feb. 22-24 in San Antonio, TX. The topics were regulation, proof-of-performance testing and telephone technology.

Current activities inside the Beltway were addressed at "Federal Communications Commission/Washington Update,"

STATUS MONITORING

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Reader Service Number 20

moderated by Prime Cable's Dan Pike.

NCTA's Wendell Bailey defended cable's refusal to give up extra bandwidth to a competitor that could be used in the future for data, telephony and other services. As for negotiations with the consumer electronics industry, cable is still seeking infrared pass-through capability to the set-back so it won't be limited by consumer remote technology. Other dealings with EIA are still a wrangle: EIA withdrew from the decoder interface agreement and wants cable to unbundle its decoder/set-top. "But don't talk to them about unbundling their tuner from the TV set!" Bailey said with exasperation.

Ron Parver of the FCC covered the must-carry rule and area of dominant influence (ADI). Stations over 35 miles away no longer have to pay the copyright fee to be carried, but must pay the freight to deliver the signal to cable. Parver said the commission has rid itself of its must-carry backlog and is now focusing on ADI.

FCC's John Wong put the best face on regulation. "These standards are for you. Think about it: You'll be delivering a good product to your subscriber." Yet, he lamented, 40% of the filings the commission has received have one deficiency or another, resulting in 2,000 deficiency letters in the mail.

Communications Attorney Steve Ross rounded out the session discussing emergency broadcasting service (EBS) and video dial tone. Citing progress at the FCC, Ross said the commission is now allowing cities and cable operators to decertify and solve their own local issues.

The "Video Proof-of-Performance Measurements" session addressed this year's broadband proof-of-performance testing at the headend required by the FCC. John Vartanian of HBO covered the use of vertical interval test signals, both composite and combination. Referring to HBO's test, Vartanian stressed the company's desire to be able to test video and audio on-line without interrupting programming. Sencore's Jack Webb discussed the reference measurement of processors, frequency response measurements and FCC multiburst.

Testament to the converging future, SCTE's Ralph Haimowitz hosted "Introduction to Telephone Technology" for cable personnel. The biggest problem facing cable in competing with the telcos, said Haimowitz, is reliability. Cable isn't ready to be a local telephony provider — not yet.

The two big markets cable should be looking at are cellular transport (delivering signals to local telcos) and data systems. Tapping into the PC market boom, cable could deliver calls on its own networks in order to avoid toll centers, and hook up to long distance providers. Reiterating reliability, Haimowitz urged operators to clean up the drop.

- General Instrument Corp. acquired an equity interest in Next Level Communications, a company engaged in the development of broadband access systems providing switched-digital solutions for the integrated delivery of video, voice and data over fiber-to-the-curb distribution networks.
- Alpha Technologies signed an agreement to provide power products to Nynex's new broadband network currently under construction in the New England area. Alpha will provide power supplies to the full-service video, telephony and digital services network that initially will serve 330,000 households in eastern Massachusetts and 60,000 households in Warwick, RI, with the capacity to carry hundreds of channels.

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BCT/E program receives endorsements

Two letters recently received at the Society of Cable Television Engineers national headquarters served as endorsements of the Society's Broadband Communications Technician/Engineer (BCT/E) Certification Program and the services provided for the program by the Society's staff.

The Alabama Cable Television Association, in a letter from its Executive Director Mary John Garrett Martin, informed the Society that "ACTA unanimously endorses (SCTE's) BCT/E Certification Program.

"ACTA understands and promotes the importance of technical education through its support of the Society's Alabama-based Dixie and Floribama Chapters," Martin writes. "As our industry develops improved standards of excellence in the training and performance of its technical personnel, it is appropriate for ACTA to recognize SCTE's certification process. This process bridges the gap between all operators as the ultimate standard of personal achievement in the technical area of the cable telecommunications industry.

"ACTA will continue to inform its members of meeting dates for the Dixie and Floribama Chapters. SCTE offers a worthwhile professional opportunity and the ACTA encourages its members to support SCTE and the BCT/E Certification Program with their attendance and participation."

The ACTA joins a long list of state associations and other industry organizations that have endorsed the Society and/or its certification programs.

Among the organizations that have proclaimed such endorsements are Buckeye Cablevision Inc., the Cable Telecommunications Association, Colony Communications, Continental Cablevision of Ohio Inc., the Federal Communications Commission, Mason Brothers Inc., the National Cable Television Association, Tele-Communications Inc.,

Time Warner Cable, Trilogy Communications Inc., Viacom Cablevision, Women in Cable, and the California, New Jersey, Oklahoma, Pennsylvania and Southern cable television associations.

The BCT/E program, in particular its administrative staff, also was praised in a letter from Keith Hayes of Georgia Cable TV and Communications in Decatur, GA.

In his letter, Hayes tells of how, when he was certified in the BCT/E program at the Technician level, his

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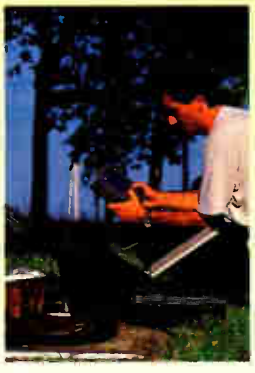

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Reader Service Number 51

Why take an interest in DAVIC?

By Bob Luff
Chief Technical Officer, Broadband Group
Scientific-Atlanta

Why indeed should the cable industry and you have an interest in an international standards body called the Digital Audio/Visual Council (DAVIC)? Aren't cable systems local networks with fibers and coax that don't reach to other countries? Haven't we managed very well in the past without standards of any kind — let alone international standards — thank you very much? And if there was some big international standards event that may affect the cable industry, I'm sure my home office knows about it and is representing our important interests. And, if the cable industry doesn't like the outcome it can just ignore it and continue on by itself. The answer is "definitely not" to all the above.

In the past, cable systems' connection to the outside world was generally limited to one-way receive-only signals from direct reception, microwave relay or via the cable satellites. Generally, signals originated within the system were not transmitted to locations outside the system. Managers and technical staffs were generally free to independently determine their own network architecture, plant hardware, test equipment and set-top selection. Ah ... the good ol' days!

The majority of potential new revenue services on cable's radar screen involve extensive interconnection of local cable "islands" into a national and international "super network." Who wants a telephony-over-coax service that can't dial anywhere in the world? Or, how much data, games and information would be accessible on the new digital two-way information highway if it had to all come from just your franchise area?

At this point, it might seem obvious that standards — indeed international standards — might be necessary to guide the orderly interconnection of thousands and thousands of cable systems to thousands and thousands data, information and entertainment sources.

The fact is we have not gone anywhere without both national and international standards in the cable industry. While the cable industry may not have had directly imposed standards, conforming to standards has been all around the CATV industry since its beginning. Recall that cable grew up as an alternative delivery system for broadcast TV — one of the most regulated and standardized telecommunications industries worldwide. For cable headend processors, modulators, optical transmitters and the millions of set-tops to function properly, they must conform to the standardized format and parameters of a broadcast TV signal defined by the National Television Systems Committee. Our satellite receivers, vehicle tires and oil, the electricity generated by our standby generators, the 75 ohm impedance, the phone lines carrying new service orders, even the sockets on the light bulbs in your office are all part of important standards that almost invisibly make our industry interface seamlessly with the outside world.

Need for international standards

The issue here is not just electrical standards. What about security of data and information coming and going from all over the world? Or, what about billing and credits where source and user are separated by continents? Cable's future depends on greater interconnection outside our franchise, state, country and industry. And, for all this interconnection to occur in any kind of orderly fashion, standard interfaces and signaling protocols need to be agreed upon — and soon!

Standards groups by the dozen

To make matters even more interesting, convergence of cable, broadcast, telephony, computers and consumer electronics have not only expanded the number of chairs around the table in the standards debate but each industry has its own well-established standards groups that have not been idle in advancing uni-industry solutions. In fact, at last count more than 28 separate standards groups or pseudo-standards groups have been identified. This has given rise to its own set of issues. "Not invented here," and bureaucracy were interfering with otherwise well-intended efforts.

One of the most serious issues across the board is standards bodies are generally comprised of interested industry volunteers who squeeze in meetings and create drafts between their regular jobs. The speed of progress was fine when issues were moving more slowly. The result was standards or at least de facto practices were generally well in place long before the actual business opportunity was knocking at the door. Today's world is running at a very difference pace, but the standards organizational model has not changed. The result is business opportunities in digital video/audio applications and services that are out in front of the necessary standards.

"International standards might be necessary to guide the orderly interconnection of thousands and thousands of cable systems to thousands and thousands data, information and entertainment sources."

Why DAVIC?

With so many existing overlapping standards bodies, why is another needed? The challenge is that while each of

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Reader Service Number 69

these groups has an important piece of the evolving end-to-end system, they and their sponsoring industry only have a piece! There is no overall coordinating body to set the necessary time line and work plan while organizing and resolving conflicts or identifying holes where no one is working on remaining critical parts. That's exactly what DAVIC has stepped up to do.

DAVIC is a body of technical representatives from more than 100 companies worldwide. They share a common goal of assisting in the success of emerging digital audio/visual applications and services by the timely availability of internationally agreed-upon specifications of open interfaces and protocols that will maximize content creation and hardware interoperability across service providers, networks and countries.

DAVIC was organized when companies who had successfully formed a worldwide consensus on digital video/audio compression through the MPEG process realized that a consensus on end-to-end systems would greatly accelerate public value of digital services and applications. DAVIC goals are being pursued through open international collaboration in a series of major meetings and DAVIC technical committees. Its scope of interest is broadly construed to include all the applications, services, networks and hardware in which there is a prevalent digital video component. DAVIC makes its work available to all interested parties and will seek endorsement of its final specifications of interfaces, protocols and architectures by the appropriate formal standards bodies, such as ISO or ITU.

DAVIC work plan

The pace of emerging digital applications and services in a more competitive global telecommunications environment is demanding a very aggressive DAVIC work plan in order to produce a comprehensive set of agreed upon end-to-end systems specifications for digital interfaces and protocols by the membership's goal of December 1995.

The DAVIC work plan consists of nine major week-long international meetings to develop and agree on the specifications and a series of technical experiments, tests and interoperability events to demonstrate they work or make modifications as necessary before final recommendations are made. Following are the major milestones of the DAVIC work plan.

Call for proposals

In October 1994, DAVIC issued its "Call For Proposals." This document was significant because for the first time a complete end-to-end reference model was presented and offered to the world experts from all interest areas to comment. This model identified the overall structure of digital video/audio end-to-end systems. It also identified for the first time the initial 17 critical interface points and gave them a name so all interested parties could begin discussions about these issues using a common vocabulary.

Review of responses

At the December 1994 meeting in Tokyo, over 80 responses were submitted. Some responses addressed all issues while others focused on an area of particular interest. Each respondent was given an opportunity to present key points regarding the critical interfaces to the total general assembly — included over 200 of the world's leading experts on compression, software, hardware, networks, satellites, consumer electronics and research labs. For the first time everyone heard everyone else's position and recommendations regarding the overall reference model and the identified 17 critical interfaces. And the process of global consensus building began.

Straw man baseline document

Recently at the Orlando, FL, DAVIC meeting hosted by Scientific-Atlanta, DAVIC's work plan called for the six technical committees (coordinated by the management committee) to create the first straw man baseline document of the end-to-end system. This document provides a very complete and organized presentation of descriptions of the proposed interfaces and protocols. The first straw man document was not designed to force a selection in contentious issues. Instead, the document simply describes in great detail the requirements of each the critical interfaces and protocols and where more than one solution has been proposed each proposal under consideration is outlined. **CT**

To be continued in a future issue: Why cable should take a more active role in DAVIC.

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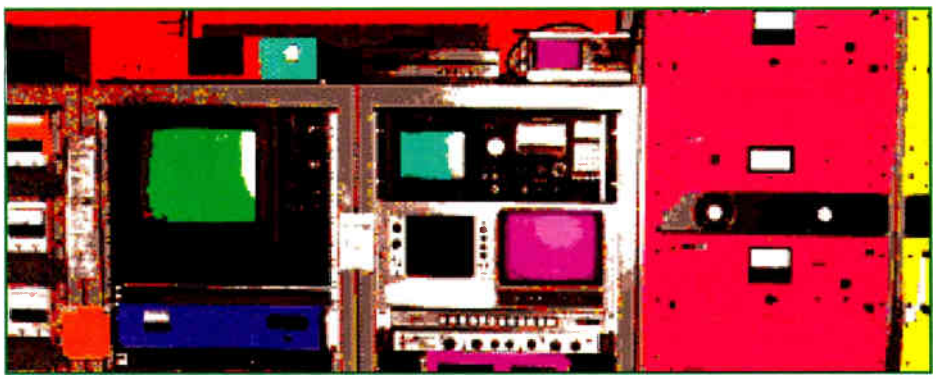
Reader Service Number 2

Network management in an increasingly complex headend

By Michael Pritz
Director of Telecom Networks
and Network Management

And Jennifer Cistola
Director of Headend Systems
Antec Corp.



The complex array of equipment and customer demands for new services are driving broadband operators to seek comprehensive network management systems to control the cable TV headend and elements in the residential network.

Digital transmission equipment and other devices will soon originate signals beyond the traditional feeds from satellites, tape and microwave links. Regional networks will bring cable subscribers access to global digital services. Centralized and distributed video file servers will become attractive to cable operators looking to increase near-term opportunities in advertising insertion and near-video-on-demand (NVOD).

As new applications originate from the cable TV headend, new challenges will arise in developing a network management solution.

Complexity in the headend

Equipment found in today's headends are manufactured by various vendors and are of different vintage. Most lack comprehensive network management capabilities.

In the past, network management has relied largely on hardware solutions. For example, to meet requirements for Federal Communications Commission testing, cable operators have used end-of-line monitors to collect information on test points and communicate that information through telephone modems. Status monitoring has been employed to communicate status changes of field equipment over the return path back to a central point. Network management software has been relatively simple, featuring closed, proprietary communication protocols.

Today, with the headend and residential network undergoing considerable change, the industry is witnessing a paradigm shift. Hardware solutions are migrating toward integrated software solutions. Isolated and proprietary status monitoring systems are no longer attractive. Integrated network management systems that rely on open communication protocols and industry standards will ultimately provide a global look at the overall broadband network that operators will need in responding to the competition.

The headend today

Operators cannot afford to rebuild the headend from scratch to take advantage of new technologies. The first objective of the network management system should be to provide management solutions while preserving the operator's investment.

For example, add-on devices at the headend can monitor equipment output and initiate switching to backup devices when a threshold of signal degradation is reached. Such add-on devices increase the reliability of headend equipment and provide operators with an ability to monitor and manage nonintelligent equipment through a network management system.

For newer equipment, intelligence and network management features are incorporated in the headend device's standard specifications. Some modulators provide operators with automatic rerouting capabilities should a given modulator fail. The self-healing capabilities of internal components automatically will monitor modulator output and switch operations to an internal backup unit should the modulator fail. Failures are detected and rerouted within milliseconds, eliminating the need for operator intervention.

Open communication protocols using established industry standards will become increasingly important to cable operators seeking to employ network management as a means to control the

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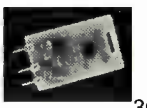

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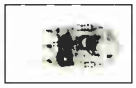

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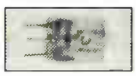

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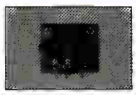

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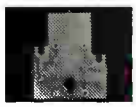

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overall network. Operators will be able to anticipate potential failures, ensure effective equipment servicing and eliminate system downtime through daily monitoring of the equipment.

Open, standardized environments

Open architectures have long been a driver in computer software development. Standardized operating systems with standardized data base management capabilities and standardized communication protocols provide for more rapid software development and greater overall system flexibility, offering the ability to interact with a broad range of new environments.

Client/server architectures — common in large-scale automation initiatives — provide scalability, multiuser capabilities and protection from computer failures. Published programmer interfaces provide the ability for third parties to add capabilities to an existing core computing platform.

State-of-the-art programming processes and languages ensure the long-term use and growth of the base network management environment as new information requirements emerge.

A good architectural foundation will mean new functionalities can be easily implemented as new applications — and new information needs — arise.

For example, the market researcher would need a PC application that allows demographic information to be analyzed. The field technician will need a list of all the power supplies requiring service over the next month. A customer service representative will require the ability to automatically provision the network for a new service based on a subscriber's call. For all of these types of applications, the network management system will prove crucial in tying information sources together to provide whatever information is required by users.

Ultimately, network management won't simply mean monitoring the performance of headend or field equipment. Network management will be a full-scale, integrated effort, involving many departments and many separate functions.

The key to implementing such a system will rest in how broadband providers understand and rely on open communication protocols and a standardized platform to build toward the integrated, long-term network management solution. **CT**

Why analog? Why digital?

By Al Johnson
President, Synchronous Communications

At first glance, the questions "Why analog? Why digital?" may seem about as relevant as a discussion of compact discs vs. LPs in the audio field. Given the media coverage regarding the digitizing of the United States, it is generally assumed anything analog is part of the good old days. Surprisingly, a major portion of the signals transmitted every day are not 1s and 0s. They continue to be analog.

In their basic forms, transmission systems come in three varieties: analog systems (which may use either FM or AM) and digital systems. For this discussion, digital transmission systems are limited to full-motion, multichannel systems. Each has its own set of benefits. The question is really not a case of either/or. Instead of treating these various systems as competitors, they should be viewed as complementary. Together, they offer the user a greater variety of options than has been available previously. No one system meets every need. There are many variables to consider. Every user has a vision of architecture for their system, which may require one or more of the transmission schemes.

"As systems consolidate and expand to greater regional functionality, the use of digital transmission (combined with other technology) presents the operator with the best method of moving many signals of all types to multiple locations."

FM transmission systems

Analog systems have been around for a long time. In the early days of cable, AM supertrunking over coaxial cable was about all that was available. In the 1970s, frequency modulation became available and was considered to be a step beyond technically. It was adopted for many transmission uses. Others felt it was too expensive for many applications. Then in the mid-1980s, the use of FM and single-mode fiber optics created a new method of transporting signals over long distances. For many it was the opening gun of the technological changes that created today's cable systems.

A substantial amount of money was spent by the cable industry in the 1980s to build interconnection facilities using FM. While some interconnection was built for coaxial service, the major change was the adoption of fiber-optic systems. In this setting, the general use of these FM systems was to provide interconnects between headends, eliminating the duplication of many costly facilities, such as satellite dishes and receivers and local broadcast receiving facilities. FM was still considered expensive but provided nearly transparent transmission. Using fiber optics allowed the FM signals to be carried long distances with or without repeating. Figure 1 illustrates a typical FM distribution system, where a single FM headend serves multiple receiving locations without effort. Where link budgets are short and no repeats are required, FM transmission systems provide excellent service.

Developments in FM systems eventually allowed the carriage of scrambled signals, which also eliminated high costs for duplicate scrambling equipment. Today, many of these systems remain fully functional. As systems increase in size and channel requirements, these FM systems are expanded as well. Expansion of a major headend to multihub system that meets the users requirements is less costly, provides excellent service and is a cost-effective method of interconnection. While it cannot be argued that new technologies may obsolete these systems, they remain good sense today.

AM supertrunking transmission systems

More recently, AM fiber supertrunking has become a reality. Because of major developments in fiber optics

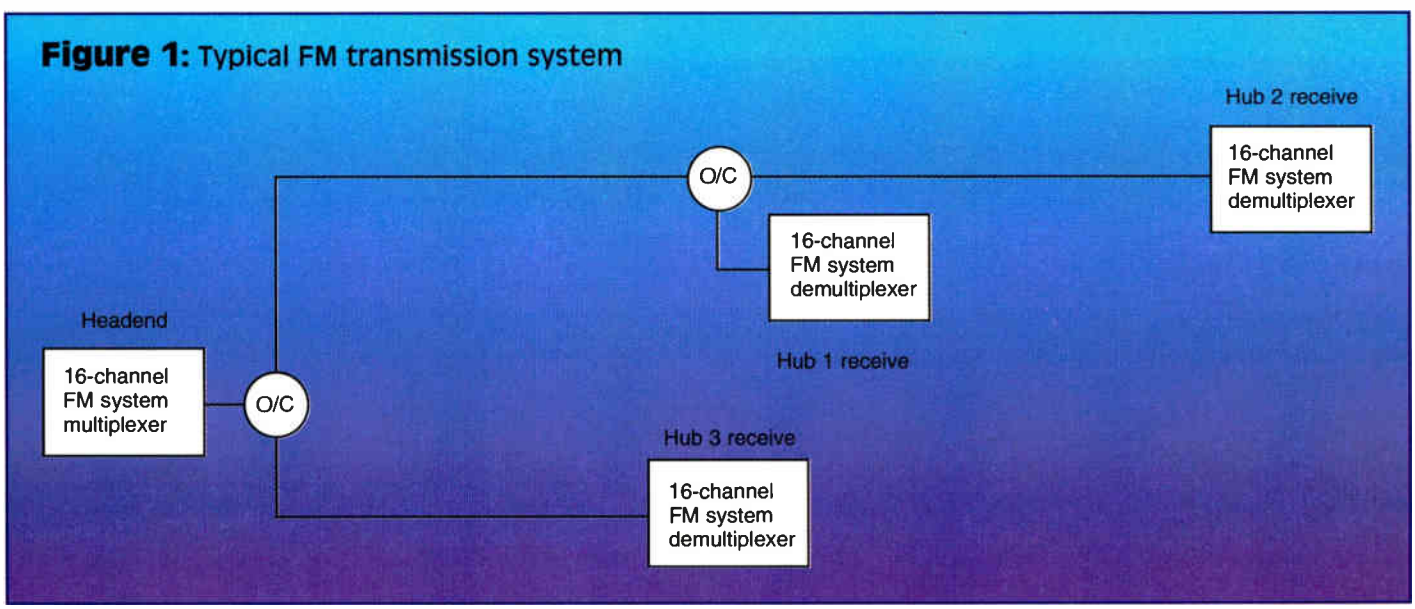

Figure 1: Typical FM transmission system

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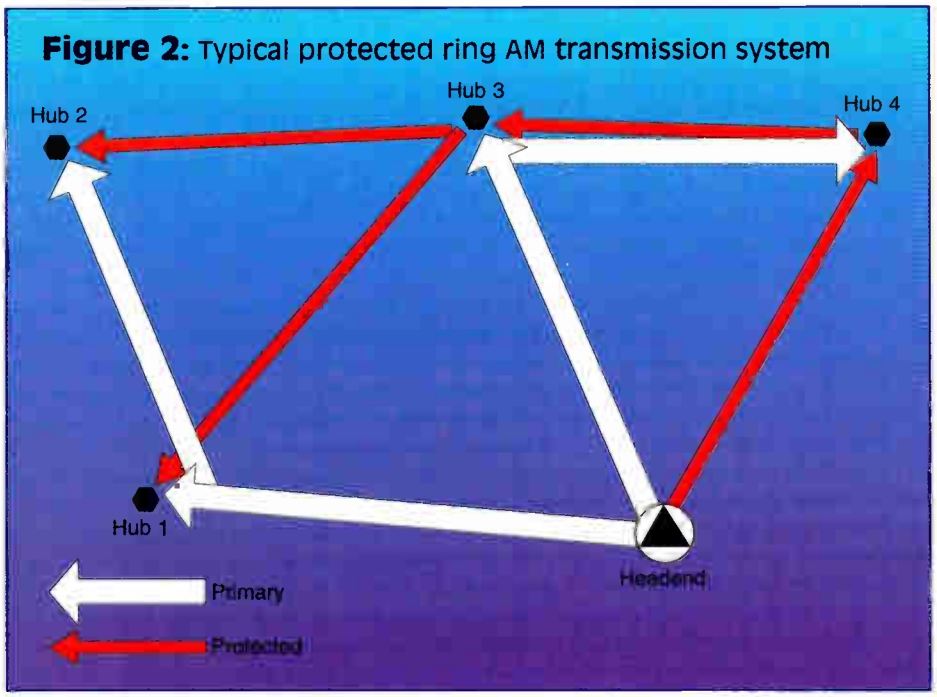
Figure 2: Typical protected ring AM transmission system



(such as external modulation and optical amplifiers, which provide excellent performance and longer loss budgets), AM supertrunking transmission is in many cases the latest alternative of choice in the operator's plan of operation. AM supertrunking allows operators to consolidate headends by moving complete 80-channel or more (up to 750 MHz) AM signals from a single headend to multiple hubs and, in many cases, onto optical nodes. Because the signal is already in a deliverable format, AM supertrunking allows easy migration from fiber trunk to either fiber or coaxial distribution. In many cases, the AM supertrunk also is ready for the transition to compressed digital delivery as the technology becomes available.

Several major operators have opted to design and implement protected rings interconnecting multiple locations within an urban area, using this high-performance AM system. As shown in Figure 2, AM supertrunking, combined with multiple optical paths, allows the operator to provide service to each hub via different fiber routes. At the hub, receivers with automatic switching capability accept signals from both optical paths. Loss of one path causes the receiver to switch to the alternate path, assuring continued service.

While signal distribution with AM supertrunking is very convenient and economical, it does have limitations. While the illustration shows a system that does not require repeats, it is possible to repeat the signal to extend the coverage area. With the advent of optical amplifiers, the signal impairment is relatively small but still exists. Extremely long distances, such as rural town-to-town interconnects or a full-scale metropolitan system, will probably require a combination of techniques to assure optimum signal quality throughout the entire system.

Digital transmission systems

The advent of digital multichannel technology provides an even higher level of technical performance. The advantages of digital systems are many. Primary among them is the ability to move signals over very long distances. The digital signal is easily repeated, frequently several times, and does not suffer performance loss as a result. Systems with video interconnects spanning 100 miles or more are completely feasible. Figure 3 on page 30 illustrates a typical transmission system, which includes a single headend and several hubs. In this example, the distance from the headend to the hub is substantial (≈30 dB loss budget) and requires a system that both drops the signal at Hub 1 and retransmits the signal to Hub 2. With the digital system, this is easily accomplished through the addition of another transmitter. One prime area for the use of digital is in advertising interconnections. The high quality of the signal is available to every member of the network. →

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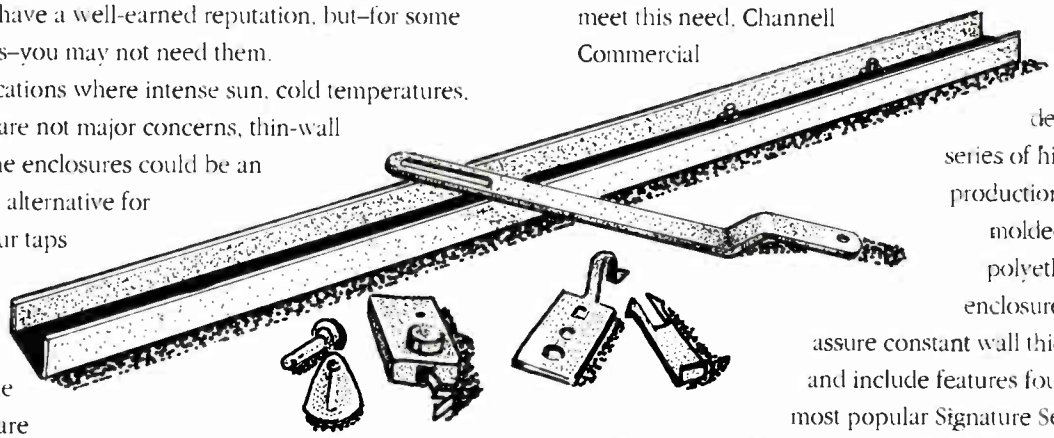

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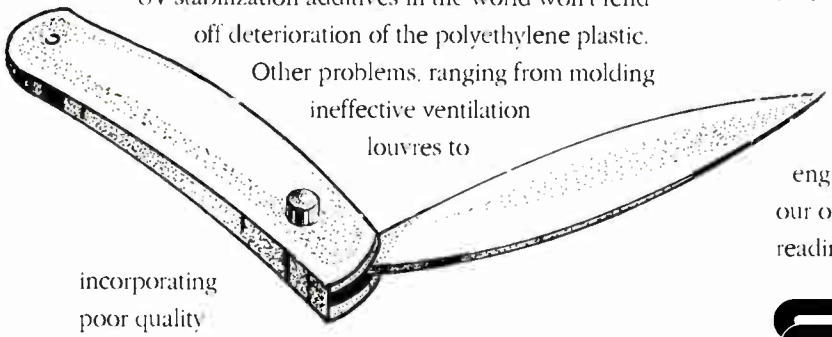

incorporating poor quality locking features, are associated with these techniques. And, as many system operators have found out, a simple pocketknife in the hands of the local street bully can be a polyethylene enclosure's worst nightmare.

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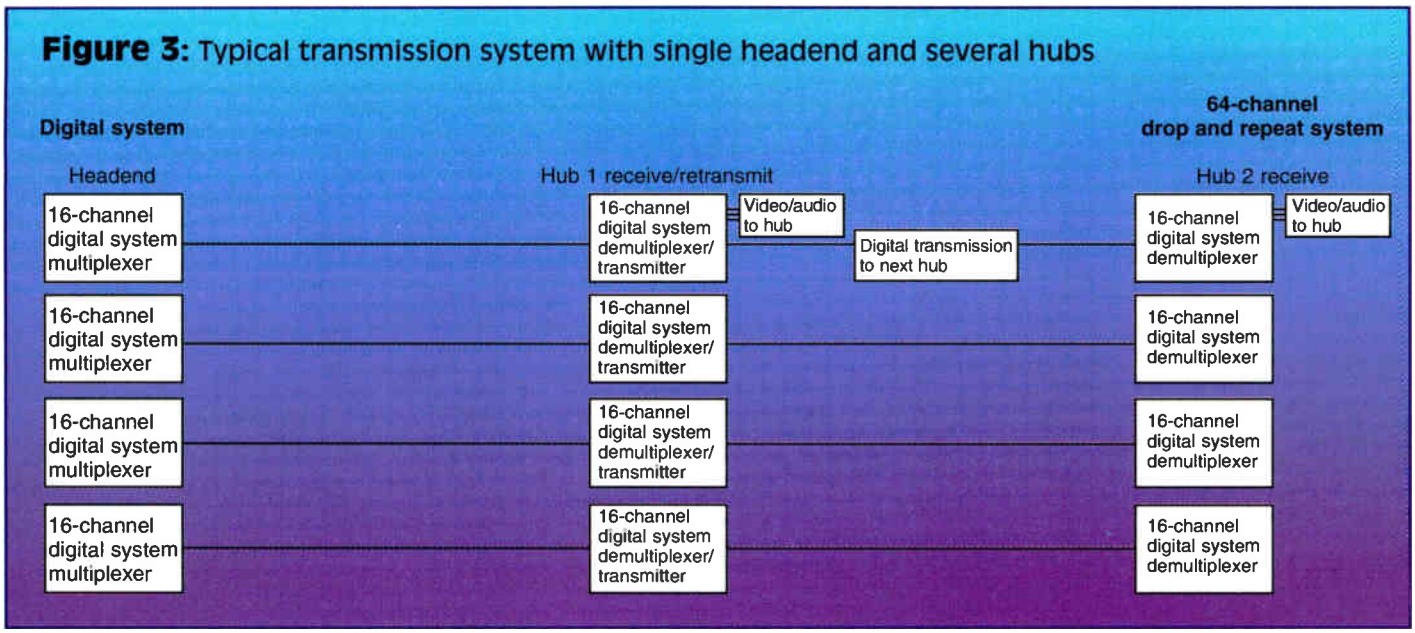
Figure 3: Typical transmission system with single headend and several hubs



Newer digital technology makes it possible to move almost any type of signal, including scrambled signals, between headend locations or even between systems. Digital signals are robust and capable of operation under noise conditions that would cause service interruption in an analog system. Digital technology not only presents another alternative but makes sense in planning new-builds.

Most digital systems are capable of such complex operations as drop-and-insert (deleting one channel and inserting another) or drop-and-repeat (feeding signals to a hub and sending the multiplexed signal on to another hub). Multiple audio channels in baseband, stereo or 4.5 MHz also may be transmitted. While most digital multichannel systems are proprietary (i.e., the data rates are not compatible with other digital systems), they provide a significant improvement in operations.

Until recently, the digital multichannel approach was hampered by high cost-per-channel. Since digital technology has advanced and the use of digital interconnection has increased, there has been a substantial cost benefit for these systems. The result is a digital cost-per-channel that is now comparable with FM analog cost-per-channel in a new installation. Furthermore, these systems continue to grow in sophistication, allowing interface of other digital signals (such as high-speed data and DS3) to enhance the performance and cost-effectiveness of the digital products.

As systems consolidate and expand to greater regional functionality, the use of digital transmission (combined with other technology) presents the operator with the best method of moving many signals of all types to multiple locations. Figure 4 on page 32 illustrates a metropolitan network system. The system contains 28 hubs that feed over 1,100 nodes. Obviously, no single transmission scheme will cover the entire area.

"In terms of cost-per-channel, AM supertrunking is substantially lower than either FM or digital systems."

In order to meet the performance requirements, the system is broken into four groups. The main headend is the supply point for all of the hubs. From the main headend, a protected ring digital transmission system feeds key hubs in each of the other groups. These hubs then become the conversion point from digital-to-analog transmission. They feed the rest of the hubs in their group, which in turn feed the nodes associated with each hub. A combination of digital transmission and AM supertrunking makes the system feasible where neither FM or AM alone or together would have been capable of covering such a vast system. The complementary systems provide the needed quality signals to the entire area.

In terms of cost-per-channel, AM supertrunking is substantially lower than either FM or digital systems. The fact that the signals are in a deliverable form (i.e., amplitude modulated) relieves the user from having to convert, either wholly or in part, the received signal into the AM format.

While FM systems represent "old" technology, they present many advantages to the user. The system is simple, efficient and provides high-quality signals. FM signals are easily intermixed with AM and modulated data signals over coaxial trunks or fiber transmission systems.

Another area where the use of analog signals is still cost-effective is in non-CATV related fields. Many uses such as traffic control, surveillance and video conferencing continue to be dominated by analog transmission technology. An example is the use of analog transmission in distance learning systems. The ability to switch channels easily using FM or AM transmission creates a clear cost savings over the drop-and-insert methods or switched video employed with digital systems. In an AM system, the TV set becomes both receiver and channel selector. In an FM system, the FM demodulator becomes the receiver and channel selector.

One of the questions a manufacturer frequently has to ask is: "Why does a technology that seems to be obsolete continue to thrive?" In the past several years, there has been a steady, ongoing market for FM products. The answer as to why is in revenue enhancement for the operator. As coaxial plant is migrated to the newer fiber technologies, many opera-

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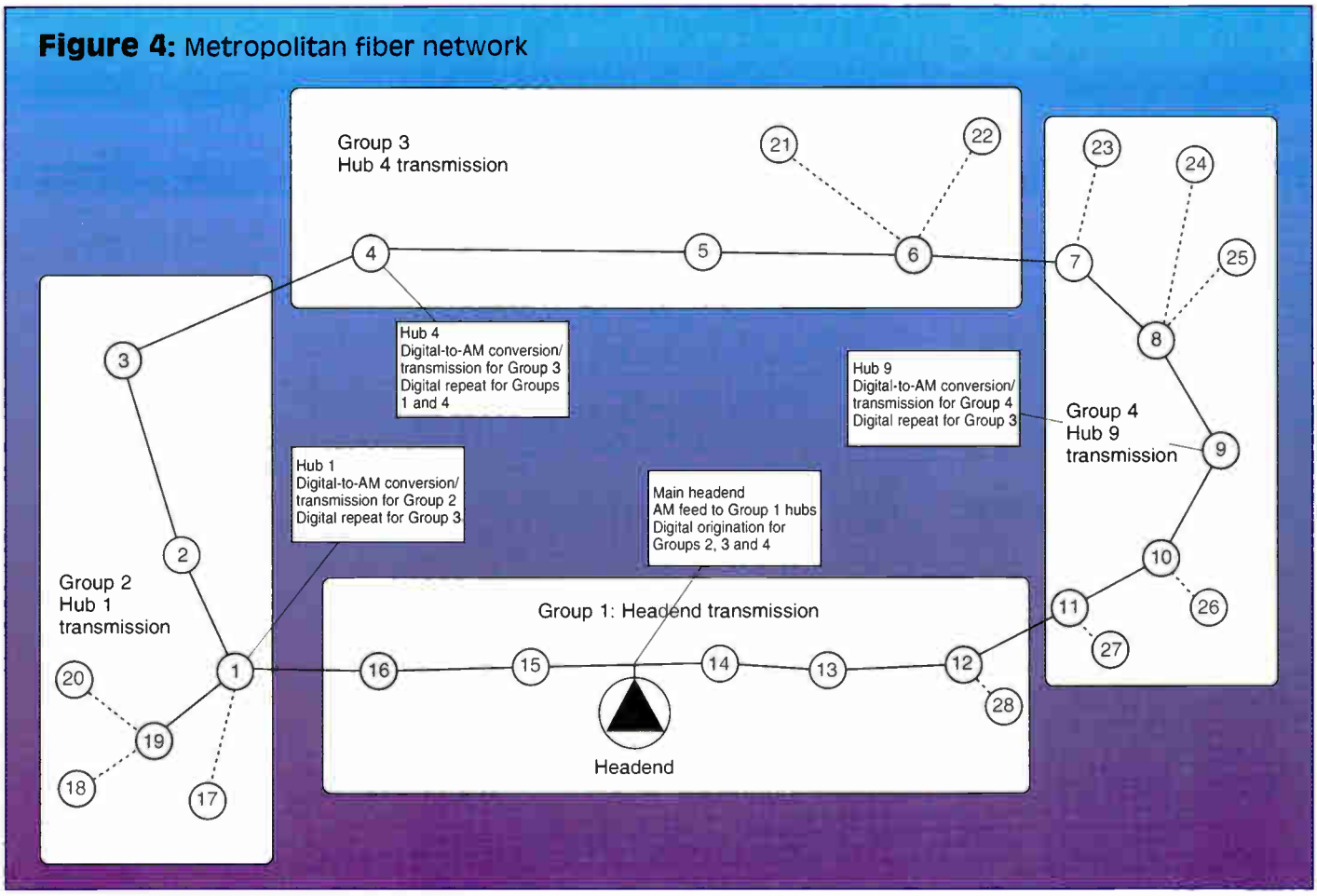
Figure 4: Metropolitan fiber network



tors have found new noncable TV uses for the coax. Many of these uses involve providing services, such as video interconnect services to customers who were not previously in the marketplace. FM and AM equipment frequently fills the customer requirement and can be fit into the system on excess facilities. Such forms of revenue enhancement not only aid the bottom line but allow the continued use of good equipment that otherwise might have to be abandoned. The broadband area is still uncharted and has much potential to grow.

So the questions "Why analog? Why digital?" are really a call to plan the requirements of a system and select the best transmission method to meet that requirement. While digital is certainly the wave of the future, within the next few years, all of these technologies will continue to exist and provide excellent service. **CT**

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Reader Service Number 10

HFC or SDV architecture? Economics drive the choice

By John McConnell
Director of Marketing

And Jane Lehar
Senior Applications Engineer
Access Platforms Systems
ADC Telecommunications Inc.

Cable TV service providers have long used RF transport for their analog broadcast TV services. As service providers prepare to upgrade their networks to provide broadband services, there are two primary architectures to evaluate. A hybrid fiber/coaxial (HFC) system — a fiber-to-the-serving area architecture — can support basic and premium analog CATV services, provide an immediate flow of revenue at the lowest cost and be easily upgraded to accommodate new services, such as telephony or interactive digital video. Another option is a switched digital video (SDV) system, which is optimized for fiber-to-the-curb (FTTC) and copper distribution for video and telephony services.

"HFC is focused on providing low-cost support and incremental capital investment for all existing and emerging narrowband and broadband services."

Of these two basic architectures, HFC is focused on providing low-cost support and incremental capital investment for all existing and emerging narrowband and broadband services. HFC has definite cost advantages when compared to switched digital video systems because of its smaller initial fiber installation requirements and the incremental costs associated with providing interactive digital video and telephony services over the HFC architecture. In short, HFC equipment expenditures are directly related to revenue generation.

HFC is actively deployed

A 750 MHz linear broadband HFC transport system delivers up to 110 NTSC channels, and can carry both analog and digital video services. An HFC system also supports two-way services, typically operating within 5 to 42 MHz upstream spectrum, and 50-750 downstream spectrum. (See Figure 1.)

Driving fiber deeper into the coaxial cable plant means lower noise and distortion, smaller failure-group size, fewer equipment-related outages, decreased network maintenance expenses and a tremendous increase in the amount of upstream return bandwidth available, required for offering both interactive and telephony-over-cable services. Most of these advantages are a direct result of the reduction in the number of coaxial amplifiers installed between any one

Figure 1: HFC spectrum

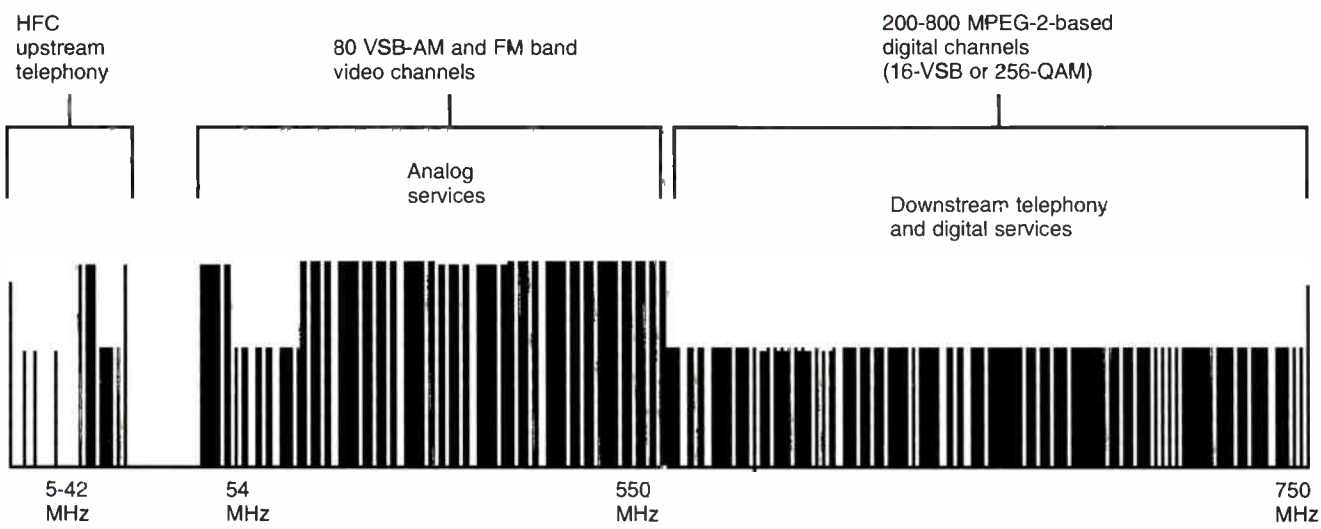

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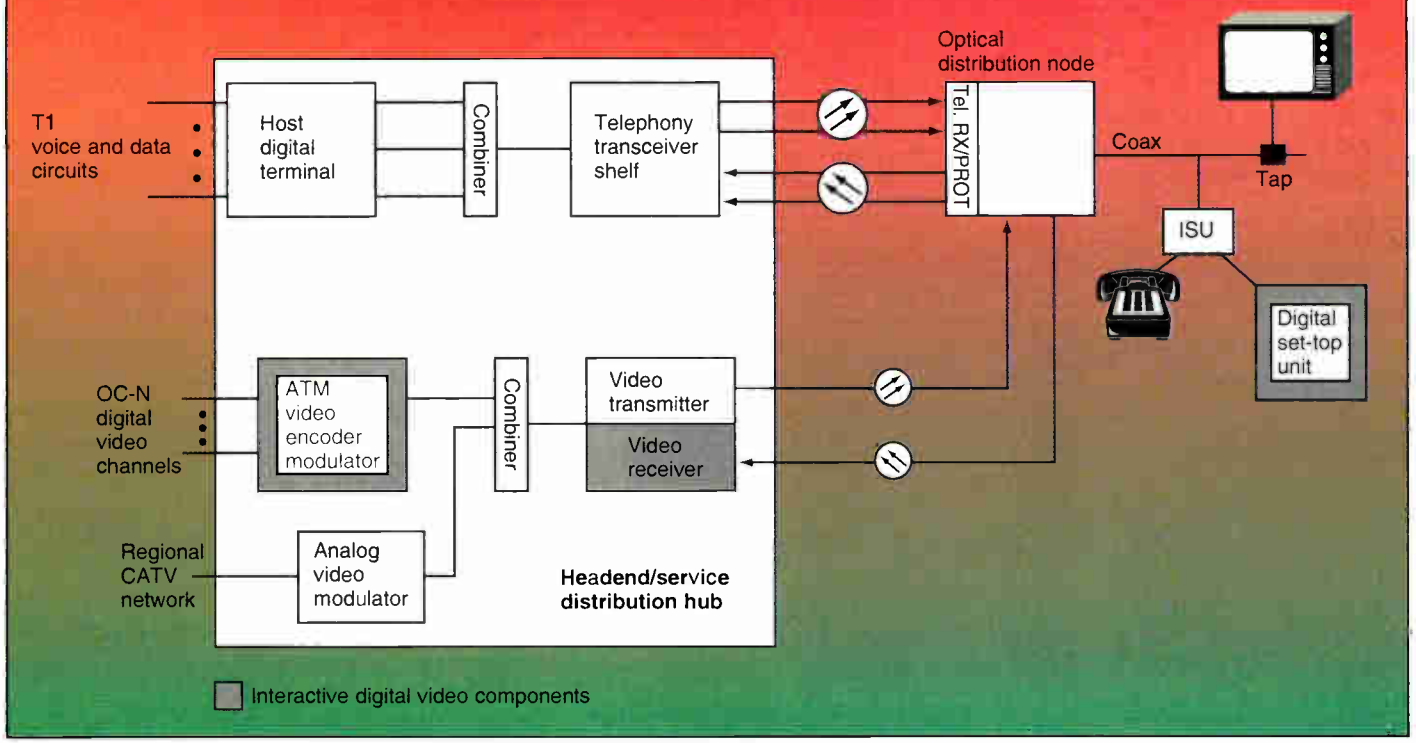
Figure 2: Hybrid fiber/coax (HFC) network



customer and the headend.

As a result of these advantages, a large number of cable service providers are already upgrading their networks, including companies like Adelphia, Cablevision Systems, Comcast, Continental Cablevision, Cox Cable, Jones Intercable, TCI and Time Warner. →

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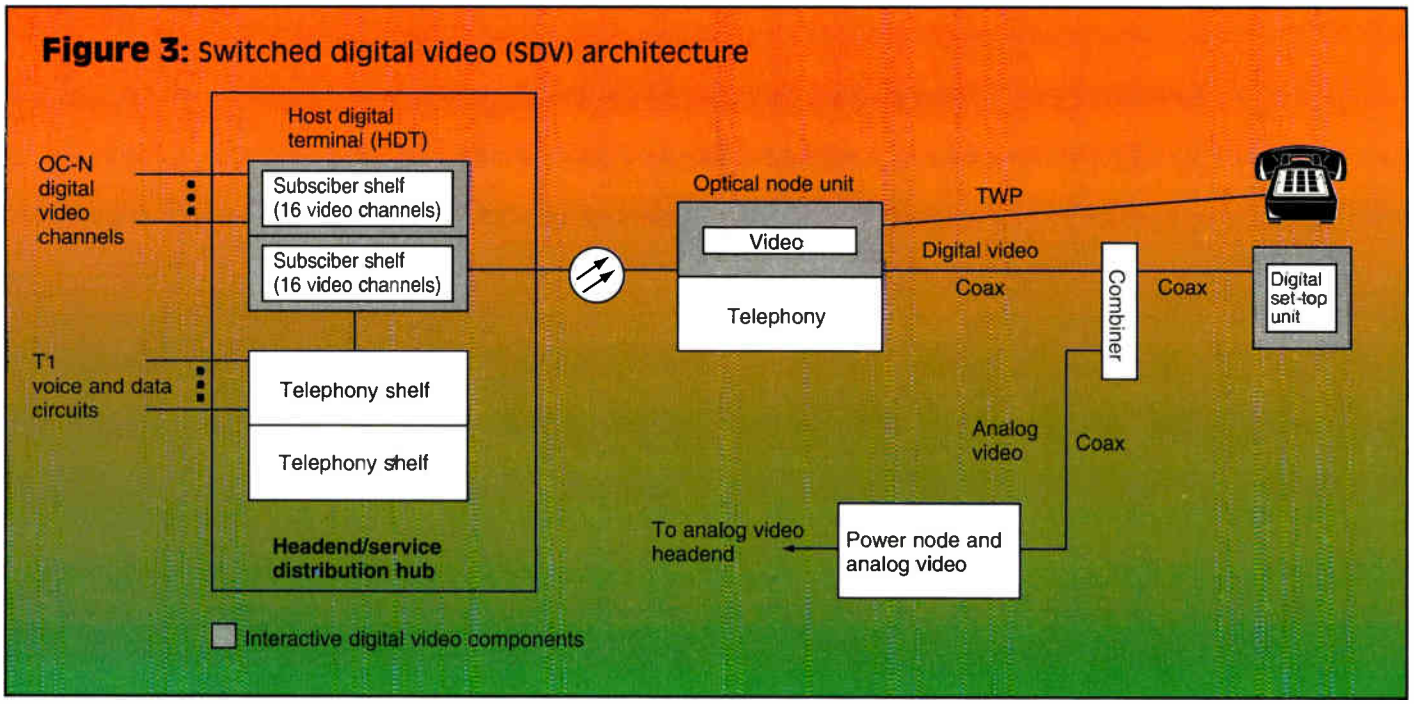

Delivery over HFC

Because of advances in video compression and modulation technologies, it is now possible to deliver a compressed video stream using digital techniques, allowing linear broadband systems to carry more information because each video signal can occupy a smaller portion of the available frequency spectrum. The process of placing compressed digital video signals onto an HFC distribution network requires two important technologies: digital encoding and modulation.

However, many of the key network elements that must be added to an existing HFC network to enable interactive and digital video services are identical (or cost-wise similar) to those required in a switched digital video architecture. They include switches, uncompressed digital transport multiplexers, analog and digital signal passive combiners and digital set-top units.

The critical network elements that differ in an HFC network include the modulator (which could include asynchronous transfer mode demultiplexing functionality), used to put digital services over the linear broadband distribution transport portion of the network, and an optical distribution node where the optical-to-electrical signal conversion occurs. (See Figure 2 on page 36.)

The modulator places an RF carrier, consisting of a multiplex of digital video channels, into a particular portion of the frequency spectrum. For example, a 16-VSB (vestigial sideband) channel can accommodate up to 43 Mbps of data in 6 MHz of RF spectrum, which may be any combination of video subchannels at lower data rates of 1.544, 3.088, 6.176 Mbps or greater.

"With HFC, it is possible to position for the future without gambling with up-front investments."

Although digital services require set-top boxes, most cable-compatible TV sets do not require them for today's basic analog CATV services that are not RF or baseband scrambled. In an HFC network, the digital set-top unit performs the decoding/demodulating functions required to deliver digital video services. The digital set-top unit also decompresses the digital signal and converts it back to an analog signal for NTSC input to a TV set.

Multiplexing in an HFC network is via frequency division multiplexing as opposed to time division multiplexing in a switched digital video network. Therefore, carrying a new service to and from a service distribution hub requires only the addition of the proper channel interface card in the modulation hardware. As a result, the initial cost of adding new, incremental revenue-producing services is quite low. This means that the time and cost for new services entry is reduced, and any new service offerings can be made more economically attractive from the start.

Telephony services over HFC

Telephony and data services can be added to an HFC architecture on a per-subscriber basis by adding a host digital terminal (HDT) at the headend or service distribution hub and an integrated service unit (ISU) at or near the customer premises. The HDT is comprised of the DS1 interfaces to a local digital switch, a digital signal cross-connect system or central office terminal and the HFC transport network interface. The HDT takes DS1 circuits from the network switch, performs a cross-connect function and outputs DS0s onto three separate coax legs using RF modulation. It supports standard switch interfaces such as Bellcore's TR-008 and TR-303 standards, as well as provides an operations, administration, maintenance and provisioning interface for network management. The HDT can support multiple ODN configurations, depending on telephony service penetration and density of subscribers.

The ISU provides telephony and data access to the customer. In order to meet the deployment flexibility requirements of an integrated video and telephony network, ISUs should be available as single and multisub-

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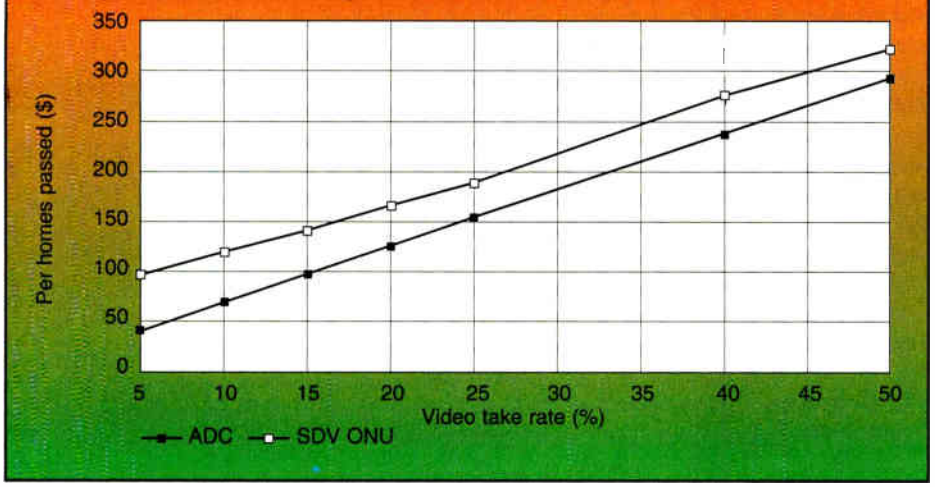
Figure 4: Hybrid fiber/coax system and switched digital video comparison (video only)



scriber devices for provisioning the specific services the subscriber requires — telephony, data or special services. Larger ISUs provide a lower cost per line and are useful in a multitenant environment. However, in a suburban application where subscriber densities are lower and service penetration is unpredictable, home ISUs provide the most flexible and cost-effective approach to delivering telephony and data services.

Upgrading a video-first HFC system to include telephony and special services capabilities does not impact the fiber-optic or coaxial network already in place. Only the telephony-related equipment (HDT and ISUs) must be added to the transport system. Cable networks can be upgraded or rebuilt with fiber-to-the-serving area for costs that are comparable to traditional, all-coaxial cable upgrades or rebuilds, assuming the nodes are properly sized.

The ratio of bits per hertz is extremely important to consider when telephony and data services are being added to the network. An HFC architecture should maximize the usage and density of the RF spectrum, improving bandwidth management with a high bits-per-hertz ratio. For example, subscribers requiring service may want up to a DS1, or 1.544 Mbps, of bandwidth to support data and telephony services in the home. When this requirement is considered in a 250-home node environment, the modulation technique must produce greater than 2 bits per hertz.

For example: 250 homes/node x 10% penetration x 1.5 Mbps = 37.5 Mbps within 18 MHz of spectrum (12-30 MHz).

"HFC enables a gradual, incremental approach to building a broadband network."

Economics: SDV vs. HFC

A switched digital video network typically uses a host digital terminal as the interface between the digital transport trunking network (and switch) and the distribution portion of the network to provide digital video services. Instead of optical distribution nodes (ODNs) typically serving 100-2,000 subscribers in an HFC network, the SDV network uses optical network units (ONUs) typically serving up to 48 subscribers. (See Figure 3 on page 38.)

Note that analog video services are usually handled by building or interconnecting an overlay network that is combined with digital services at or near the ONU in the distribution portion of the network. This overlay is exactly the same architecture that is fully integrated to support analog services in an HFC network. A digital set-top unit is necessary to separate the analog and digital services, but no demodulation functionality is required, since video signals in an SDV network are not modulated.

The network overlay required with a SDV network also makes operations support issues more complex. Unlike an HFC network with its integrated capability for remotely performing network diagnostics and provisioning, SDV network management is accomplished by installing a separate operations support system for the digital and analog networks. Additional equipment and systems add to network installation and maintenance costs as well as reduce a service provider's flexibility in managing the network. In increasingly competitive markets, the ability to diagnose and provision the network remotely will be essential to cost control, and as the complexity of networks increases, more sophisticated systems capable of accommodating change will be necessary.

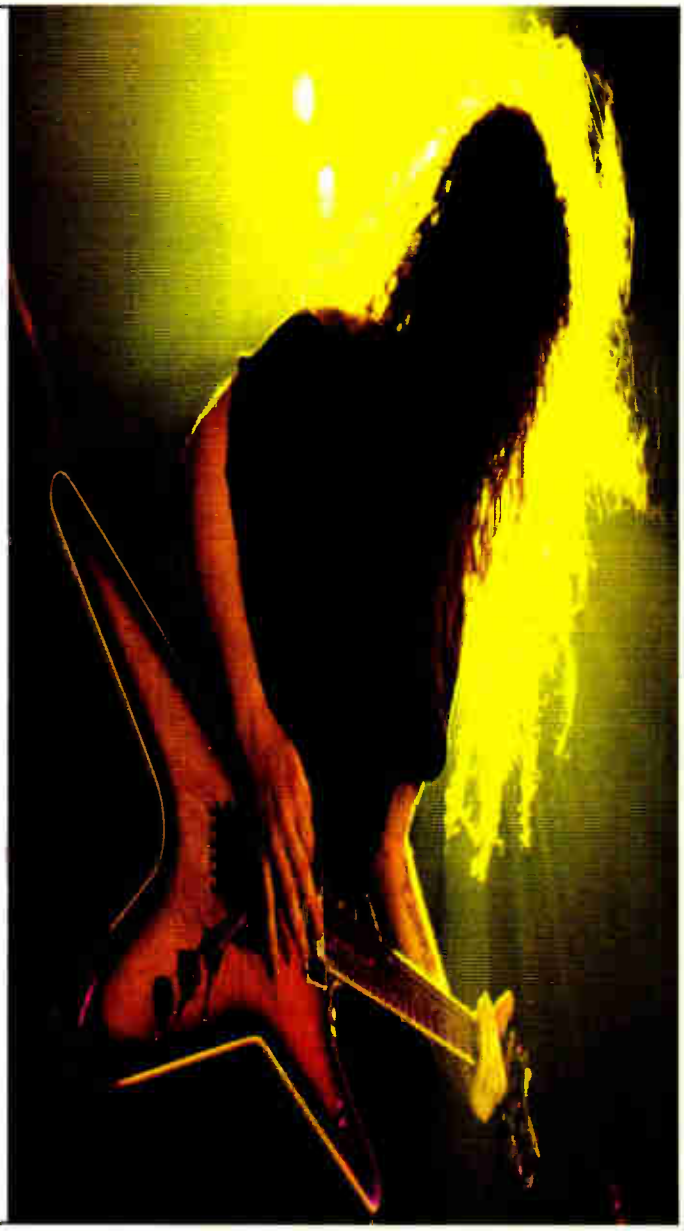
From 0% to 50% take-rates for interactive digital video, HFC has definite cost advantages over a switched digital video architecture because of its smaller initial fiber installation requirements and the incremental costs associated with providing interactive digital video services over an HFC architecture.

Cost parity occurs at about 50% interactive video take-rates. However, a 50% take-rate is much higher than the current take-rate of less than 2% that is typical for most popular pay-per-view events.

Figure 4 compares the cost per home passed for HFC and SDV at varying interactive video service take-rates. The pricing model assumes equipment costs to support interactive digital services only and volume pricing for digital set-tops. The cost estimates are based on only that hardware that is unique to the HFC and SDV architectures to support interactive digital services.

HFC enables a gradual, incremental approach to building a broadband network. Despite all the hype about gigantic future revenues, no one really knows how much consumers are willing to spend on interactive digital services, most of which don't even exist yet. With HFC, it is possible to position for the future without gambling with up-front investments. If revenues skyrocket, service providers that have built an HFC network will have the common analog structure in place, along with the platform that will enable expansion to capture additional revenue. If growth lags or new services fizzle, having overextended won't be an issue.

With HFC, today's investments in the network will help position service providers to be profitable now as well as in the future. **CT**



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Reader Service Number 185

Advertising insertion: Analog vs. digital systems

By James O. Farmer
Chief Technical Officer
Digital Video, a division of Antec

Cable operators seeking an immediate, short-term way of increasing revenues are now looking more seriously at advertising insertion as a supplement to their current income base. Operators offering this type of service typically use videotape-based analog systems, whether they operate as an individual cable system or as part of a regional ad insertion network. Analog ad insertion systems have created lucrative revenue streams for many systems, but those new rev-

Figure 1: Components of digital ad insertion system

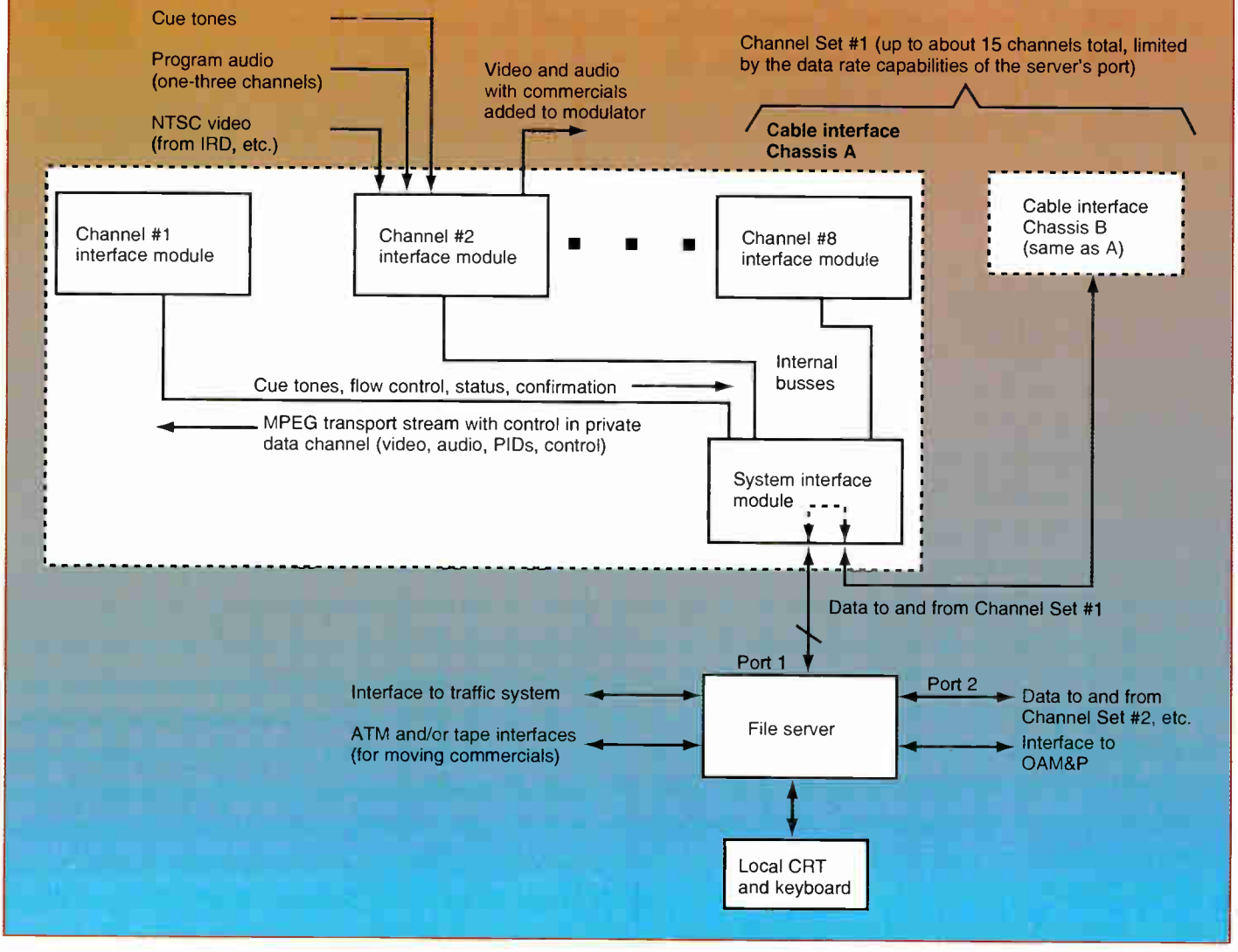

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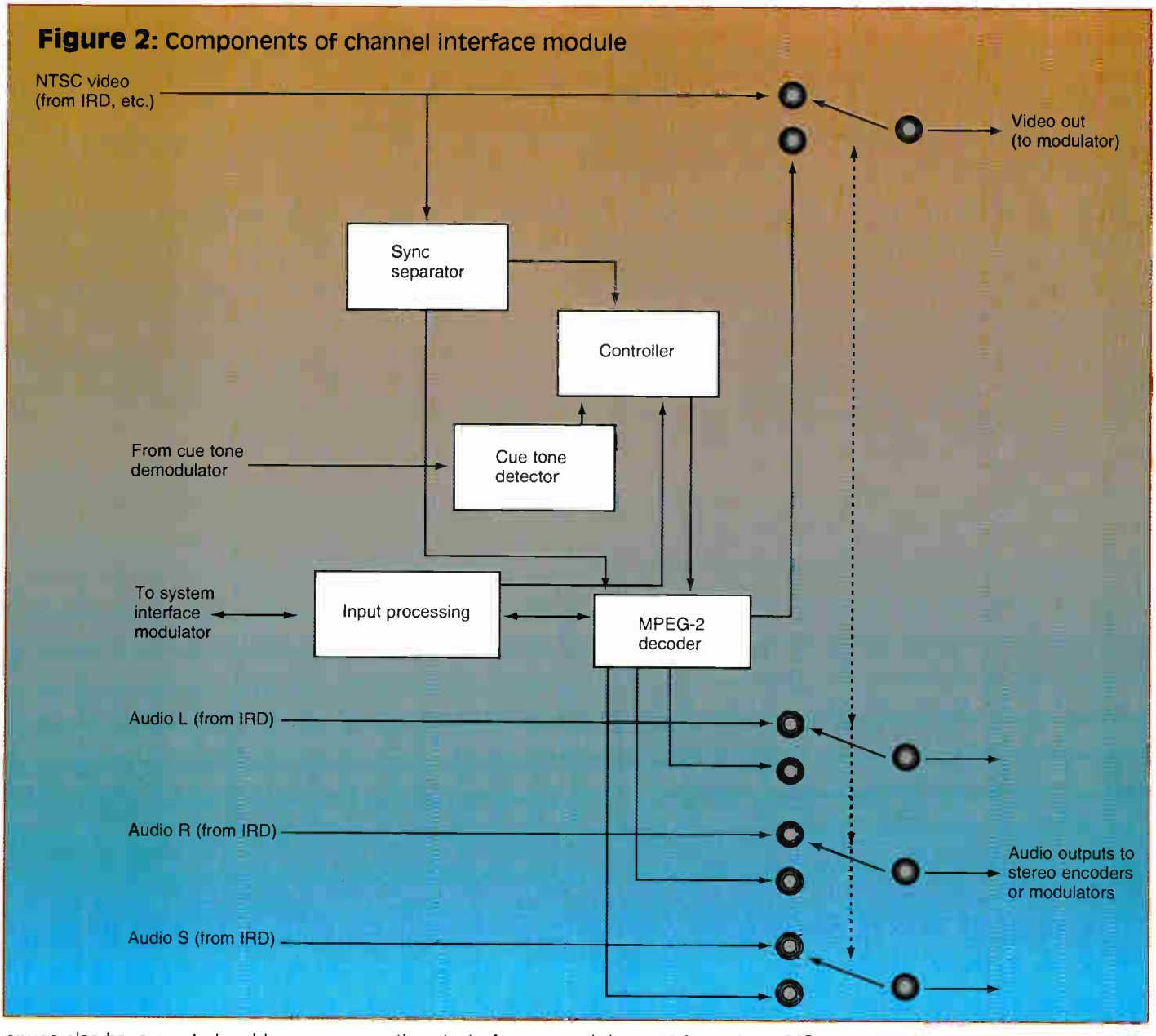
Figure 2: Components of channel interface module



enues also have created problems.

Today, new digitally based ad insertion systems are emerging that can eliminate most of these problems. For some current ad insertion users, migration to a digital system can mean an end to the inventory, billing and routing troubles of existing analog-based systems while strengthening existing advertiser relationships by more readily meeting their needs. For newcomers to the ad insertion business, advancements in digital technology have reduced equipment costs, providing operators with an ability to build the ad insertion business slowly, in a scalable fashion.

Analog-based ad insertion systems

An analog ad insertion system consists of cue tone detectors to detect the start of commercials, sent from the networks. They include switching equipment to transfer the video source from the primary program source (normally an earth station receiver and a decoder or an IRD) to the output of the appropriate tape deck. The tape decks constitute the largest part of the system since one deck is required for every channel, even if commercials on two networks run simultaneously. Tapes loaded into each machine carry the commercials to be run on that channel.

Since current analog systems are primarily VCR-based, a great deal of manual labor is required. Numerous problems with the VCRs can result: clogged heads, stretched videotapes and VCRs regularly malfunction from constant wear and tear. Since one VCR is required for each cable channel, headend space becomes a premium, and videotapes must be physically moved from one insertion point to the next.

Installation and maintenance costs also are high. Analog systems cost the cable operator or interconnect about $12,000 per channel to install and maintenance can mean costs can run up to $3,500 per channel each year.

Verifying that an ad actually ran represents a critical problem. In a perfect world, interconnects and cable operators would need to monitor every network at every headend to verify that all spots ran on the 33 reportable networks. Limited staffing doesn't permit such careful viewing, so operators rely on computer verification that integrates two computers — one at the

master location, others at each headend. The master computer calls out every two hours to a headend site and checks the VCRs to report if that site is operating. A two- to six-hour delay often occurs before a system can verify if a commercial ran. This type of system also can't verify the quality of the spot. Some interconnects must reimburse advertisers if they can't prove a spot ran.

Lead times to change ads — an important criteria for the advertiser — can take a week or more with analog-based systems because of the duplication process and the need to distribute finished tapes. Some interconnects have reduced this process to five days, but this remains noncompetitive compared to broadcast TV's less than 24-hour turnaround.

While analog systems do perform a valuable function for cable systems, interconnects and advertisers, digital ad insertion systems are an easier and more cost-effective way to increase revenues from targeted insertion.

Addressable commercial insertion

Addressable commercial insertion (ACI) opens the door for targeted advertising by relying on digital ad insertion systems for local avails. By dividing the cable system into demographic nodes, each node can receive a commercial specific to that demographic. For example, upper income areas can receive advertisements for luxury cars and middle income areas could see spots for mini-vans.

ACI gives advertisers an opportunity to customize their messages to a specific audience — even down to the 500-home node level. For cable operators, ACI provides an opportunity to build new revenue streams without radically changing their networks.

Digital file server-based systems take full advantage of the residential broadband architecture to deliver ACI. Like analog systems, digital ACI systems include similar cue tone detectors and switches. But unlike analog systems, one file server is able to supply video simultaneously to any number of channels, so commercials need be recorded only once.

Figure 1 on page 42 shows a typical file server-based ad insertion system and its connections to external systems. Interfaces to the traffic system tell the file server what commercial to play on what channel and at what time. This interface also allows the file server to confirm that the spot ran, thereby providing proper billing information for the advertiser. While this interface is similar to those provided in tape-based systems, the ability of an operator to check status, perform diagnostics and make last-minute changes means lead time is cut significantly over analog counterparts.

Compression and interface needs

Digital video file servers rely on video compression to store each ad. Files can be compressed remotely (a likely scenario in the early days because of the cost of compression equipment) and sent via high-speed digital telecommunication lines to the server. In the future, such transmission is likely to involve the asynchronous transfer mode (ATM) protocol, an open system that (it is hoped) will allow transmission equipment made by different vendors to talk to each other. ATM divides the files into fixed length packets that are then routed to the correct file server.

Alternative ways of getting commercials into the file server include local compression systems, which may ei-

"Digital ad insertion systems are an easier and more cost-effective way to increase revenues from targeted insertion."

ther operate in real time ("on-the-fly" commercial compression) or in longer than real time (compressing a 30-second spot over five minutes). Today, the latter may be more cost-effective.

At the low end, a software compression routing scheme running on the file server can be used if it isn't busy playing back commercials. The problem with this approach is that it requires a tape machine that can run slowly, under control of the file server. Such tape machines are available, but are costly themselves.

Another interface likely to become standard on file servers is an interface to an operational, administration, management and provisioning (OAM&P) system. OAM&P systems allow various subsystems, such as an ad insertion system, to be monitored and controlled by a higher-level computer that's monitoring many other different systems within the network.

Finally, data must be transmitted from the file server, converted to NTSC and inserted in the appropriate channel. In Figure 1 (page 42), two interface ports are shown, labeled Port 1 and Port 2. Each services a number of NTSC channels, limited by the bulk data transfer rate of which the port is capable and the data rate needed by the commercial. In the example system, one port on the file server can interface with up to about 15 channels, assuming a bulk data transfer rate of something under 100 Mbps and a requirement of perhaps 6 Mbps per channel.

The channel set served from Port 1 is physically contained in two chassis, Chassis A and Chassis B, each of which holds up to eight interface cards. The data signal from Port 1 is looped through the first chassis, then routed to the second. Port 2 and more ports on the file server can service additional sets of channels, up to the limitation of the file server internal structure.

Standard interfaces vary, including FDDI and fast and wide SCSSI, both derived from protocols used in disk drive systems in small computers. Another interface likely to be important in the future is OC-3, an optical interface operating output circuitry in the cable interface chassis. Data flowing back to the file server may include detection of cue tone and confirmation that the commercial actually made it to the correct output channel. Also included is flow control that regulates the rate at which the file server sends out the MPEG-2 data needed by the decoder.

This system interface module extracts MPEG-2 information bound for one of the channels from the file server's storage, stores that signal temporarily to compensate for delays in the flow control loop, separates the information into that needed by individual channels and routes the information to the channel interface. Each channel interface controls insertion onto one channel, including the audio and video as well as the cue tones from one incoming channel. The channel interface also receives MPEG-2 data for that channel, decompresses it and switches it to the output.

Figure 2 (page 44) shows the block diagram of one channel interface module. Video from the IRD enters at

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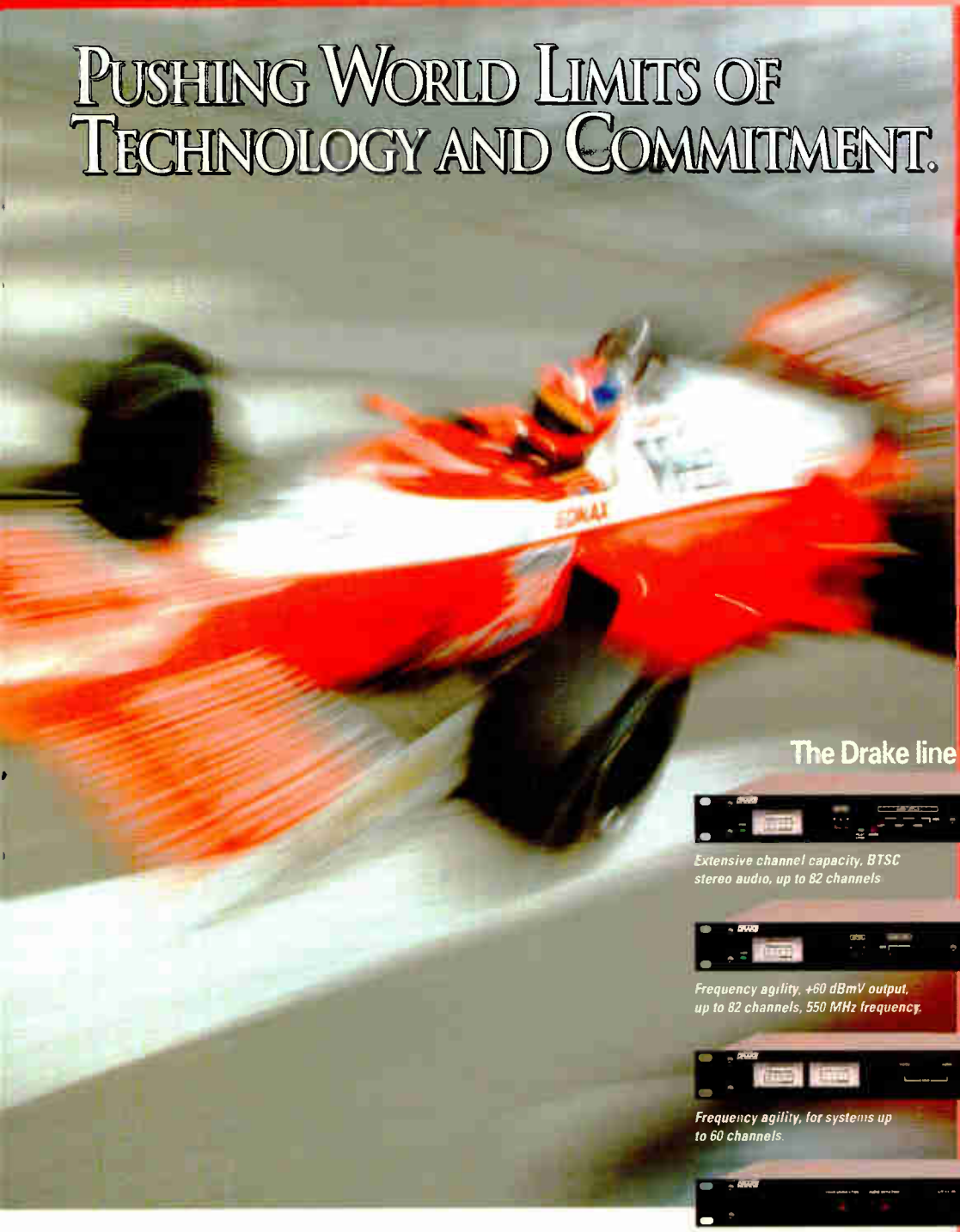

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the top left and is transmitted to the transfer switch, which selects either that video or the advertising video from the MPEG-2 decoder. The cue tone demodulator supplies cue tones to the detector, which informs the controller, typically a microprocessor, when cue tones are received. MPEG-2 data from the system interface module is supplied to input processing circuitry that controls the supply of data to the decoder and controls return of information back to the system interface module.

The sync separator synchronizes the MPEG-2 decoder and switches between the incoming NTSC video and the decompressed MPEG-2 video. This switching must be done between synchronized video sources and must be done in the vertical blanking interval to eliminate any visible artifacts on the TV screen.

Other digital ad insertion features

Since file servers rely on disk storage, much like personal computers, the unit is fully scalable. Additional storage, or increased output capacities, can be added at any time in the future. This gives the cable operator or interconnect the ability to expand capacity incrementally using new revenues to drive increased functionality and power.

Some digital ad insertion systems even allow operators to transmit commercials in two different languages simultaneously using a secondary audio programming (SAP) feature. This is a benefit for neighborhoods where English is a second language.

"For cable operators, (addressable commercial insertion) provides an opportunity to build new revenue streams without radically changing their networks."

Overlay technologies imbedded in the system allow local stores to advertise their location over a national product commercial. This could mean large numbers of cooperative advertising dollars for cable operators.

Maintenance costs tend to be about 10% per year of the original cost of the digital system, but that can cut the present $3,500 per channel maintenance and operating costs under current analog ad insertion system to $670 per channel for an 80-channel digital ad insertion system.

Digital ACI also provides a greater benefit to the advertiser — an ability to target commercials to much smaller pockets of subscribers. For instance, the cable system may start by establishing zones of similar types of subscribers, no matter what the service area size. If eight different zones were initially established with advertising available on 10 different cable channels, digital ACI systems provide the potential for 80 simultaneously run, but different commercials per zone and channel.

Once the ad insertion business is established, the operator could take a next step by breaking down those zones further. With an infrastructure that would support node-by-node services, operators could start placing node-specific advertising. For smaller advertisers, node-specific advertising would result in overall lower advertising costs. For the broadband operator, more time slots in more areas means greater opportunity to sell advertising space on a per-node, per-channel basis.

Node- or service area-specific advertising placement also can prove helpful for political advertising. ACI permits different, segmented commercials to run on defined nodes related to a politician's specific constituency, thus allowing a "narrowcast" that leaves other nodes available to commercial advertisers during the same time period.

Digital ACI also fits the long-term plans of the broadband network. Because digital ACI is based on the standardized MPEG-2 format and works with today's existing analog video transmission systems, cable operators looking toward the future can rest assured of a long-term ad insertion solution. Unlike tape-based analog systems that can't migrate up to digital, a digital system can deliver today's analog video while providing the standardized platform the digital video network of the future will require. **CT**

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- Digital TV
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- Digital transmission bit rates
- Quantization
- Digital compression (both vector quantization and descrete cosine transform)
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Enhanced services over advanced cable networks — Part 2

This article investigates the efficacy of the new advanced cable networks for delivering enhanced TV services to the home. In Part 1 (which ran in the February 1995 issue of "Communications Technology") the failure of a previous attempt by cable to launch two-way interactive services was reviewed and an evaluation of the potential for success for the current plans for new enhanced services was presented. In this part, some of the subtle features of the new architectures and enhanced services are discussed, and a supposition of why two-way interactive TV will succeed is proposed.

By R.S. Burroughs
Manager, CATV R&D
Panasonic Technologies

Cable systems traditionally have been used as a distribution path for products. Cable has been used for other applications, but the predominant use of cable networks has been for delivering entertainment TV into the home. Contrast this with another primary use of information networks such as the telephone network. This network is a medium for exchanging information between users, without much consideration given to content. Telephone networks are primarily a communication channel and not a product delivery path. This is one reason why telephone networks have a common carrier status. These are two critically important differences in network usage when you are looking to provide enhanced services.

To understand the importance of entertainment distribution channels, consider the case of movie studios. When a studio makes a movie, likely they will lose money on the movie. But they make money on the distribution of the movie. Now consider a new venture that wants to create a new enhanced service for television. It also needs a distribution channel for its product. Should it choose a common carrier network or a product distribution channel? Whichever it chooses, it needs to understand the audience characteristics of the distribution channel it decides upon.

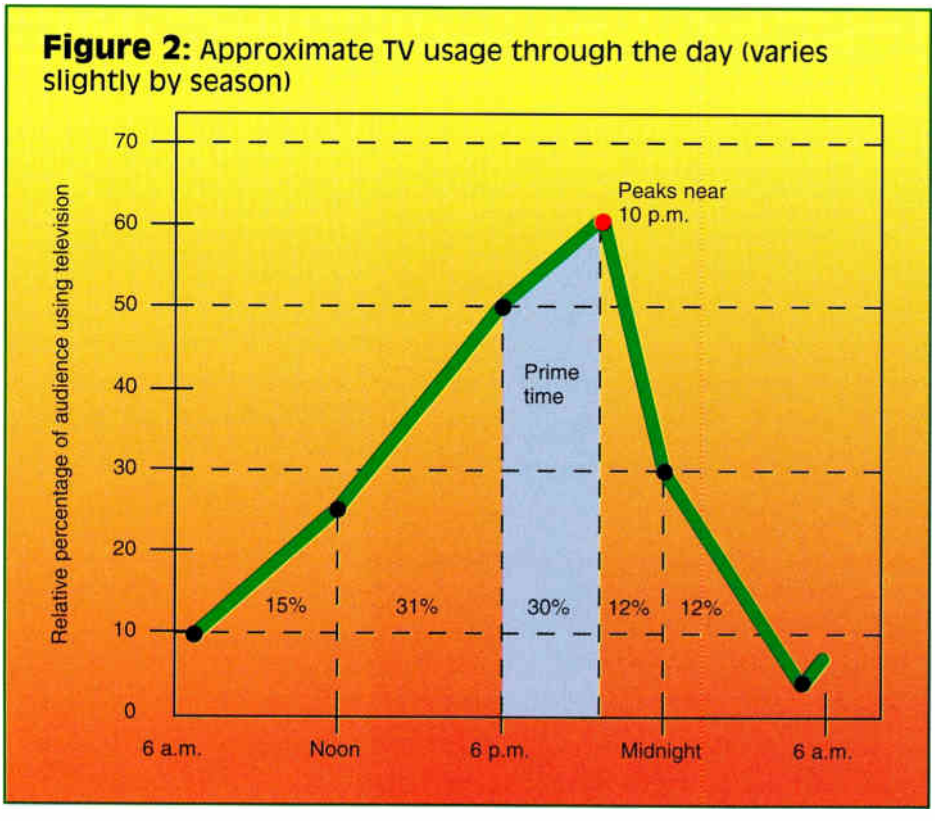

Figure 2: Approximate TV usage through the day (varies slightly by season)

Let's take a look at the channel for distribution of new programming that cable's new advanced architecture offers. Figure 2 shows a statistical curve that is an approximation to the viewing habits of audiences for conventional TV, including cable. Although the curve varies slightly from day to day and over seasons, it tends to retain enough of the approximate shape and relationships shown to make some useful observations about the path for distribution of new enhanced services to subscribers.

The curve is divided into five sections. We see that during the four-hour period from 6 to 10 p.m., 30% of the audience uses television. This is the window that most services seem to target because it represents the highest concentration of buyers for the product. The competition for this time slot is going to be fierce, even with expanded channel capacity.

Those that can put the best product out will dominate this time slot. The best product, in the case of near-video-on-demand (NVOD), may take the major portion of the available spectrum, leaving little space for any other services. This sug-

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gests that if you are going to design a new enhanced service, then you might not think in terms of dedicated channels, but you might find a better approach by targeting one of the other time segments. Most services today target the full 24-hour time period. This is because they usually have a full channel available to them on a 24-hour basis.

With the new digital architecture it will be hard to distinguish one program packet on the network from another. So it is very likely that services will not have full use of a 6 MHz channel (or spectrum) for 24 hours. Because of digital time compression and packetization, even the concept of a channel will fade. New services will have to think in terms of time slots and bit rates. For instance, if a new service is developed to target a specific audience between midnight and 6 a.m., it might be able to achieve success by capturing a significant portion of that audience. A service also could be developed that took advantage of the unused gaps between packets of other TV programs.

The service developer is usually looking for the best way to distribute its product and for the best distribution path (and possibly multiple paths). But the distribution path supplier (the cable operator) is looking to maximize its profits and it controls the distribution channel to the end user. The cable operator can optimize the use of this distribution channel by leveling the usage curve.

One way to achieve leveling is to use the network for non-real-time applications such as delivering programs to a storage device in the home (i.e., VCR). Another way is by delivering data to program guides, which are getting bigger and bigger and taking longer and longer to download during off-peak hours. Yet another way is by loading electronic catalogs or video games to the subscriber. VOD with full VCR capabilities would be relatively easy to deliver at 3 a.m. when the viewing audience is typically small. This might even be a good method to give subscribers an incentive to buy programs at off-peak hours.

The other use of information networks mentioned uses the common carrier model. In this model, the network is used only as a vehicle for interconnecting two or more users/sources. From a business standpoint this use differs significantly from the way cable is accustomed to using its network. In the common carrier model it is traditional to charge for time, distance and bandwidth used. But in the product delivery model, it is not the time, distance and bandwidth used that is the key determinant of what the product cost will be. It is the value to the end user of the delivered product. This is exemplified in cable today, where a single 6 MHz channel can be used to charge $30 for a two-hour PPV event while The Weather Channel, using the same 6 MHz bandwidth, will only charge pocket change for a full month's worth of service. In the common carrier model, such as used by telephone companies, these two services (if they used the same bandwidth at the same time and delivered the programs over the same distance) would likely charge the same price for the use of the network.

It is interesting to speculate how a telephone company, as a common carrier, is going to deliver a two-hour movie for $3 to $4. A typical movie takes a 3 Mbps (or more) data stream for about two hours. A two-hour phone call could easily cost $30 to $40, and voice takes significantly less bandwidth, requiring 64 (or less) kbps data. The disparity in cost vs. bandwidth needs to be resolved if the common carrier model is to be used for video services but an even bigger dilemma for the common carrier model is that the network provider does

not participate in the profits of the enhanced service provider. And even if your social consciousness thinks the network should be open to all users, it is going to take huge investments by cable companies to build these networks and to grow and support the new services.

"Catch 22." No network, no services. No services, no network. No rational businessperson is going to make the investment in these networks without the assurance of participating in the profits of the services. These networks won't be granted monopoly status either as was done to launch telephone early in the century. Granting monopolies is not the direction our government is taking. If you want to use the common carrier model then you probably need to be a monopoly, but if you are in a competitive market you'll more than likely need to use the distribution channel model.

Enhanced services?

There will always be a place for entertainment that does not require any more interaction from the consumer than turning on the TV set and selecting the program. It is my contention, however, that any future enhanced services will of necessity be two-way interactive to some extent to be successful. It will probably start gradually, but once it catches on a service will not be competitive without interactivity.

What do I mean here by interactivity? Almost any service is interactive to some extent. Currently in cable, a subscriber can interact with the channel tuner to move from channel to channel. In PPV the subscriber can select and order programs over the phone. By using a downloadable electronic program guide the user can interact with the information in the guide to select channels to watch or program. These are all simple forms of interactivity and a minor form of what I mean when I refer to interactive services.

Services that download electronic games to a home game machine and send programming to VCRs where the user is able to control the program with "play," "stop," "rewind" and "pause" are not what I consider two-way interactive TV. The reason is that the major part of the interaction is done in the home and these services could just as easily be delivered by some means other than networks (such as CD-ROM).

By two-way interactive TV, I mean a service where the subscriber has a dialog with machines or other people electronically over the network. The subscriber may interact with a video server at the cable system service center, or with other subscribers in the network, or with service providers in remote locations. A key element to this interactivity is that a two-way communication channel adds a benefit to the service that can't be achieved without the network.

The two-way interactive TV service may enhance the user's interactivity in the home. For instance, interactive resources in the home such as PCs and video games can interconnect with more extensive resources external to the home through the cable network. In this way, higher quality audio and video with more complex interactivity and larger data bases can be accessed through the network than could be generated in the home. The most obvious benefit is convenience.

Will interactive TV happen this time or will another less costly more easily deployed service, such as NVOD, push it off another 20 years? It all depends on whether digital terminals are deployed in sufficient quantities to provide an attractive distribution channel for enhanced service providers. With the competition from Hughes' DSS, the telephone com-

Table 2: Potential revenue sources for cable

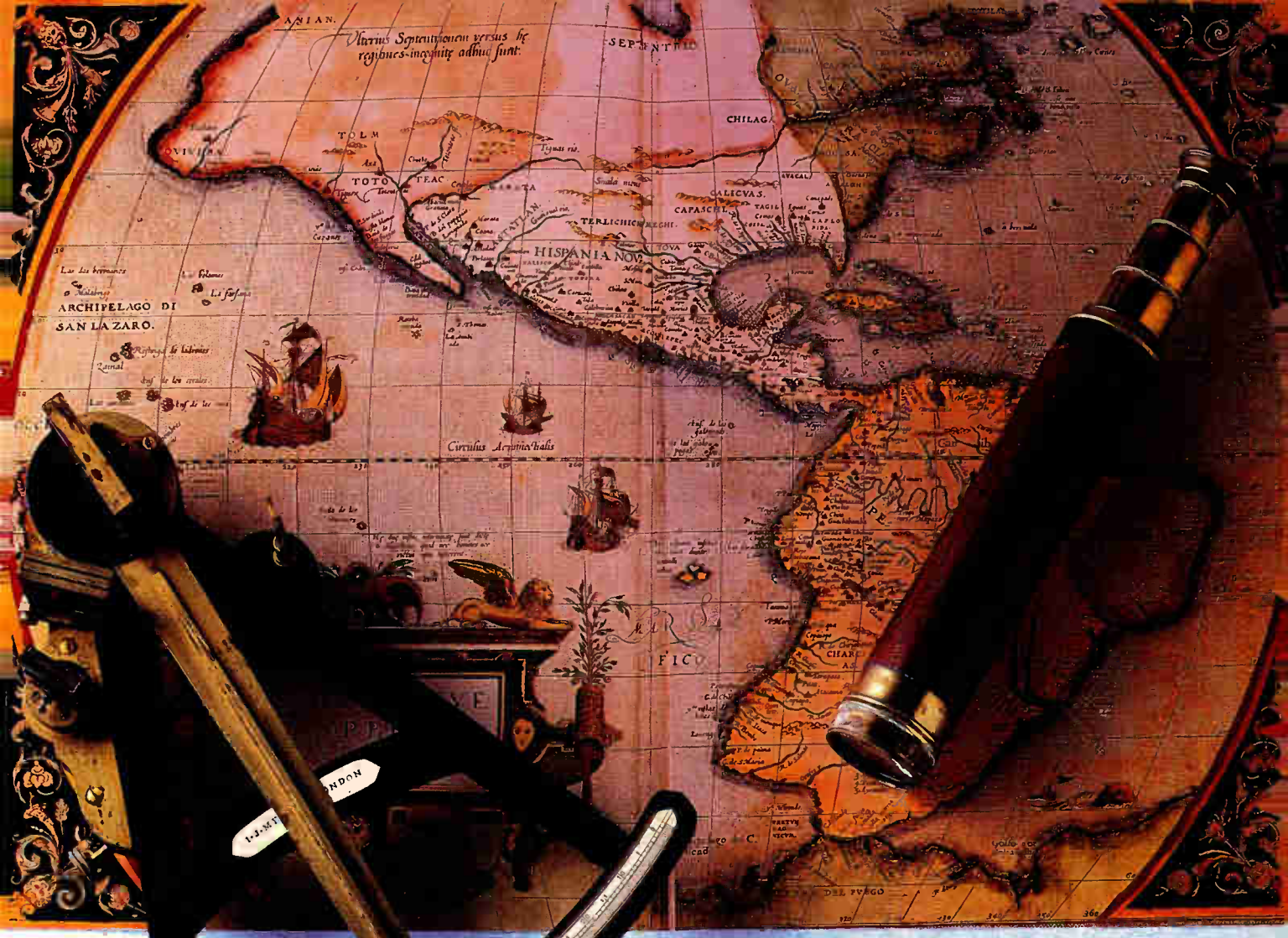
Source	Approximate revenue (±20%)	Cable's advantages
Video rental stores	$12 billion	Convenience, ease of selection and purchase
Video games	$7.5 billion	Better graphics/audio, more variety
Advertising	$40 billion	User-directed
Home shopping	$60 billion	Point-of-purchase convenience
Gambling	Unknown	Convenience
Telephony	$120 billion	Shared cost
Education (home-delivered)	$2 billion	Convenience

pany's threat and the PC's proliferation in the home, digital is happening now and there is no stopping the change.

So digital is virtually here, but how does digital imply interactive TV for cable? Digital satellite transmission still makes sense to gain instant distribution to existing subscriber bases. But once the commitment is made to install digital decoders in the home, then other digital services can be inserted in the gaps between the satellite's program packets, with no additional cost to the home terminal. These added services can be either independent of the satellite programs or they can complement the programs. One form of these complementary services could be advertisements with interactive ordering. Or there could be additional related program information or user-controlled viewing angles of a sporting event.

Additional channel capacity for new services can be found during nonprime-time hours. During these hours, not all of the bandwidth in all service areas will be used. Even with 500 channels for NVOD, not every bit of bandwidth in every service area will be used simultaneously. An example of this is the Super Bowl, where a large percentage of the TV audience would be watching the same program. If for instance 30% of the subscribers in a particular serving area with 500 subscribers and 500 digital channels were watching the Super Bowl, then there would be 499 channels for the remaining potential audience. In a digital system it should be pointed out that the concept of a channel is a bit fuzzy. Many programs are sent simultaneously in packets to be selected and reassembled in the digital terminal. Each program packet can consist of several audios, multiple videos and private data with an association to the program (such as closed captions).

The term channel, in the example, is used only to convey a point. In actuality most proposed digital cable systems will be deployed with 6 MHz bandwidths carrying digital bit rates from about 30 Mbps to 40 Mbps. Since digital programs can be compressed with varying rates, the number of programs that can be transmitted over one 6 MHz portion of the bandwidth is variable. In most cases the transport system will insert null packets when the programs do not satisfy the required data rate. These null packets could be replaced by information packets (or short segments of downloaded programs such as commercials) and then reassembled in the proper sequence at the digital terminal. In essence, many in-



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"Will interactive TV happen this time or will another less costly more easily deployed service, such as NVOD, push it off another 20 years?"

teractive services could be squeezed between regular programming. And programming that had no active audience could be deleted from the packet streams and alternative programs or data could be inserted.

Where is the revenue?

It's one thing to put a few million dollars into an enhanced services experiment and quite another to deploy digital TV and video servers to 60 million subscribers. The digital FTTN networks will take a lot of money to build and new enhanced services will take a lot of money to launch. Why do we think subscribers will pay substantially more in its cable bills for these services? Didn't recent government regulations get imposed because subscribers were complaining about increasing cable bills?

There are a few reasonable means for cable to gain the necessary additional revenues to build its digital systems. A traditional method used by cable is to increase subscriber penetration such as was done with the pull of "original" cable programming in the 1980s. I am skeptical of this method working in the beginning of the digital rollout. There will probably be a fad reaction that will attract some new subscribers, but new products have always taken several years to gain the support of the majority of the consumers.

The second method for gaining additional revenues is for cable to siphon revenue from products in other markets that consumers have shown they will buy. Table 2 on page 54 gives a list of several viable markets that cable is targeting and some of cable's advantages in these markets.

A third possible way to get new revenue is to develop "killer applications" that everybody wants, but this has the same problem as the first proposal: It will take a while to gain consumer acceptance.

This leaves the second option mentioned as the reasonable answer: Siphon business from already established markets. In the process, the other options should fall in place. NVOD and VOD might arguably be classified as belonging to the first or second option, but I contend that to get substantial penetration from these services, cable needs to take the business away from videotape rental stores.

Currently movie studios are moving cable's show window back, not forward. Without an earlier release date than the tape rental stores, neither NVOD nor VOD will provide significant revenue. This suggests that to gain the earlier window, cable needs to launch an all-out campaign to capture the tape rental business. Otherwise it will take a long time for NVOD or VOD to be successful. And by that time there will likely be many more competitors and cable will not be in as advantageous a position as it is now.

A common belief today is that there will be no one service that will pay for the building of the network but that a combination of services will be required. It could be risky if there is no anchor service that essentially pays for the network. Each new service needs to be able to support its proportionate share of the resources used. If these conditions are not met, then there is a risk that not enough new systems will be deployed to be able to reach "critical mass".

This is where the deployment of digital systems has an advantage over analog. With digital, it is easy to incrementally add services, especially services that do not take the full spectrum of a two-hour movie. If there is adequate standardization of digital, such as is being done in Europe today, then new services can utilize existing video servers, transport systems, modulation schemes and digital terminals. Then it should be relatively easy to try new services and to expand cable systems in step with the growth of the generated incremental revenue.

One application that does not quite fit the ideal architecture for interactive TV services is telephony. This is a very attractive revenue source and for competitive reasons cable needs to continue its pursuit of this business. But, the requirements of the FTTN architecture will be stressed. Cable is best at sending orders of magnitude into the home. This results in asymmetric networks. Telephony, on the other hand, uses symmetric networks, since most of the traffic is between two users with equal requirements. Providing voice

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SPECIFICATIONS

PARAMETER	SYSTEM M/N	SYSTEM B/G	SYSTEM D/K China*	SYSTEM I
VIDEO SECTION				
Input: C3F Neg	NTSC	PAL	PAL	PAL
Input Impedance	75 ohms unbalanced	75 ohms unbalanced	75 ohms unbalanced	75 ohms unbalanced
Frequency Response	±0.5 dB	±0.5 dB	±0.5 dB	±0.5 dB
Bandwidth	4.2 MHz	5.0 MHz	5.0 MHz	5.5 MHz
Differential Gain	2% max	2% max	2% max	2% max
Differential Phase	2 degree max	2 degree		2 degree max
Hum & Noise	-60 dB	60 dB		-60 dB
AUDIO SECTION				
Input: 50 Hz-15 KHz	0 dBm (.8V)			.8V
Impedance	600 ohms balanced			
Frequency Response	±1.0 dB			
Frequency Tolerance, ±500 Hz	4.5 MHz	5.5 MHz		
Frequency Deviation	±25 KHz			
Harmonic Distortion	1% max	1% max		
Preemphasis	75µs	50µs		
IF SECTION				
Video IF Level	+37 dBmV +97 dBµV	+37 dBmV +97 dBµV	+37 dBmV +97 dBµV	+37 dBmV +97 dBµV
Audio IF Level	+22 dBmV +82 dBµV	+27 dBmV +87 dBµV	+27 dBmV +87 dBµV	+27 dBmV +87 dBµV
Return Loss	>14 dB	>14 dB	>14 dB	>14 dB
IF Frequency				
Video Carrier	45.75 MHz	38.9 MHz	38.0 MHz	38.9 MHz
Audio Carrier	41.25 MHz	33.4 MHz	31.5 MHz	32.9 MHz
Video-Sound Spacing	+4.5 MHz	+5.5 MHz	+6.5 MHz	+6.0 MHz
Vestigial Sideband Width	0.75 MHz	0.75 MHz	0.75 MHz	1.25 MHz
RF SECTION				
Output Frequency	470-750 MHz			
Frequency Tolerance	±2 KHz			
Output Level	+60 dBmV max			
adjustable	+120 dBµV			
Output Impedance	75 ohms unbalanced			
Spurious Output 470-750 MHz @+60 dBmV/+120 dBµV Output Level	<-60 dBc			
Return Loss	>14 dB			
Frequency Response	<2 dB			
MECHANICAL AND POWER				
Dimensions	Standard 19" (48.26 cm) Rack Mount, 1.75" (4.44 cm) High & 14" (35.56 cm) Deep			
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"It's one thing to put a few million dollars into an enhanced services experiment and quite another to deploy digital TV and video servers to 60 million subscribers."

traffic over cable networks does not represent too serious a challenge. But video telephony will demand that cable architectures assume a more symmetrical architecture. This will reduce advantages that the current advanced architectures have in delivering standard as well as interactive TV. The way the competition for telephony services will play out is extremely complicated because of the major differences between the two major competitors (cable and telephone) and because of the uncertain legislative issues.

Besides telephony and movies, there are a whole group of services that could bring substantial revenue to interactive TV. Video games, advertising, home shopping, gambling and education all need to be entertaining and need to be interactive if cable expects to capture significant market share. Entertainment is needed to get subscribers to access and continue using the services. The services also need to be interactive to give cable an advantage over the existing distribution channels. It is very unlikely that the existing suppliers will roll over and just let cable take away their business. Expect a fight. Cable's ability to address all markets simultaneously suggests that cable has a big advantage. By using a common distribution channel, cable has the potential for making the cost of the product delivered to the consumer cheaper and more convenient than the current means of distribution.

Why it will happen

It will happen for two primary reasons:

- Convergence of technology fostered by digital compression.
- Competition, which hopefully will be made possible by deregulation. A secondary reason is that the people are being made ready for interactive TV through usage of video games, PCs and interactive CDs. There is only a limited time before the huge financial resources of the telephone industry are brought to bear, so the next 10 years are critical for cable. **CT**

Author's note: In the first part of this article, which ran in February, I discovered an error.

On page 40 of that issue, in the first paragraph under the subhead "Digital — the key advance," I compare a full analog system with a full digital system and showed how 15,000 channels could be expanded to 150,000 channels. But I erroneously stated that the 150,000 channels were for a 10,000-subscriber system. Since the comparison was to an analog system of 50,000 subscribers, the digital system also would be 50,000 subscribers, giving only 3 channels per subscriber and not the 15 channels as was stated.

Although there is a significant difference between 15 and 3 channels per subscriber, there is little change in the argument that there is more than enough channel capacity for all-digital systems with fiber-to-the-service-area architectures. After all, every subscriber on the digital system can have access to 3 channels simultaneously.

In-home cabling for digital: Future-proofing signal quality and minimizing signal outages

The following article is adapted from a paper presented at the Society of Cable Television Engineers' 1995 Conference on Emerging Technologies. The complete proceedings manual is available from the SCTE, (610) 363-6888.

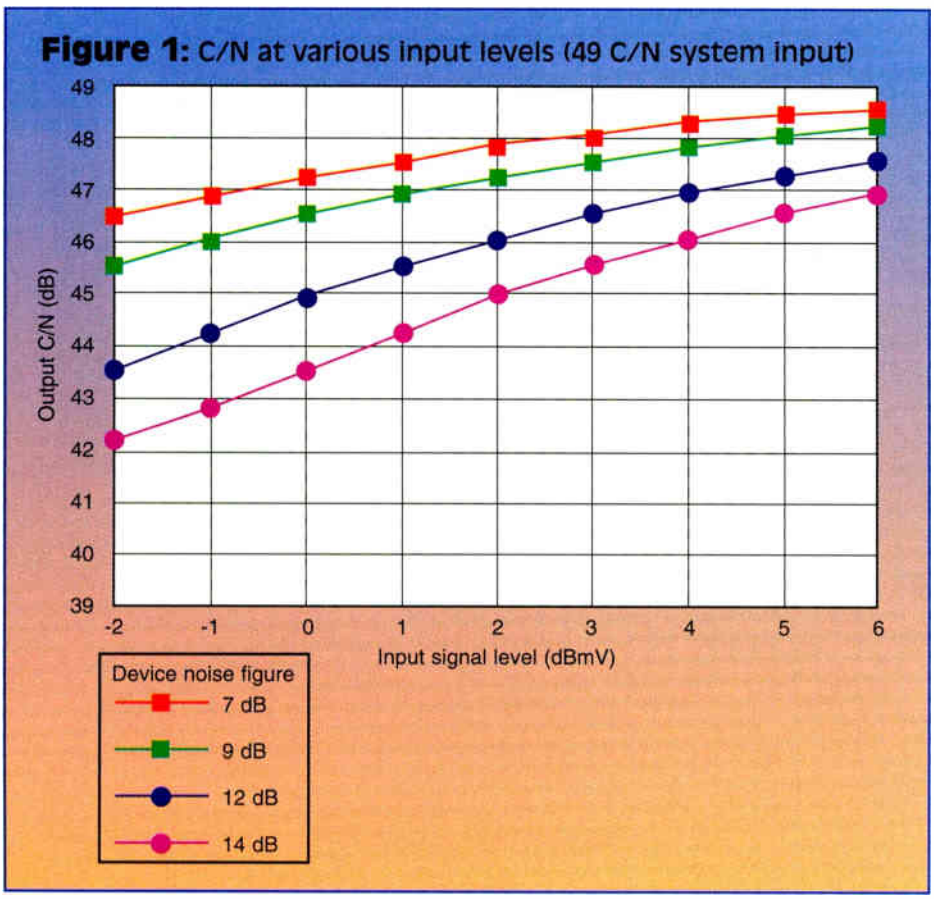
By Brian Bauer
Marketing Research Manager, Raychem Corp.

The cable industry is on the verge of transmitting digitally compressed signals to the home over hybrid fiber/coax (HFC) networks, a technology that will vastly increase the potential for revenues. With high-rate digital encoding and decoding capabilities coming to fruition, success lies in the ability of the network to maintain signal integrity. Fiber portions are excellent, the distribution network is very good and the industry is continually improving drop practices. In general, network equipment controlled by system operators is improving. It will likely be the in-home cabling environment, an area traditionally inaccessible and uncontrollable, that will be the greatest challenge.

The barriers to delivery include degraded signals and component failures caused by subscriber tampering or installation of substandard products. Alternative approaches to home cabling practices include more stringent component requirements, consistent architecture specifications, permanent cable drops, greater built-in surge protection, and consumer awareness campaigns. Improving service constitutes both a challenge and an opportunity.

The in-home cabling network will have to be strengthened before digital signals can be reliably delivered to the home TV set. If the industry designs the outside network with the goal of meeting Federal Communications Commission levels inside, chances are improved for providing digital services, but variations in the home do not assure reception.

Figure 1: C/N at various input levels (49 C/N system input)



The way the industry meets transmission requirements today is by estimating the drop system performance into the home and designing tap signal output appropriately. If even a low percentage of homes fail to meet the standards for in-home cabling, maintenance costs for service calls could be substantial. Degraded analog signals are often tolerated today, but digital images are perfect until the signal level is inadequate and then the image drops out. Drop-outs of digital pictures will be unacceptable and will generate excessive, expensive and slow customer service responses. Such a scenario does not produce satisfied customers.

As the choice of service providers emerges, it becomes increasingly important to improve both quality and availability of service. Regardless of responsibility and ownership of equipment in the home, the cable system operator will need to service and maintain the home network if the company wants to be perceived as a quality supplier.

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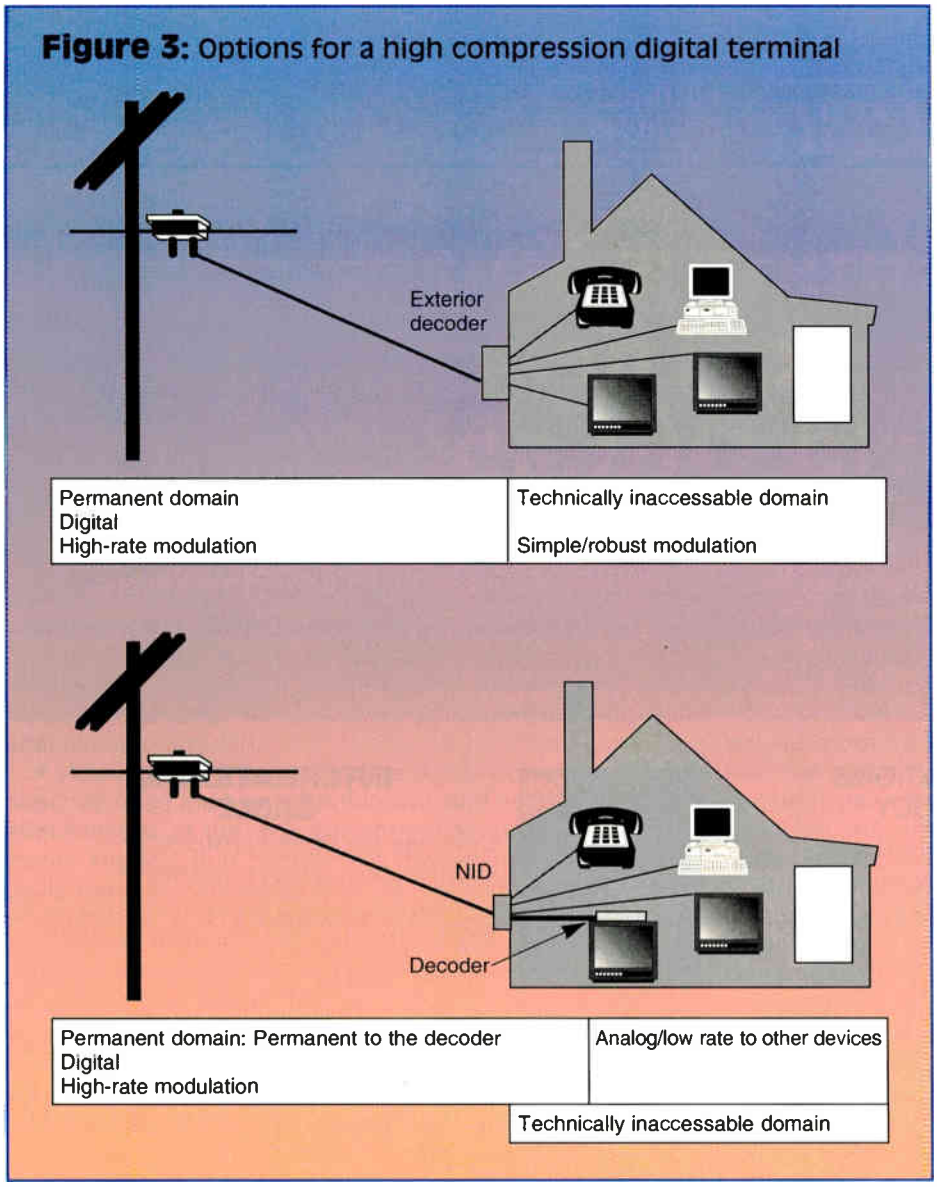
Figure 3: Options for a high compression digital terminal



availability is outage of home network actives, particularly the set-top converter. Using better quality components and protecting the components from surges will substantially improve the reliability of this equipment.

Large voltage spikes, due to switching, capacitive discharges or other power disturbances, can cause impulse noise and/or equipment damage. High-voltage protection at the point of entry and effective grounding at the ground block will effectively protect the home system against surges and minimize the level of energy entering the home. Below this level, surges can be stopped with additional protection included at the board level.

Standards to ensure good practices

The SCTE Engineering Committee has committed to working on home cabling issues and its Interface Practices Subcommittee is drafting recommendations for circuit protection, amplifiers, passives, connectors, cables and installation for home use. An installation guide is currently being introduced and "seal of approval" standards are being developed.

To improve the level of circuit protection in the home, comprehensive primary (point-of-entry) and secondary (board level) standards are being drafted. The IEEE (PC62.64) also is developing a circuit protection standard for next-generation communications equipment.

Bellcore, the Telephone Industry Association and a number of telephone operators have recently studied the detrimental effect of customer premise equipment (CPE) failures upon the operations of telephone companies. Though the indoor environment is not the responsibility of the operator, excessive failure of equipment in the home, regardless of fault, can deeply affect maintenance operations. Maintenance costs caused by extra service calls have become such a burden that several organizations are considering setting standards or regulations in the effort to reduce home outages due to CPE. If standards are set to improve the ability of CPE to withstand repeated surges and/or overall reliability, it is likely to have positive reliability implications for set-tops.

Executing good practices

Knowing what should be in the drop is fairly straightforward. Assuring that it is executed is of course, the real challenge. Home accessibility is easiest at the time of installation rather than during box retrieval, service termination or when cumulative leakage problems emanate from inside a home. When new set-tops are installed, operators should assure that the home cabling is service-ready and tight, especially for digital service. Proper component usage and (semi-) permanence can be assured at this time and cable can be checked for shielding integrity and braid count. Whichever industry or MSO standards are used, the first installation is the time to ensure compliance and make efforts to promote sustainability.

Effective architectures

Meeting FCC requirements will go a long way toward assuring sufficient signal levels to the decoder. The typical home (if one exists) should not create a problem in the delivery of service to the consumer. However, industry planning typically entails making assumptions about in-home drop lengths and levels of attenuation through passive devices. Two options for improving reliability include deploying home-run architectures and creating permanent, tamper-resistant drops to the digital decoder.

The home system can be considered a subnetwork. Several new approaches are currently being introduced, most of which insist on home-run architectures. As with outside architectures, those that succeed in minimizing the number of actives and discontinuity points will cause the fewest impairments. Just as the outside network is improved by having dedicated fiber to nodes and by reducing cascaded amplifiers, the home network will be improved when the drop is seamless from the home point-of-entry to

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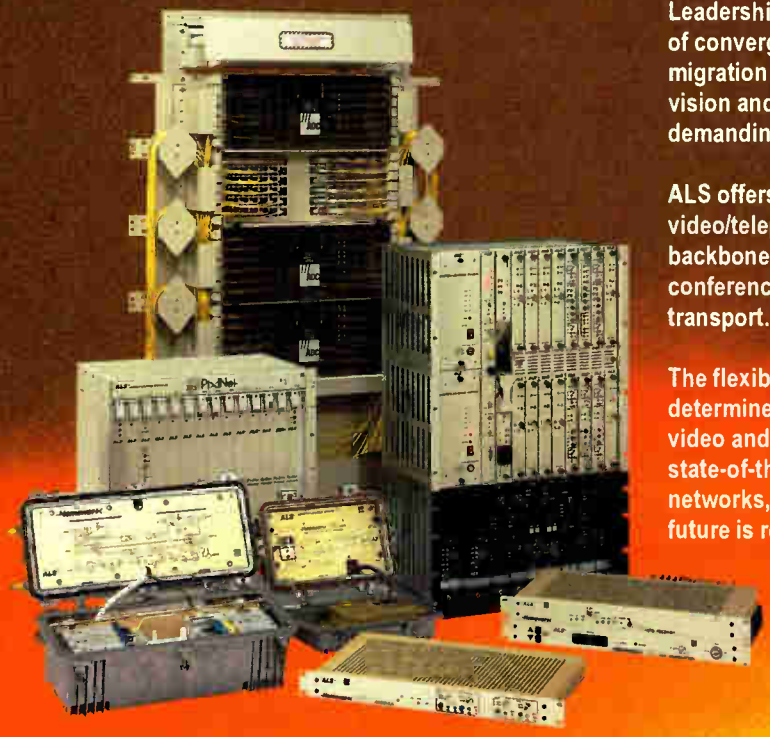

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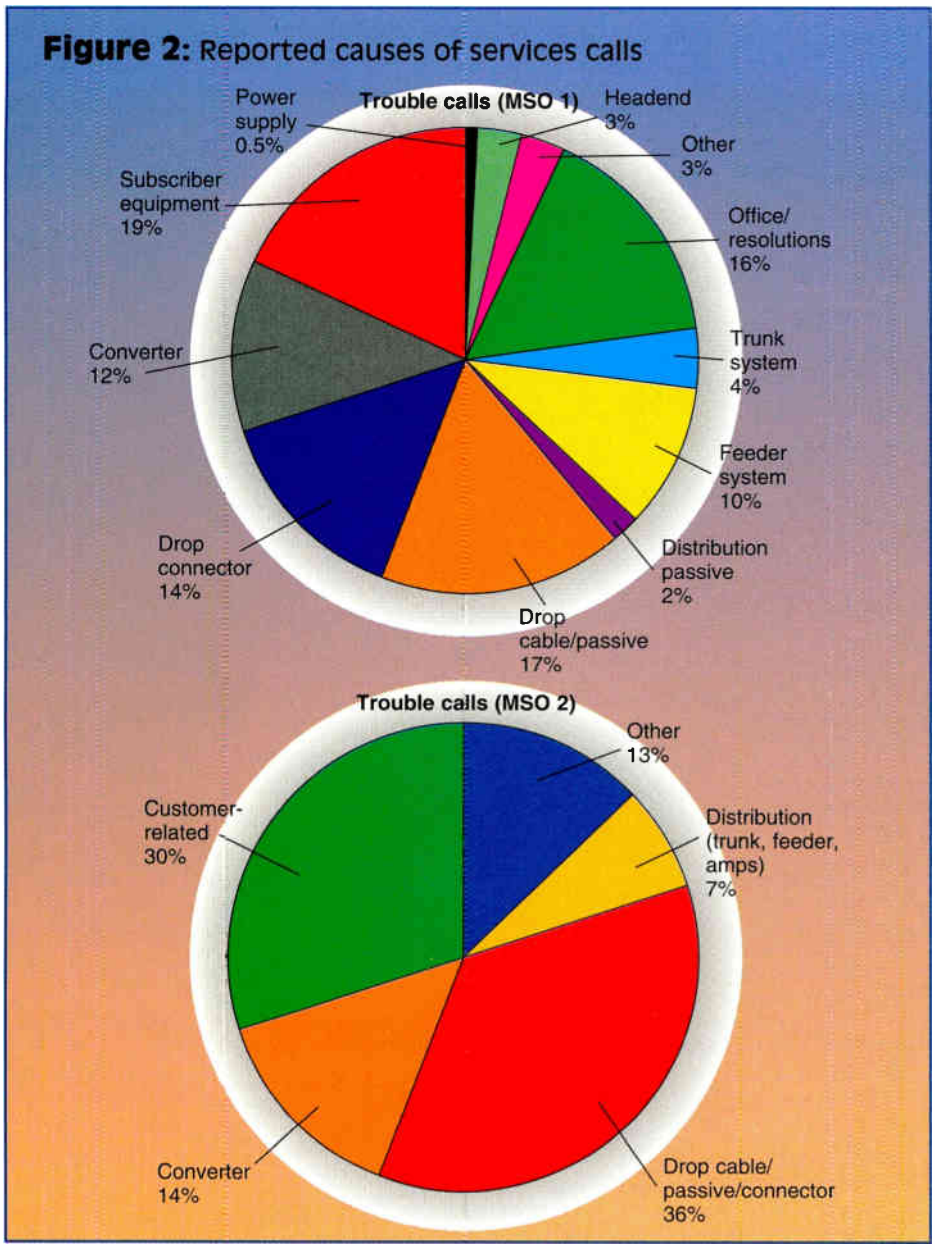
Figure 2: Reported causes of services calls



Several initiatives can be taken or are currently under way to assure that in-home cabling will not disrupt continuous, quality service. We will review the important considerations of the in-home system in delivering signal. Then we will explore some of the ways to influence the components that go into the home and to use industry standards to motivate the many parties that install equipment.

Barriers to delivery

Though delivering excellent picture quality in a digital realm may not require the levels of signal quality that are necessary for traditional analog delivery, keeping that picture on continuously is key. First we need to define the requirements of the home cabling system: What does it take for services to function? If consumers are receiving service, they are likely to be receiving excellent results ("all or nothing"). But what if the equipment degrades over time and the future holds a busy paging company just next door? Or what if blender drinks will be whipped up while a crowd is watching a football game? And what if the received signal is just at the threshold? These questions can only be truly answered when services are deployed. But it is likely that everything will look great until the threshold is reached. Transmission quality is irrelevant to the consumer as long as a signal is received. Problems that affect availability, such as threshold impairments and component outages, are critical.

From engineers' perspectives, the consumer's availability translates into the need to keep signal quality high and equipment outages to a minimum. The signal also must be reliable and available over some period of time, ideally for as long as the consumer desires services from that box.

The factors that can reduce the availability of digital service fall into two main categories: excessive reduction in signal quality and component outages.

Signal quality

To ensure transmission quality, system designers target low levels of the common reference, bit error rate (BER). Increased BER caused by any one of the signal quality parameters, such as noise, reflections and attenuation, may or may not produce consumer service outages. But a combination of these will reduce signal quality, increasing BER, causing outages.[1]

Two services in widespread use today can be used to predict the effects of these signal parameters:

1) The service provided by the very robust modulation schemes of digital music services.

2) The less robust modulation, yet shorter transmission run, of the new direct broadcast satellite (DBS) services. These services provide excellent benchmarks for cabled digital video.

What follows is a look at some of the transmission quality issues we must consider:

- *Noise:* Many of the drop-offs occurring today with digital music emanate from strong burst sources, such as pagers and mobile radios, as well as impulse noise due to electrostatic discharge from appliances or power switching networks. Poor shielding has caused some problems in the roll-off frequencies in the FM band. Problems are even more likely if connections do not shield effectively or if the connections are loose. Such problems typically come in the form of cracking and popping noises.

In general, the use of strong modulation schemes and effective error correction techniques has produced quite robust systems. Schemes proposed for digital video (64-QAM or 16-VSB), requiring higher levels of decoder sensitivity, will require increased system integrity.[1]

- *Reflections:* It is difficult to define or measure the effects of reflections on a system without using special test equipment. But in the lab, where reflections are seen to cause intersymbol distortion leading to symbol errors, the

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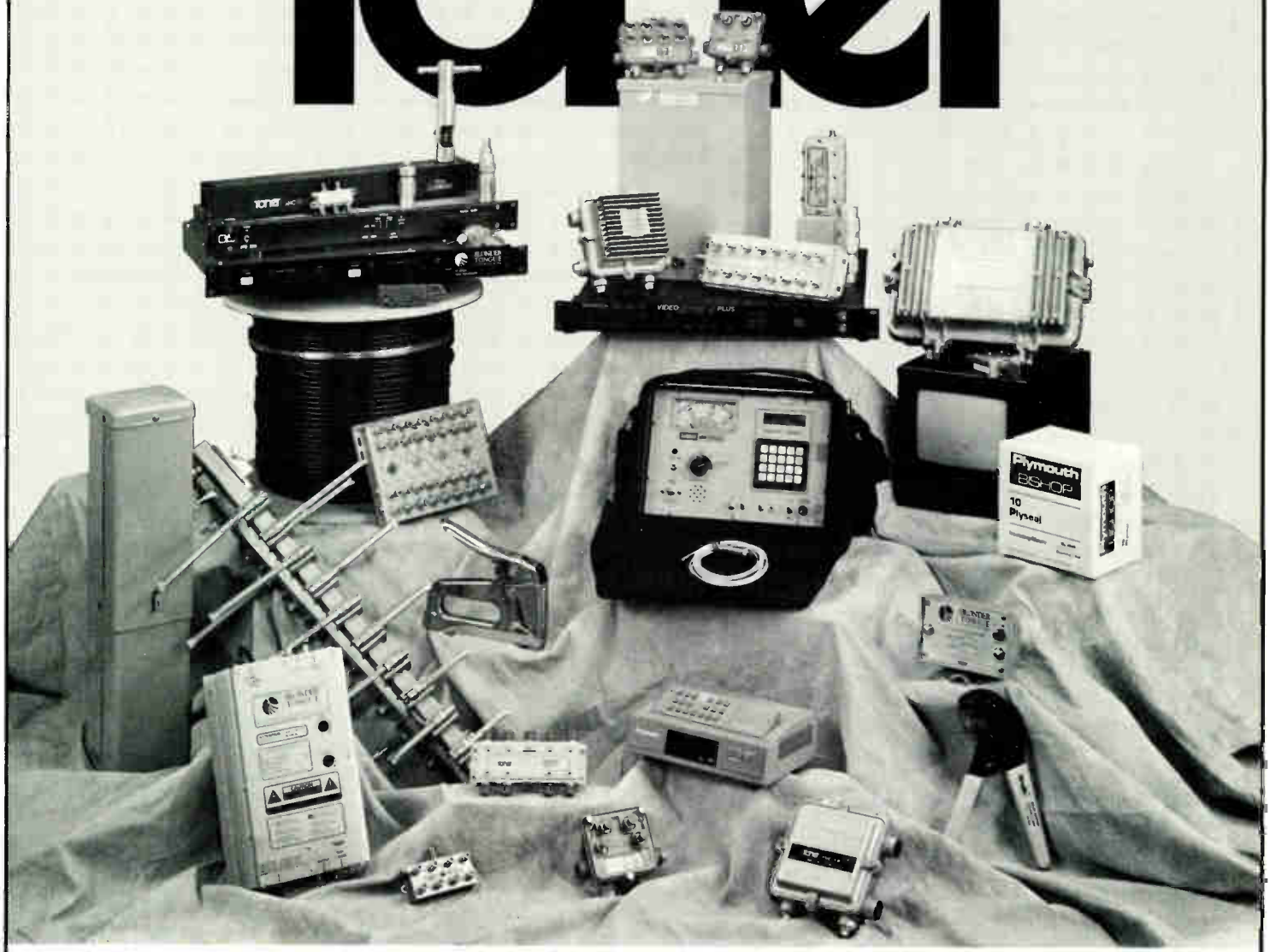

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"Alternative approaches to home cabling practices include more stringent component requirements, consistent architecture specifications, permanent cable drops, greater built-in surge protection, and consumer awareness campaigns."

potential negative effects are well-understood. Reflections can combine with noise to cause signal quality to approach its minimum threshold. Depending upon the spacing of discontinuities (e.g., connections, passives or cable kinks), standing waves can be additive or canceling.

The effect of reflections on signal quality is nearly impossible to predict or control in the house where component spacings and tampering may occur frequently. Adaptive equalization taps in the terminal devices are helpful here, but for some percentage of homes it will not be economical to attempt to resolve all possible problems with adaptive equalization.

- *Attenuation:* The required carrier-to-noise ratio (C/N) depends upon the level of reflections and noise and on the effectiveness of the decoder correction capabilities. Estimates suggest that homes with high levels of reflections could need as high as 37 dB C/N to avoid threshold-related problems.[1] If drops are kept to FCC levels, it should be possible to maintain C/Ns above the minimum thresholds. Attenuation is common in the home when long cable lengths and the number of passives in the system are not controlled. Maintaining high carrier levels is increasingly important, particularly when home amplifiers or other components contribute additional noise. Figure 1 on page 60 shows input level effects on a 49 dB C/N input system.[2]

Component outages

The second type of impairment, component outages, has a direct and immediate effect on the signal available to the consumer. Just as actives in the outside network can cause outages when they fail, in-home actives, whether at the point of entry or at the end of the line (set-top), must be made more reliable to maintain a high degree of signal availability. The elimination of loop-through or bus architectures in the home will minimize the effect of any component failure or degradation on signal availability in the network. This is particularly important in threshold-dependent transmission sections such as the compressed digital "trunk" to the set-top.

The simplest form of outage is unintentional disconnects or intermittents caused by poor installation. Short duration intermittents can vary reflections and noise patterns, but if intermittents are more than tens of milliseconds in duration, they can cause direct drop-outs in a digital realm.

Converter outages, occurring at the end of digital transmission also can be a problem. If we look at some recent service call reports from major MSOs (Figure 2 on page 62) we see that a substantial percentage are either caused by problems with the drop or are attributable to converters. This is an increase over previous 1990 studies showing only 7% converter-related calls,[3] suggesting that other plant troubles are decreasing faster than those of converters. Many of these outages could have been avoided had the set-tops been made to higher standards or designed for longer life. Parts such as capacitors, fuses and batteries could be substantially upgraded.

Qualitative data from a major converter repair facility where over 30,000 boxes of one brand were repaired indicate that there could be a huge reduction in the number of repairs if capacitors did not fail. In this case more robust capacitors are needed that will not "dry out" because of prolonged heating. On average, over 1.5 capacitors needed replacing per box repaired. Further studies are recommended to determine the root cause of these failures (electrical surges, lack of heat sinking, etc.).

Another way maintenance costs could be reduced and availability of service could be improved is if fuses did not need to be replaced. In the same study of over 30,000 converters, between 2% and 10% of the service repairs (depending on model) required fuse replacement. The use of resettable fuses would eliminate these service calls. The use of more surge-resistant parts throughout the board also can be advantageous. A combination of improvements would reduce converter outages. In the future, the set-top will be more valuable (and the repairs more expensive) than the converters used today. Therefore, using improved components, especially those that reset after a hazardous condition, will provide a solid economic return by protecting other devices and eliminating many service calls.

One final example of a way to improve signal availability is prolonging battery life. Batteries had to be replaced in over one-third of the converters serviced. Using lithium rather than NiCad batteries should substantially extend the useful life of the converters. Again, such components may be expensive but they could prove very cost-effective if they minimize service calls and increase the value of the next-generation boxes.

Future-proofing home cabling

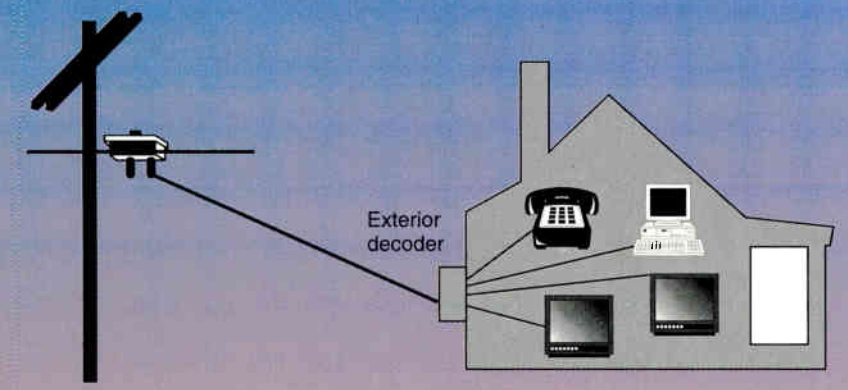
In-home cabling will always present a challenge for companies delivering digital signals because operators cannot control the quality of the home system. To improve the home capability, providers need to enhance the awareness of consumers and manufacturers so that high-quality components will be deployed in appropriate architectures. Efforts in this direction are to include developing performance standards for components and practices, designing effective architectures and educating consumers.

Devices, particularly cable and connectors, should provide a high level of shielding especially in areas near burst noise sources. The weakest link here is at the F-interface. One-piece outer conductor connectors should be considered as a way to simplify the installation process and make high-level shielding installations easily repeatable. The single-piece outer conductor minimizes intermittents and in most designs improves the shielding effectiveness for a variety of less-than-ideal applications.[4]

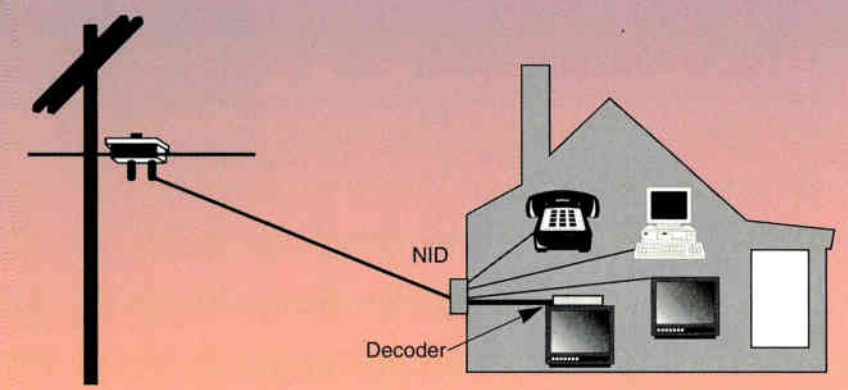
High return loss splitters, ground blocks, wall plates and other passives should be specified to high-quality levels to avoid excessive reflections. Furthermore, the isolation between ports in splitters should be high enough to limit the effects of "channel surfing" on adjacent outlets.

Other than the F-interface, the greatest threat to service

Figure 3: Options for a high compression digital terminal



Permanent domain Digital High-rate modulation	Technically inaccessable domain Simple/robust modulation



Permanent domain: Permanent to the decoder Digital High-rate modulation	Analog/low rate to other devices
	Technically inaccessable domain

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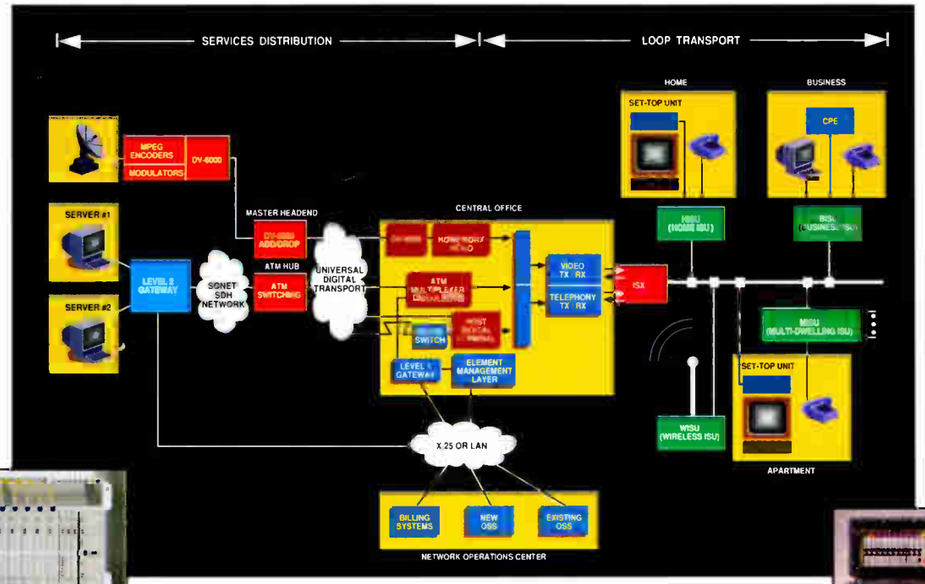

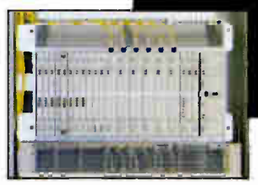

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the decoding terminal. After the signal is decoded and/or decompressed, it is in a higher threshold form and transmission to one or more devices becomes more robust (e.g., QPSK) and familiar (analog). The benefits of this indoor architecture are similar to those of the star-star-bus outside architecture (minimizing discontinuities to the "node"). If the terminal is located at the point-of-entry, the need to control home practices is far lower, from a signal availability standpoint, than if the terminal is at the set-top.

A seamless, permanent drop is very beneficial,[4] especially if it extends to the digital service terminal, regardless of its location. For servicing and other access reasons, the terminal would ideally be located at the side of the home. (See Figure 3 on page 66.) If the decoder terminal is in the home, high-quality cable should be used to connect to the set-top.

Figure 3 shows options for a high compression digital terminal. To minimize service outages, the decoder should be located at the point of entry, where its sensitive rate signals would be guarded from home tampering. A second permanent, tamper-discouraging option would involve checking the existing installation and creating a "tight" drop all the way to the digital terminal in the home.

Splits would only occur at the point-of-entry or downstream from the decoder. Specially labeled cable can be used to identify the run leading to the terminal and can be marked: "Digital services. High frequency. Do not splice." Permanent connectors also can be attached to the terminal. These procedures would greatly reduce any tampering that could result in loose connections, poor return loss components and other quality degrading modifications.

Consumer and industry awareness

Building industry and customer awareness is a critical requirement in assuring that subscriber behavior improves. In addition to standards setting, the SCTE is publishing a manual that not only guides the subscriber in basic installation, but also emphasizes the importance of using high-quality cabling to prepare the system for future services. The objective is for cable operators to distribute the manual with their company name/logo and contact telephone number included in it.

In addition to SCTE efforts in this arena, a newly formed group (the Home Automation Association) is initiating a campaign to improve home cabling. The HAA consists of several manufacturers that install home networks for multimedia applications, complying with the Engineering Industry Association Consumer Electronics Bus (CEBus) standard. Members of the CEBus Committee and SCTE have begun discussions to improve overall home practices.

Subscriber practices can cause excessive service calls with or without digital services. Consumers often purchase products without regard to quality and without understanding the possible service problems they may create. To increase awareness of quality, a brief information card describing how to "future-proof" the system can be distributed with each digital terminal installation. In order to make this guide effective, the consumer must be strongly encouraged to read the guide before using the services for the first time. In this guide, the term "CATV-approved" should be mentioned. The subscribers should be told to look for "seal of approval" products at retail stores and electrical supply outlets. (Many stores have agreed to stock such products when they come into existence.)

Conclusion

Today's home cabling networks provide significant challenges to deploying effective digital signal. Physical options for improving the state of the in-home systems range from component upgrades to installing permanent drops and even to designing new architectures that are more stable over time. A combination of stricter component performance standards, new architectures and increased consumer and industry awareness can make it possible to future-proof signal quality and minimize signal interruptions. **CT**

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WESTERN SHOW PRODUCT WRAP-UP
CT DAILY IC
PBI From *Communications Technology* and *International Cable* magazines
April 1995

The following is the final installment of our three-part series highlighting products introduced recently at The Western Show.

Foxcom Highlights Fiber-Optic Link

Foxcom Inc. showed its System 7000 L-band fiber-optic link, a system designed to transmit the entire L-band output over distances from 300 feet to 10 miles, allowing the flexible placement of satellite antennas and CATV headend equipment.

Fiber-optic technology provides numerous advantages over traditional coax including: low signal attenuation, even for long distance transmission; simple installation, eliminating thick coax, amplifiers, equalizers and their signal degradation; and dielectric fiber cable construction to isolate headend electronics from electrical storms and avoid ground loops.

All present video and data formats are transmitted, making the link "protocol-transparent" and digital-ready. Breakthroughs in RF and fiber-optic design have been incorporated to deliver a low cost satellite fiber-optic link.

The link features input and output AGC for simple "plug and play" installation, even for professionals new to fiber optics. The AGC sets and maintains optimum signal levels allowing hands-off performance even over a wide range of inputs and outputs.

System characteristics include single channel carrier-to-noise of 35 dB (in 35 MHz bandwidth). The frequency response is specified from 900-1,750 MHz (2,050 MHz optional), input signal range is -40 to -20 dBm total power with input/output impedance of 75 ohms and intermodulation products of >-40 dBc. Optical specifications call for 1,310 nm ± 10 nm on single-mode fiber with FC/APC connectors. **Reader service #201**

Lectro Localizes Powering Cabinet Needs

Lectro featured its new localized powering cabinet for multiple installations of its ZTT family of power supply products. This weather resistant enclosure is precision fabricated from heavy gauge aircraft grade aluminum and available in ground- or pole-mount configurations. It is available unfinished or with powder paint coating for long-term protection from harsh environments.

The spacious, prewired interior features a fan-assisted flow-through ventilation system for constant air circulation. The six heavy duty shelves are each capable of supporting up to 280 pounds of equipment. A typical installation could incorporate three models of ZTT uninterruptible power supplies and up to 12 batteries for a total of 6 to 60 amps of dependable standby power. Provisions for optional status monitoring capabilities are incorporated into the design and the completed system includes an internal transfer relay panel for on-line redundancy in full compliance with Bellcore N+1 specifications. **Reader service #205**

SCTE Unveils New Member Directory

The Society of Cable Television Engineers released its 1994 SCTE Membership Directory and Yearbook, which has been mailed to all SCTE members. It includes a complete member list, information on SCTE programs, the Society's committees and subcommittees, award winners, scholarship recipients and local chapters and meeting groups. **Reader service #197**

QRF Demos MDU Amp, More

Quality RF's new QDAX750 multidwelling distribution amplifier offers push-pull, power doubling or quadrapower technology in one or two-way models, with bandwidths through 750 MHz.

In addition to the amplifier, QRF featured replacement equalizers and attenuator pads for Magnavox and S-A amplifier product lines. The initial offering for both OEM accessories is through 550 MHz (with 750 MHz units to follow shortly). **Reader service #200**

Telecorp's PPV Fax Reports Instantly

A new fax reporting service providing cable operators with a sophisticated means of obtaining pay-per-view transaction data was on display at the Telecorp Systems Inc. booth.

Telecorp On-Line is available to Home Ticket Intelligent ANI customers, giving PPV managers the reporting tools needed to better manage their PPV business. Announced in September, the service is the newest and most sophisticated ANI reporting service, according to the company.

To use the service, Home Ticket customers dial an 800 number anytime day or night from any touch-tone phone and hear report options from a voice menu. After the desired reports are selected, they are faxed automatically to the customer.

Types of reports include detail reports that provide a detailed accounting of each PPV call, including subscriber home telephone number (ANI), DNIS (dialed number identification service code), event ID, PIN entry, date and time. Summary reports can give a snapshot of how a movie or event is doing during a given time period. Reports can be pulled for any time period and can be customized to include the information desired by each PPV manager. **Reader service #208**

New Cables From Times Fiber

Times Fiber Communications Inc. announced its T10 coaxial drop riser cables, which conform to both SCTE and Bellcore specifications, and are suitable for use in vertical runs in shafts and from floor to floor in buildings. Also, the cables have fire-resistant characteristics that can prevent fire from carrying between floors.

Conforming to the requirements of the National Electric Code Article 820 — Community Antenna Television and Radio Distribution Systems, the products are listed by UL as Type CATVR and meet all industry specifications. According to the company, they have the lowest cable attenuation losses available. The product is now available in standard sizes and shielding configurations. **Reader service #209**

Network Monitoring And Control System From Philips Broadband

Net-Prophet, a network monitoring and control system that provides complete coaxial and fiber performance analysis of broadband communications networks, was introduced at the Philips Broadband Networks booth. The system provides cable TV operators with basic and advanced network administration and security solutions for all of the company's fiber-optic and RF coaxial performance monitoring and control devices.

The system is a joint development effort between the company and AM Communications, and is comprised of a personal computer system including IBM-compatible software, an interface unit for location at the headend, and a number of monitoring and control devices located in strategic parts of the broadband network. The monitoring devices provide coverage of the complete networks, including the headend, fiber-optic network and RF coaxial network.

Features include: automated FCC proof-of-performance testing, fault management functions, performance monitoring, remote control of network devices, a menu-driven user interface, graphical analysis tools and a topologer that provides a graphical representation of the network topology with a color-coded component alarm status. **Reader service #202**

Northern Telecom Demos End-To-End Telephony

Northern Telecom highlighted communications networking and digital services at its booth, exhibiting The Digital Network, the company's vision of a cost-effective multimedia network for cable operators. Access, transport and switching portions of the network were represented.

The end-to-end telephony solution includes the new DMS-500 switch, Cornerstone fiber/ coax technology and operational support system capabilities.

The booth featured a variety of applications and technologies, both wired and wireless, including PCS. Telephony, video-on-demand, flexible bandwidth videoconferencing, remote learning and access to on-line services were among the applications presented. The exhibit included live demonstrations of voice, video and data services over coaxial cable. Visitors to the booth also saw medical imaging and data applications working with dialable wideband service. The company's PowerTouch ADSI terminal demonstrates interactive advertising and screen-based telephony.

The S/DMS TransportNode system demonstrates backbone network survivability, while the S/DMS AccessNode system offers shared tenant services and demonstrates the capabilities of service adaptive access for the company's Cornerstone Voice offering. Narrowband and wideband services are offered from the DMS-500 switch. **Reader service #176 (The Digital Network), #175 (S/DMS)**

Power Guard Intros Unity Wave

Power Guard announced the Unity Wave broadband network powering system. The company says the system is the most important achievement in broadband powering for convergence systems yet. Problems of power factor, multiple power locations, corrosion and effective reach are solved.

The unique waveshape and topology of the system enable the operator to power all the way to the home or business in a typical node (500 homes) with a single power supply. Unlimited standby and full network management also are available. **Reader service #207**

ABC Remotes Are Two-In-One

ABC Cable Products Inc. announced its new line of two-in-one ProMotes universal remote controls specifically designed to operate all popular cable converters as well as the TV set. Music Choice (formerly Jerrold's Digital Cable Radio) and Digital Music Exchange (Scientific-Atlanta DMX) are available as an option.

Also featured was a new Jerrold on-screen display remote control unit, plus the company's current line of enhanced OEM compatible units. **Reader service #206**

Multitaps Highlighted By Signal Vision

Two-, four- and eight-way output multitaps were displayed at the Signal Vision booth (Models SVT-20, SVT-40 and SVT-80). Features include true performance to 600 MHz and beyond, machined brass ports and corrosion-resistant 380 diecast aluminum housings. As well, the products are irradite plated and epoxy coated and have an aluminum gasket for maximum RFI integrity and PC board grounding.

Further features include: stainless steel spring loaded clutch, tapered entry for center conductor, tapered entry for center conductor, and neoprene weatherproof gasket. Aerial or pedestal mounting is possible without changing center seizure screws. **Reader service #198**

Zenith Hooks Up Work-At-Home Modem, Distance Learning

Emphasizing the growing potential created by applications such as work-at-home, distance learning and real-time, two-way videoconferencing, Zenith Electronics Corp. demonstrated its HomeWorks high-speed cable modems. The HomeWorks Elite 4 Mbps and HomeWorks 500 kbps cable modems for data and information access are part of the company's MetroAccess line of network products.

The HomeWorks modem was used at the CableNet exhibit in conjunction with CompuServe and Viewpoint Systems, which conducted live videoconferencing demonstrations linked to Zenith's booth.

At its booth, Zenith showcased a variety of specialized modem uses in dedicated workstations. HomeWorks and HomeWorks Elite were used with a host of online services and software products (both modems are interchangeable, depending on access speed demands).

Additionally, the company introduced a high-speed cable modem that delivers previously unavailable universal computer compatibility. **Reader service #195 (HomeWorks modems), #194 (high-speed modem)**

Made For Installers: ComSonics WindowLite

ComSonics highlighted its new WindowLite Installer meter, designed specifically for cable installers. The unit is waterproof, shockproof and delivers a full frequency range from 50 to 750 MHz. It also delivers accuracy that equals that of much more expensive full service signal level meters.

The unit can withstand total immersion in a foot of water for 30 minutes without intrusion. It also will sustain a 12-foot drop on concrete and continue to work.

The user selects and sets six video carriers from the full tuning range available. Clones can be easily produced using the available multi-charger option. User preference settings from host instruments are quickly copied. It is adaptable worldwide with full programmability and international channel selection. **Reader service #167**

FPN Demos Two-Way Digital Telephony

First Pacific Networks Inc. demonstrated its FPN 1000 two-way digital cable telephony and PowerView energy management simultaneously over a coaxial cable network. Both products provide two-way communication over hybrid fiber/coax networks, an integrated digital platform for delivering voice, data and video, and an operating range of up to 50 miles. PowerView is a customer-controlled load management system enabling real-time delivery of energy prices to the home. **Reader service #204 (FPN 1000), #203 (PowerView)**

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Pioneer Unveils WORM

Pioneer New Media Technologies Inc. announced a high-speed, high- capacity WORM (write once read many) digital video disc system suitable for video archival and video server applications. The system is MPEG-2 based with the capability of conforming with General Instrument's DigiCipher II and other video compression formats. A dye-polymer recording process facilitates up to 20 Gbytes of data on a single disc. This translates to over two hours of video at 20 Mbps on a two-sided 30 cm disc. **Reader service #199**

Grass Valley Intros Multichannel DS3 Video Codec

Grass Valley unveiled its video transmission product, the J Series multichannel DS3 codec. The J Series features full motion and full color resolution video as well as CD quality audio. These, along with its modularity, provide the capability for many applications including headend consolidation, video dial tone, video conferencing, security and surveillance.

With a single channel, the J Series provides Beta SP videotape machine quality for entertainment applications where the highest quality video is a requirement. With two channels, video quality is ideal for video trunking, according to the company. **Reader service #196**

DX Antenna Enters Digital Fray

DX Antenna announced it is entering into the digital compression equipment business. The company has developed a MPEG-compatible video compression system consisting of an encoder and decoder that can compress, transmit and deliver clear digital video, audio and data over satellite or through a CATV system.

The company conducted a live demonstration at the show of its digital system using the 64 QAM MPEG compression standard, compressing and decompressing four video channels, one audio channel and two data channels. **Reader service #179**

TV/COM Demos QPSK Modulator/Demodulator Pair, Processor

TV/COM International highlighted its new variable rate QPSK modulator/demodulator pair at the show. As part of the company's Compression NetWORKS system (a total digital compression, control and communications system for delivery of digital services over both satellite and cable) TV/COM's variable rate QPSK modulation is able to carry a multiplex of data at channel rates to 90 Mbps, making the capacity of TV/COM's modulation the highest in the industry, according to the company.

The breakthrough delivers a fully error-corrected 55 Mbps of payload into a 60 cm dish. Using Compression NetWORKS, a typical 54 MHz satellite transponder can transmit over 30 entertainment-quality channels on a single carrier to cable headends or direct-to-home satellite consumers. This represents a 50% increase in channels and revenue over current designs limited to filling 36 MHz bandwidth transponders.

TV/COM also featured its new MPEG-2 digital compression universal service processor (Model USP-4625). Designed for both satellite uplink and cable headend applications, it accepts video, audio and data as inputs and digitizes and compresses both the video and audio signals. **Reader service #193 (modulator), #192 (USP-4625)**

S-A Rolls Out Taps

MultiMedia Taps, a product family of power-passing RF cable taps from Scientific-Atlanta, was shown for the first time. By deploying 1 GHz Multimedia Taps in new or upgraded broadband systems, network operators can inexpensively prepare for providing residential telephone service in the future. The approach allows operators to defer most expenses of network-powered telephony until the optional service is introduced. At that time, the operator can selectively add the extra equipment needed to provide dial tone and backup power to paying subscribers.

In telephony-over-cable networks, the taps enable network operators to pass power, video, telephony and data services along a composite cable, which contains coax and twisted pair copper cables in the same sheath. A customer interface unit located on the side of the house separates the signals and distributes them to the appropriate cable TV or telephone lines in the home. The taps are available in two-, four-, and eight-home versions and are compatible with CoAxiom, S-A's complete telephony-over-cable system. **Reader service #191**

Tektronix Intros SignalMini

Tektronix introduced its the RFM 90 SignalMini hand-held signal level meter. The unit is tailored to meet the requirements of fundamental cable TV installation applications, offering basic signal level measurement capabilities.

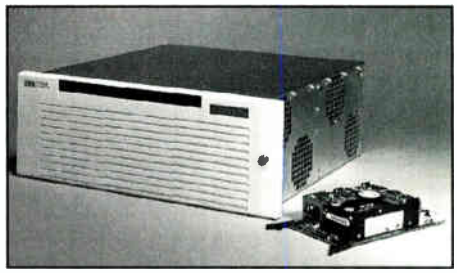
The SLM includes a 48 MHz to 861 MHz frequency range and up to 64 user-definable frequency setups, as well as a host of other key features: easy-to-use interface; in-service carrier-to-noise measurement; multi-standard compatibility — NTSC, PAL, SECAM; built-in AM/FM detector, speaker and headphone jack; and replaceable battery and durable weather-resistant case. **Reader service #180**

West End Demos HFC Networks

West End Systems, an affiliate of Newbridge Networks, offered information at its booth regarding its WestBound 9600 broadband access platform, which provides residential and business subscribers with access to voice, video and data services over an integrated hybrid fiber/coax (HFC) network architecture.

The platform is a fully managed solution that uses an orthogonal frequency division multiplexing modulation scheme and advanced digital signal processing DSP to achieve exceptional bandwidth efficiency, security of communications and resistance to ingress. Up to sixty 64 kbit/s channels can be delivered in blocks of 1 MHz, allowing network operators to deploy voice and data services incrementally as demand warrants. **Reader service #178**

RAID At Storage Concept



Storage Concepts introduced the Concept 910-SW Series RAID (redundant array of independent disks), which facilitates a high level of scalability, flexibility, field expansion and upgradeability for markets such as video-on-demand (VOD), interactive TV, medical imaging, data acquisition/transmission and other bandwidth-demanding environments.

The unit offers an industry first in guaranteed sustained data rates in excess of 35 MB/s (280 Mbits/s) to 50 MB/s (400 Mbits/s) across the 32-bit extended differential fast bus (EDFB) and sustained data rates of 18 MB/s (144 Mbits/s) across the 16-bit SCSI-2 fast and wide bus. This dual-bus system architecture ensures image integrity and image delivery in real-time operations to a large user base and is supported with an RS-232 port for remote system control and status reporting.

Features include pluggable interfaces that provide interchangeable system characteristics to allow multimodality support for cost efficiency while maintaining the original system investment. Among its many features are the system's hot-pluggable dual redundant power supplies and drives that can be pulled in or out during operation without causing system down time.

The Matrix Array architecture provides scalability, a key feature in VOD application operation, allowing server programming capacities as well as the number of video streams to flow as the system's user demand increases. **Reader service #168**

New International Receiver From Standard

A new domestic and international satellite receiver designed for use in broadcast, SNG, special network and CATV systems is currently available from the Satellite & Broadband Products Division of Standard Communications Corp.

The MT900 Intercontinental features a fully synthesized PLL tuning circuit with digitally locked continuous tuning AFC and microprocessor control. The C/Ku-band 950-1,750 MHz RF input is dual converted to a commercial, industry standard 70 MHz I.F. The unit can be used for rebroadcast in any area of the world from almost any satellite format.

The unit's core RF circuitry is based on the company's agile omni satellite receiver design, and in addition incorporates digital AFC, real-time C/N meter, multistandard video/audio and space saving SMD construction.

Also, signal purity and baseband technical excellence with virtually all international satellite signals is ensured. The unit complies with RS250C, CCIR and Intelsat satellite standards. Increased burn-in, component matching and a printout of video performance are provided for customer review. The receiver can be ordered without audio to minimize cost in dedicated scrambling systems. **Reader service #177**

Sadelco Intros SLM, Calibrator

Sadelco displayed its Maxdata signal level meter, available to 1 GHz, which provides automated testing in a new compact weatherproof package. All functions such as carrier-to-noise, hum, tilt, scan and record are accessed easily using direct front panel keys. Signal level is displayed both digitally and on a unique 100 dB analog bar graph. An RS-232 connector is provided for downloading recorded information to a PC.

Also, the company displayed its SC1000 calibrator. Accurate to ±0.25 dB from 4.5 to 1,000 MHz, the unit is the fastest and easiest way to check the calibration of signal level meters and other active and passive CATV components, according to the company. **Reader service #151 (SLM), #150 (SC1000)**

Computer Disk Catalog At CommScope

The CommScope Inc. division of General Instrument introduced its complete product line catalog on computer disk. The automated product catalog is a Windows-based software package complete with product electrical and mechanical specifications as well as shipping and pricing data. This information can be customized or updated by the user and can be used to generate a worksheet for a bill of materials or purchase order. **Reader service #174**

Ipitek Shows New Color-Coded

Ipitek's new offerings included color-coded couplers and asymmetrical passive optical splitters.

The couplers use the EIA resistor color codes to identify split ratio, operational wavelength and bandpass. The color code process is intended to save the end user time and money during installation or reconfiguration of signal distribution fiber plant. The color-code can be used to verify the part without the need for checking diagrams or the serial number. Red fiber leads always signify the throughput port, with the clear buffer used as the drop port.

The passive optical 1 x 3 signal splitters with asymmetric split ratios for CATV application reduce the need for additional couplers and/or attenuators to arrive at the optimum signal level at the receiver. The company has developed single fused splitters with 30/35/35, 20/40/40, 40/30/30 and 50/25/25 split ratios in addition to the previous 33/33/33 device. These splitters are available in standard, broadband and extended bandpass options. Various packaging options provide the user ease of operation. **Reader service #173 (couplers), #172 (splitters)**

IBM's MediaStreamer Delivers Multimedia Storage

IBM Corp. demonstrated its MediaStreamer system for multimedia storage and delivery based on a new, broadly scalable system architecture. The system stores source information of an array of hard disks, smoothly delivering multiple streams of data from a single copy of the original.

It offers cost-effective solutions for information delivery by multimedia providers in cable TV, broadcast, lodging and information services. End-to-end, open systems multimedia solutions can be reached, either as part of an existing IBM environment, or as an attachment to a processor in a multivendor environment.

Hotel guests, for example, will be able to receive movies at any time on command from their rooms, and hotel operators will be able to offer this service without incurring the expense of storing and handling multiple copies of popular movies.

The broadcast industry can simplify the process of inserting commercials into regular programming and to store program content for time-delayed broadcast.

Adstar Distributed Storage Manager software transfers data within the system to the most cost-effective media. This technology saves operating costs by automatically transferring infrequently accessed information from disk to tape. **Reader service #171 (MediaStreamer), #170 (Adstar software)**

One Of A Kind Media Server At Digital

Digital Equipment Corp. unveiled its second-generation media server, enabling cable and telephone companies to deploy high-performance, cost-effective interactive applications to mass markets.

The new media servers are completely compatible with the first generation, enabling cable and telephone companies to upgrade easily and expand their server solutions as their needs grow.

The units optimize video and interactive applications using combinations of three specialized server engines. Highest-demand movies are most cost-effectively distributed by semiconductor (RAM) memory-based servers that handle thousands of simultaneous users; movies in moderate demand are most cost-effectively served from disk array-based servers; and interactive applications, typically requiring increased processing power, are serviced by disk array-based interactive application servers.

The peripheral component interconnect (PCI) network and storage adapters link the media servers to WANs, LANs, local loop and cable networks. Multiple PCI adapters configured on each media server enable the company to tap RISC processor performance at far lower costs than competitors using custom adapters, according to the company. **Reader service #169**

C-CUBE Intros MPEG-2 Encoders

C-CUBE Microsystems announced the CLM4700 MPEG-2 video encoder family, which compresses digital video into MPEG-2 syntax in real-time. The world's first highly integrated MPEG-2 video encoder, the CLM4700 is required to deploy digital TV systems, including wide-screen enhanced definition TV (EDTV), 500-channel cable, digital direct broadcast satellite and video-on-demand systems. CLM4700 products consist of multiple C-Cube VideoRISC processors combined with one of several microapplication programs to support Main Level, Main Profile or frame-based encoding in a variety of video formats. **Reader service #166**

Get Interactive With H-P

Hewlett-Packard offered details on the company's Home Products Division Kayak system next-generation set-top box. The "smart" set-top includes General Instrument's DigiCipher II access and control, compression, and transmission technology, making Kayak compatible with GI's uplink encoding and headend equipment. Kayak will feature LSI Logic's CoreWare program to provide key digital audio/video capabilities, including support of MPEG-2 technology. H-P plans to use a Motorola microprocessor for the Kayak system. **Reader service #165**

Pioneer Showcases Addressability, Digital

Pioneer New Media Technologies demonstrated a full line of addressable terminal and digital-based products for the cable TV industry. The cornerstone of the exhibit was the BA-V1000 command station, featuring extensive near-video-on-demand (NVOD) functions, on-screen display capabilities, electronic program guides, dynamic picture shift scrambling and virtual channels.

Other products on display included the 16 VSB modulator and single MPEG-2 video decoder chip — for high-speed data transmission for narrow bandwidth applications in the CATV industry, capable of multi-level and multi-bit modulation, based on the VLSI, CD1301 developed by Pioneer.

Another product displayed was the digital LCD player with four independent heads and both analog and digital output. The player features the company's proprietary CD1100 Series VLSI chip set for MPEG-2 compatibility, 5.24 Mbps data transfer rate and 5.4 Gb of data. **Reader service #163 (BA-V1000), #162 (modulator/chip), #161 (LCD player)**

90 VAC UPS Powers Alpha Technologies Show

Alpha announced a 90 VAC version of it XM Series uninterruptible power supply (UPS). Developed in response to changing powering requirements, the XM9012 will address end-of-line voltage loss problems associated with some contemporary cable systems. Increasing the powering voltage will lengthen the necessary distance between power supplies, allowing an extended power range and the increased transmission capacity needed for full service architectures. **Reader service #164**

Cable Security Unleashes Ground Beast

Cable Security displayed the pedestal mounted Ground Beast, which incorporates both pedestal and an apartment box in one enclosure, making it much less expensive to install and extremely secure. Key features include box-in-a-box design made of 16 gauge aluminized steel, with full stainless steel welds, and electrostatically applied powder coated paint, baked on for maximum antitrust protection. Locks with nonreproducible key ways provide maximum security. **Reader service #160**

StarNet Adds New Technology To Inserter

The StarNet digital inserter system now utilizes MPEG B-frame technology to further enhance its digital video quality and to significantly increase video storage capacity, according to the company. B-frame (or bidirectionally predictive frame) technology allows video to be encoded at lower bit-rate levels with equal or improved quality. Substantially smaller video files are produced, increasing video storage capacity as well as decreasing the processing time for each file. **Reader service #159**

Global Reception At Standard

The Satellite & Broadband Products Division of Standard Communications introduced the MT830IBR agile omni international global VU series satellite TV receiver. Coupled with the CAM830I computer software option, the receiver's operation between Domsat, Intelsat and regional satellites is easily achieved through its flexibility in design. **Reader service #158**

ADC, ALS Display Networking Solutions

ADC Telecommunications, with its American Lightwave Systems subsidiary, exhibited the ISX optical distribution node and Frameworx administration software tools. The ISX is an active device that supports from 50 to 500 or more subscribers. The node can support as much video capability as is required, from analog broadcast CATV to digital video-on-demand or interactive channels, and is fully upgradable to telephony, supporting video-first, telephony-first or both. **Reader service #157 (node), #156 (Frameworx)**

Antec Launches Imagess Headend/Products, Server Solution

Antec unveiled its Imagess headend product line, which includes a full line of modular broadband satellite receivers, demodulators, channel processors, stereo encoders and modulators used to position the cable network for digital transmission and video file server platform via a regional interconnect architecture. The line supports Antec's Digital Video Division's commercial insertion and near video-on-demand systems, providing cable systems with an opportunity to specifically target commercials or on-demand services to specific subscribers.

The Imagess product line also includes the DSM45, a digital multiplexer used to deliver nontraditional services such as Sega video games and Scientific-Atlanta Digital Music Express. **Reader service #154**

ASC Highlights Tapeless Virtual Recorder

ASC Audio Video Corp. displayed its Virtual Recorder (VR) tapeless, random access player for spot insertion and time delay. The unit's PlayList allows user-programmed seamless playback of nonsequential segments and stills, serving as an add-on for spot insertion applications. **Reader service #153**

Telecorp Enables Agent Snapshots

Telecorp provided information on the new Agent Statistics feature for its System 9000 Predictive Dialer. The feature provides on-line coaching of agents by providing real-time detailed statistics.

The System 9000 has always provided real-time statistics on all agents and campaigns for the supervisor. Now it provides the ability for agents to take a quick snapshot of their progress any time during their shift, including close ratio, breakdown of all calls by result code, talk time, wrap-up time, paused time, wait time, average talk time and average call length. **Reader service #155**

Heterodyne Modulator New At Standard

Standard Communications Corp. completed development of its newest frequency agile, CATV broadcast quality TV modulator system. The TVM550/550S series is frequency agile to 550 MHz and fully compatible in a wide range of system applications.

The series is designed to eliminate expensive and less reliable switching bandpass filter networks, while still matching or exceeding the RF performance of a fixed channel system. With six levels of filtering, coupled with very stable phase-locked RF circuitry, the unit offers out-of-band noise and spurious-free performance previously available only with fixed frequency modulators. This system is tailored specifically for the expansion of channels, upgrade of headends and building of a complete system. **Reader service #152**

Riser-Bond TDRs Coax, Twisted-Pair

Riser-Bond Instruments displayed its new Model 1205C time domain reflectometer and cable fault locator. Although designed for coaxial cable, the instrument also will test twisted-pair. The company says its Super-Store feature provides excellent waveform storage and the user can view, compare and store 1,500 times more information than competitive TDRs. The accompanying Wave-View software package turns the PC into a virtual TDR. **Reader service #149 (1205C), #148 (software)**

Troubleshooting audio in the headend

By Ed Lindsay
Customer Service Engineer
Wegener Communications

Troubleshooting audio problems in the headend can be a frustrating dilemma. Where do you start? What do you look for? What are the clues to headend audio that will make you rich and famous? Well maybe that's stretching it, but quickly fixing an audio problem can make your life a little easier. Here are some tactics to help you determine probable causes when things don't sound right.

Verify the installation

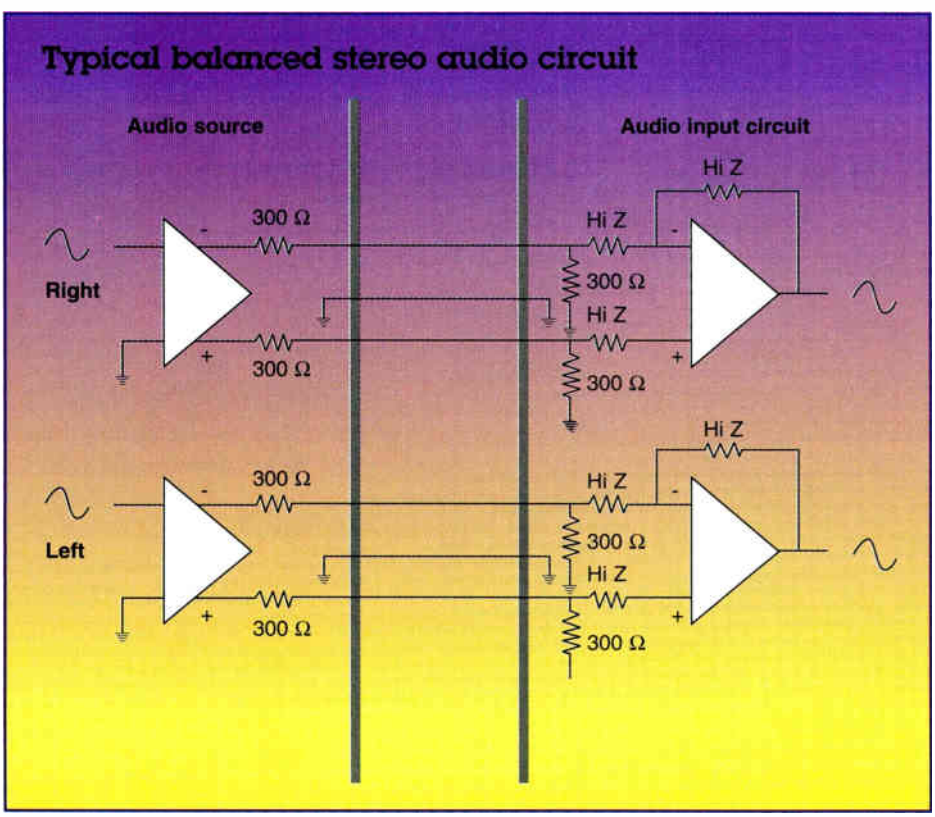
The first step in determining the fault is a detailed inspection of the installation. Using balanced audio reduces noise but at the same time it opens up more opportunity for problems caused by incorrect wiring. The full dynamics of the audio are regained when it is properly perceived by the human ear. Anything that impedes or alters a portion of the signal in relation to the rest of the signal changes the perception.

For instance, on a stereo channel, if the integrity of the channels is compromised by cross-wiring between the channels, separation and frequency response can suffer greatly. Using the right + with the left - for one channel and the right - with the left + for the other channel will kill separation. In this condition, the two channels are, for the most part, carrying the same audio. A listener's stereo receiver detects a pilot carrier and will indicate a stereo signal based on the pilot. Due to summing of the signal by the crossed wires, two monaural channels are created.

Balanced audio circuitry reduces noise by a method called common mode rejection. That is, the output circuitry on the audio source inverts the signal on one polarity so that the + and - legs of the balanced line are 180° out of phase. The input circuitry re-inverts one polarity of the signal then sums to the two legs together. The desired signals are now additive. Any random noise picked up along the way cancels itself out. Therefore, if the wiring reverses polarity on the left or right channel (not both) in a stereo system, the common information is canceled out and the noise becomes additive. In this mode it can be hard to predict the outcome of every miswiring possibility, but there are a few signs that can guide you to the problem.

If the bass seems to be very low in level, the polarity may be reversed on one channel. Flat voice but good high end or good low, but not both, can indicate one channel in use for both left and right. A harsh sound occurs when the + of one channel is used with the - of the other and polarity also is lost in only one channel. This configuration also may have some stereo quality, but it does not sound good. The key point here is to make sure that all the wires go to all the right places.

The accompanying figure shows a typical balanced stereo/audio circuit.



Measure signal levels

If a visual inspection does not turn up anything, a high impedance VOM (volt-ohm multimeter) may. Start the VOM analysis on the input device end of the circuit. Measure the voltage (referenced to audio ground) on the inputs. The DC measurement should be close to 0 volts. The AC measurement should show that both legs (and both channels if in stereo) of the signal are equal in amplitude. If one leg of the signal is 2% or 3% above the other, it could indicate a problem. If you have any doubts about what you see, make the same measurement on a known good channel and compare your results.

Generally when the signals are not in balance, poorly terminated or faulty cables are the culprit.

Cable continuity and impedance

After making sure that the connections are electrically sound, you should test the cables for continuity. Chances are the cables are too long to place a VOM probe on each end of the cable, so here's a trick.

Disconnect the cable at both ends. Tie

the + and - together at one end. Tie one VOM lead to the + and one lead to the - at the other end, and measure the resistance. Make the same measurement using the shield with the + lead and with the - lead. All of the measurements should yield low resistance values, not greater than 10 ohms in most cases. If your readings are inconsistent, check a known good piece of cable for comparable readings.

Look at the source

If the cables test OK, it's time to look at the audio source. If it's possible, listen to the output of the source directly. Look for the obvious (i.e., audio level adjustments, read the manual). But, when no obvious solutions presents themselves, there is a quick test to indicate if there may be simply a bad output driver in the source device. Disconnect the cable from the input device. Measure the AC voltage referenced to audio ground on the cable. Place a 600 ohm load from the + to the - terminal on the source device and measure it again. The unloaded voltage level should be twice the loaded voltage (2:1 ratio). If it is not, read the troubleshooting section in the technical manual for guidance.

Look at the audio input device

If the audio source and cables appear to be good, take a look at the audio input device. The input device's effect on the level is due to the fact that the input impedance (Z) is a fixed value. The test for input device loading is the same as the voltage comparison test described before. The difference is, the receiver is used in place of the 600 ohm load. The test result should be the same for both tests. Even when the input device is turned off, the input resistance stays the same.

After levels are verified, check the input device technical manual for clues. Pay particular attention to sections on input level and audio deviation adjustments.

Distortion

Any unwanted change to the audio envelope can be called distortion. The most common form of distortion is clipping due to amplifiers having to give just a little bit more than they have. To drive two 600 ohm loads with one 600 ohm source and maintain the same voltage output as with one load, the internal or open loop voltage must increase. When loaded, the increase cannot be seen. The internal voltage in a double loaded system is 1.5 times that of a single load system. The power supply limits may not allow a driver to work with this excess where normally it would satisfactorily drive one load. Many times this problem cannot be perceived at the time of setup because of APL (average program level) tones used for testing. Clipping problems may only be seen at or near PPL (peak program levels). Clipping can be seen by looking at any leg of audio with a oscilloscope. If the distortion is caused by overloading the output of a source, a distribution amp should cure this problem.

What now?

Both ends have good signal and are terminated properly. The cable is in good shape. Everything checks out OK and it works great. Right? Not necessarily. But, we still have some options. However, now things get just a bit unscientific.

Disconnect one end then the other of the shield and listen for improvement. Lifting one end of the shield from ground changes its characteristics. It may work great one way and not at all the other. Trial and error may show that the shield is acting as though it were an antenna. If you find the audio sound best with the shield disconnected, you may have bad grounding as a system problem. Fix it. Don't leave it disconnected.

Noise is always looking for a path to ground. Make it easy. Using conduit for the third wire ground is not an accepted practice. A 3-inch braided cable used to interconnect the racks is a much better solution. Bolting the racks together if possible is an even better way to get a common ground. Using an electric outlet tester will help prove power service to your racks. However, grounding at the frequencies that a headend works at is not so easy to prove.

Conclusion

When looking for audio problems, start with the point of view that nothing was done right from the start. Keep an open mind and set out to prove that everything works. If everything works and the problem still exists, rethink the troubleshooting possibilities with the new found knowledge from the work that has just been completed.

You may find you started your search in the wrong manner or that the answer was right in front of you all the time. The little things we overlook seem to give us the most grief. Make sure all terminations not only look good, but are good. Check for wire damage and that all equipment is working properly.

Finally, remember that if you made changes that affected the levels at the modulator, it is necessary to read the technical manual and make the necessary adjustments to input level and possibly audio deviation.

As technicians we take pride in what we do, and we do it well. The only time anyone wants us is when things aren't going their best. Perhaps these thoughts on distortion, noise and frequency response will help you through your audio troubleshooting trials and tribulations. **BTB**

THE SOCIETY OF CABLE TELEVISION ENGINEERS

CABLE-TEC EXPO® '95

LAS VEGAS CONVENTION CENTER LAS VEGAS, NEVADA JUNE 14-17, 1995

THE FACTS ABOUT CABLE-TEC EXPO® '95

dates

Registration and Pre-Conference Tutorials, June 13, 1995
Annual Engineering Conference, June 14, 1995
Technical Workshops and Exhibits, June 15-16, 1995
Certification Testing, June 15-17, 1995

location

Las Vegas Convention Center
Las Vegas, Nevada

history

Cable-Tec Expo® '95 is the thirteenth annual convention/trade show sponsored by the Society of Cable Television Engineers Inc. The show has proven to deliver the latest information on technological advancements and applications in a format that allows hands-on training through technical workshops and instructional hardware exhibits. The Annual Engineering Conference will be SCTE's 19th yearly conference dedicated to current engineering issues. FCC compliance, technical management and issues focusing on cable and telephony as converging industries. 1995 marks the 26th anniversary of the Society as a leader in technical training for the Broadband Communications industry, with this year's Expo offering additional opportunities for exposure to the newest trends in the expanding telecommunications arena.

attendance

Attendance is open to individuals within the CATV industry as well as those involved in broadband and telecommunications who wish to capitalize on the opportunity to learn about the latest industry developments. Over 3,000 registered attendees are expected from all levels of cable television, telco and related businesses, including non-technical personnel.

program

The Annual Engineering Conference consists of six hours of technical papers including such topics as FCC regulations and the convergence of cable, telco and data services. Speakers will include many of the industry's engineering leaders. The annual membership meeting, held at the conclusion of the conference, will afford attendees the opportunity to meet with members of SCTE's national Board of Directors.

Following the conference, the two-and-one-half day Cable-Tec Expo® is comprised of practical workshops offering interactive technical training combined with hardware displays on the exhibit floor. The workshops, technical in nature, feature presentations dealing with the proper operation and maintenance of CATV systems, plus effective methods for training industry personnel. No other activities are scheduled during these sessions in order to guarantee maximum attendance and participation.

exhibits

As with all SCTE activities, the main purpose of Cable-Tec Expo® '95 is to provide the maximum amount of training opportunities for the lowest possible cost. The event has been coordinated to fulfill this purpose, as it offers a wide variety of informative, up-to-date technical training programs. Additionally, Expo '95 will give attendees the opportunity to prepare for and participate in the Society's Broadband Communications Technician/Engineer (BCT/E) and Installer Certification Programs, gaining valuable knowledge and practical skills in the process.

The exhibit floor has a focus on education, with many industry suppliers presenting live technical demonstrations of their products. Over 300 hardware exhibitors are expected to reserve space on the Expo '95 Exhibit Floor. Exhibits will include all types of products, supplies, services and equipment used in the design, construction, installation, repair, maintenance and operation of broadband telecommunications systems. The exhibit floor will also feature a Technical Training Center for further equipment demonstrations.

CABLE-TEC EXPO® '95 REGISTRATION FEES

	PRE-REGISTRATION Until May 5, 1995		ON-SITE** After May 5, 1995	
	Member	Non-Member	Member	Non-Member
Engineering Conference and Expo*	$240	$340	$280	$380
EXPO only	$190	$290	$230	$330
Engineering Conference only*	$145	$225	$185	$265
Spouse Registration*	$95	$95	$95	$95

* *Includes ticket to the Awards Luncheon on June 14. Additional luncheon tickets are available for $20 each.*

** *Attendance at the Awards Luncheon is not guaranteed, but will be made available as seating permits.*

admission

Admission to all events will be through color coded badges to be picked up at the registration desk upon arrival.

transportation

SCTE has made special arrangements for discounted airfares to Cable-Tec Expo through Lobb Travel using US Air and Southwest Airlines. US Air is offering zone fares and 5% to 10% discount options. Southwest is offering discounts on both restricted and unrestricted fares to Las Vegas.

US AIR: 1(800) 344-2527— LOBB TRAVEL OFFICE

SOUTHWEST: 1 (800) 433-5368— REFER TO CONVENTION #H1865

AVIS: 1 (800) 367-2847— REFER TO MEETING A/B#622932

entertainment

Expo '95 hotels feature a tour desk with brochures covering area attractions, dining, nightlife and sightseeing activities. The discounted hotel rates are in effect for Expo attendees wishing to stay in Las Vegas for three days before or after the conference.

LAS VEGAS AREA ATTRACTIONS

- Top Name Entertainment
- Championship Golf
- Belz Factory Outlet Mall
- MGM Grand Adventures Theme Park
- Grand Canyon Air/Ground Tours
- Hoover Dam/Lake Mead Recreational Area
- Wet 'N' Wild Water Park
- Southern Nevada Zoological Park
- Red Rock Canyon
- Valley of Fire State Park
- Imperial Palace Auto Collection

event sponsor

Society of Cable Television Engineers Inc.
669 Exton Commons, Exton, PA 19341-2401
(610) 363-6888; (800) 542-5040; FAX: (610) 363-5898

PRELIMINARY PROGRAM

Pre-Conference Tutorials—Tuesday, June 13, 1995

Organizing Safety Training Programs at the System Level with Ralph Haimowitz, SCTE; and Barbara Wyatt, TCI

Audio Quality with Dom Stasi, TCI

Effective Learning Strategies with Ron Hranac, Coaxial International; and Pam Nobles, Jones Intercable

Engineering Conference—Wednesday, June 14, 1995

SESSION A: **Improving System Operations—Building On a Firm Foundation** with Ted Hartson, Post Newsweek Cable (moderator); Syd Fluck, CaLan; Ron Hranac, Coaxial International; Bill Nash, TCI; Pam Nobles, Jones Intercable; and "Dr. Strangelook"

SESSION B: **Designing Tomorrow's Broadband Network** with Hugh McCarley, Cox Cable (moderator); Gaylord Hart, XEL Communications; Al Johnson, Synchronous Communications; Mark Myslinski, General Instrument; and Andy Paff, ANTEC

SESSION C: **Advances in Digital Technology** with Rex Bullinger, Hewlett-Packard (moderator); Mark Globuschutz, US WEST; Leo Hoarty, ICTV; Brian James, CableLabs; and Jim Radmann, Milwaukee Cable Advertising

SESSION D: **Telephony and the Cable Industry** with Joe Van Loan, Cablevision Industries (moderator); John Anderson, P.E., Rogers Engineering; Chris Barnhouse, Time Warner Communications; David Hume, Motorola; and Tom Staniec, NewChannels

Expo Workshops—Thursday and Friday, June 15-16, 1995

- ❤ **Alternative Applications of Hybrid Fiber Coax Systems** with Mike Nelson, Media General Cable; and Mark Davis, Cox Cable
- ♠ **Ask the FCC** with Mike Lance, Priya Shrinivasan, John Wong and Priscilla Wu, FCC
- ◆ **BCT/E Technical Certification** with Marvin Nelson, SCTE
- ♣ **Digital Technology 101** with Megel Brown, Comcast; and Helen Chen, Hewlett-Packard
- ❤ **Emergency Alert System (EAS)** with Dr. Helena Mitchell, FCC; Shellie Rosser, ANTEC; and Ken Wright, Intermedia Partners
- ♠ **Network Architectures** with Jim Kearney and Carl McGrath, AT&T Bell Laboratories
- ◆ **Powering for Reliability** with Greg Hardy, Scientific-Atlanta; and Tom Osterman, Comm/net Systems
- ♣ **Practical CATV Networks** with Bill Morris, Corning; Tony Nieves, Keptel Inc.; John Phillips, Siecor; and Walt Srode, Philips Broadband Networks
- ❤ **System Tests and Measurements** with John Cecil, Hewlett-Packard; and Brad Harris, Tektronix
- ♠ **Telephony 101** with J.R. Anderson, ANTEC; Ralph Haimowitz, SCTE; and Justin Junkus, AT&T Bell Laboratories

CABLE-TEC EXPO® '95 SCHEDULE OF EVENTS

	Registration	Training	Exhibits	Testing	Special Events
Tuesday, June 13	Attendee Registration 1 - 7 p.m.	Pre-Conference Tutorials 2 - 5 p.m.			SCTE Engineering Subcommittee Meetings 2 - 5 p.m. Arrival Night Reception 6 - 8 p.m.
Wednesday, June 14	Attendee Registration 7:30 a.m. - 4 p.m.	Engineering Conference 8:30 a.m. - 4:30 p.m.			Awards Luncheon 12 noon - 1:30 p.m. SCTE Annual Membership Meeting 4:30 - 5:30 p.m. Welcome Reception and Cable-Tec Games 6 - 8 p.m.
Thursday, June 15	Attendee Registration 7:30 a.m. - 3 p.m.	Expo Workshops 8 a.m. - 12:15 p.m.	Exhibit Hall Open 11 a.m. - 6 p.m.	BCT/E and Installer Certification Testing 10 a.m. - 2 p.m.	NCTA Engineering Committee Meeting 8 a.m. - 12 noon Expo Evening (Western Party and Casino Night) 6 - 9 p.m
Friday, June 16	Attendee Registration 7:30 a.m. - 3 p.m.	Expo Workshops 8 a.m. - 12:15 p.m.	Exhibit Hall Open 11 a.m. - 5 p.m.	BCT/E and Installer Certification Testing 10 a.m. - 2 p.m.	Exhibitors' Reception 4 - 5 p.m. Ham Radio Operators' Reception 6 - 8 p.m. International Reception 6 - 8 p.m.
Saturday, June 17				BCT/E and Installer Certification Testing 9 a.m. - 12 noon	Golf Tournament 8 a.m. - 2 p.m.

Attendee Registration Instructions

Registration:

- ♠ Complete and return the Attendee Registration Form. Use a separate form for each attendee. Photocopies are accepted. SCTE will not accept registrations by phone.
- ♠ Payment must accompany forms in order to be processed. SCTE will accept registrations by FAX only when paid by credit card. If forms are faxed, DO NOT MAIL THE ORIGINAL.
- ♠ Non-members wishing to join SCTE may complete the membership application below and submit it with the registration form. Individuals submitting a completed membership application with payment are eligible for SCTE member registration rates. Annual member dues are $40 within the Continental US, $60 outside the US (including Canada).

Registration Types:

- ♠ FULL REGISTRATION: Includes Engineering Conference, Workshops, Exhibits, and Annual Awards Luncheon.
- ❤ EXPO ONLY: Admittance to Workshops and Exhibits only.
- ♣ ENGINEERING CONFERENCE ONLY: Admittance to full day conference and Annual Awards Luncheon.
- ♦ SPOUSE REGISTRATION: Includes all sessions, Exhibits, and Annual Awards Luncheon.

(All above registrations include evening hospitality events)

Registration Deadlines, Cancellations and Substitutions:

MAY 5, 1995 DEADLINE FOR PRE-REGISTRATION

- ♦ Registration forms must be received at SCTE prior to this date.
- ♦ Forms received after MAY 5 will not be processed and individuals must register on-site at the on-site rate.

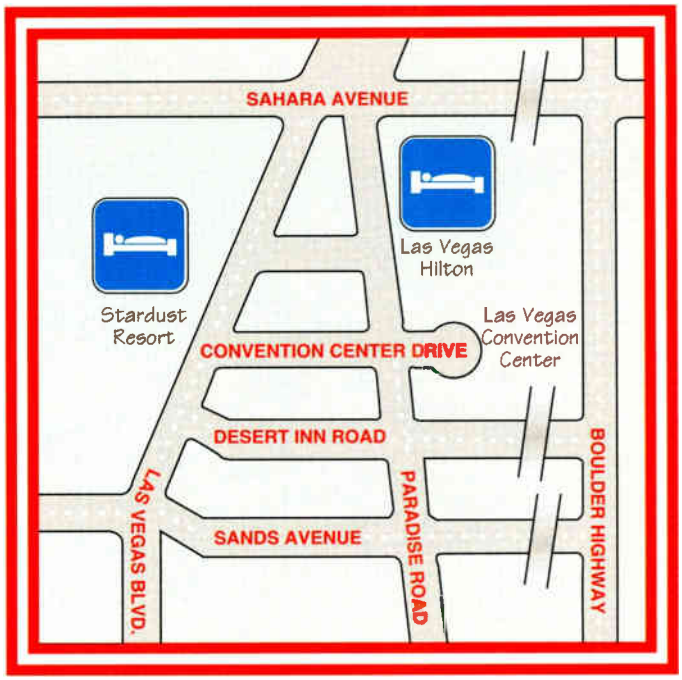
MAY 12, 1995 DEADLINE FOR CANCELLATION/SUBSTITUTIONS

- ♣ All requests for cancellation must be received in writing prior to MAY 12. All requests for cancellation will be subject to a $50 cancellation fee. NO REFUNDS WILL BE GIVEN AFTER MAY 12.
- ♣ All requests for substitutions must be received in writing prior to MAY 12. After this date, substitutions must be processed on-site at the Registration Assistance Booth. Written company authorization and a $10 processing fee are required.

Dress Code:

- ❤ Since the primary purpose of the Expo is education, we urge you to dress in a manner that is comfortable and conducive to your getting the most out of the program (slacks, jeans, short sleeve shirts-NO shorts or tank tops).

HOUSING



Attendee Housing Reservation Instructions

Expo Hotels:

HOTEL	ROOM RATE	ROOMS AVAILABLE
Las Vegas Hilton	$95 Single/Double	2,400
Stardust Resort	$79 Single/Double	450

LAS VEGAS HILTON: The 3,000 room Las Vegas Hilton features 10 restaurants and an 8 acre recreation deck with swimming pool, 6 tennis courts and a health spa. The Hilton is adjacent to the Las Vegas Convention Center.

STARDUST RESORT: The 2,500 room Stardust Resort features 6 restaurants, two swimming pools and an indoor shopping mall. The Stardust is two blocks from the Las Vegas Convention Center. Bus service will be provided.

Hotel Reservations:

♣ **Reservations will be accepted only with paid registration forms. No reservations will be accepted by phone.**

♣ Hotels are assigned first come, first served based on availability. Every effort will be made to honor your hotel request. However, SCTE reserves the right to place your reservation where rooms are available (this may include overflow hotels).

♣ Housing reservations (with accompanying attendee registration form) must be received **by MAY 5, 1995**. After May 5, please call SCTE for housing availability information.

♣ Beginning **MAY 15, 1995,** reservations must be made directly with the hotels.

Confirmations:

♥ You will receive a written acknowledgment of your hotel reservation from SCTE. Actual confirmation of hotel reservations will be sent to you directly from the assigned hotel. Do not call SCTE for confirmation numbers.

Hotel Deposits and Guarantees:

♠ A deposit of one nights room rate must be included with hotel reservation. If using a credit card to pay room deposit, credit card information must be filled in completely on housing form. Failure to fill out all information will delay processing of reservations. PLEASE NOTE: THE DEPOSIT OF ONE NIGHTS ROOM RATE WILL BE CHARGED TO YOUR CREDIT CARD IMMEDIATELY UPON RECEIPT BY THE HOTEL. SCTE is not responsible for the cancellation of reservations due to failure to follow hotel deposit procedures.

♠ To pay room deposit by check, send a separate check payable to the appropriate hotel in the amount of one nights room rate with housing reservation form. DO NOT INCLUDE HOTEL DEPOSITS ON THE SAME CHECK AS REGISTRATION FEES.

Cancellations and Name/Date Changes:

♦ Hotel cancellations must be received in writing by SCTE prior to MAY 5. After that date, cancellations must be made directly with the hotel.

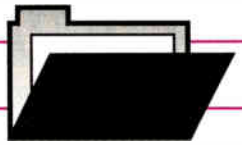
♦ Any requests for changes in arrival/departure date or substitutions must be made in writing and received by SCTE prior to MAY 5. After that date, all changes must be made directly with the hotel, subject to availability.

♦ PLEASE NOTE: CANCELLATION POLICY IS TWO WEEKS PRIOR TO ARRIVAL for the Las Vegas Hilton, 48 HOURS for the Stardust Resort. If a reservation is canceled any time after the stated policy, NO REFUND OF THE DEPOSIT WILL BE GRANTED.

CABLE-TEC EXPO® '95 EXHIBITORS

(as of February 1, 1995)

3M Telecom Systems Division
ABC Cable Products
ACT Communications Inc.
AEL Industries Inc.
AM Communications
ANTEC
AOFR Americas Inc.
AT&T
Alcatel
Alcoa Fujikura Ltd.
Alpha Technologies
American Lightwave Systems
Amphenol CATV Connectors
Arcom/Northern CATV
Arnco Corp.
Augat Communications Division
Authorized Parts Co.
Belden Wire and Cable Co.
Ben Hughes/Cable Prep
Blonder Tongue Laboratories
Broadband Networks Inc.
BUDCO
C-COR Electronics Inc.
CED Magazine
C.F.T. Tower Sentry
C.I.S. Inc.
Cabelcon Connectors
Cable AML
Cable Constructors Inc.
Cable Innovations Inc.
Cable Leakage Technologies
Cable Link Inc.
Cable Ready Inc.
Cable Security/Power Guard
Cable Shoppe Inc.
Cable Spinning Equipment Co.
Cable TV Supply Co.
Cable Technologies International Inc.
CABLETEK Wiring Products Inc.
CADCO Inc.
Cadix International Inc.
Can-Am Services Inc.
Canusa-EMI
Carlon, A Lamson & Sessions Co.
Channel Master
Channell Commercial
Channelmatic
Coast CATV Supply Inc.
Com-Tek
Commercial Electronics
CommScope Inc.
Commonwealth Communications
Comsonics Inc.
CommSpec
Communications Technology Magazine
Condux International Inc.
ConTec L.P.
Contech
DX Communications Inc.
Diamond
Diamond Communication Products
Digitrace
Dumbauld & Associates
E-Z Trench Manufacturing Co. Inc.
Eagle Comtronics Inc.
Earthvision Systems Ltd.
Electroline Equipment Inc.
FM Systems Inc.
Fiber Instrument Sales Inc.
Flight Trac Inc.
GC Technologies Inc.
GLA International
General Instrument
Gilbert Engineering
Gold Communications Inc.
Gould Inc., Fiber Optics Division
Harmonic Lightwaves
Hennessy Products Inc.
Hewlett-Packard Co.
IDK Technologies
Jackmoon USA Inc.
Jameson Corp.
Jerry Conn Associates Inc.
Kamp Specialists Inc.
Kennedy Cable Construction Inc.
Knaack Manufacturing Co.
Leaming Industries
Lectro Products Inc.
Lemco Tool Corp.
Light Brigade Inc.
Lindsay Speciality Products
Lode Data Corp.
Long Systems
MK Battery
Main Line Equipment Inc.
Masterack
Mega Hertz
Metrotech Corp.
Midwest Cable Services
Mobile Tool International Inc.
Molex Fiber Optics
Monroe Electronics
Moore Diversified Products
Multilink Inc.
NCS Industries Inc.
NCTI
NaCom
Nationwide Tower Co. Inc.
Network Construction
Northern Technologies Inc.
Novaplex Inc.
Noyes Fiber Systems
Ortel Communications
Osburn Associates Inc.
Pencell Plastics Inc.
Performance Cable TV
Photon Systems Corp.
Photonic Components
Pico Products Inc.
Pioneer New Media Technology
Pirelli Cables North America
Porta Systems Corp.
Power Battery Co. Inc.
Practical Communications Inc.
Preformed Line Products
Primus-Sievert Inc.
Progressive Electronics
Pyramid Industries Inc.
Quality RF Services Inc.
Quazite
RDL Inc.
R.L. Drake Co.
RMS Electronics Inc.
RTK Corp.
Radiant Communications
Radiodetection
Rainbow Technology Corp.
Reliance Comm/Tec
Ripley Co./Cablematic Division
Riser-Bond Instruments
Satellite Export & Engineering
Scientific-Atlanta Inc.
Scott Cable Communications
SeaChange Technology
Siecor Corp.
Signal Vision Inc./
John Weeks Enterprises
Sprint/North Supply
Standard Communications Corp.
Sumitomo Electric Lightwave
Superior Electronics
Synchronous Communications
T-Com Corp.
TVC Inc.
TW Communications
Taco/Wade Antenna Products
Tektronix Inc.
Telecommunications Techniques
Telect
Telecrafter Products
Telewire Supply
Tellabs
Teltone Corp.
Texscan Corp.
THOR Enterprises Inc.
Thomas & Betts
Time Manufacturing Co.
Times Fiber Communications Inc.
Toner Cable Equipment Inc.
Trilithic Inc.
Trilogy Communications Inc.
Triple Crown Electronics
Tulsat
Tyton Corp.
U.S. Cable Inc.
U.S. Electronics
Universal Electronics
Video Data Systems Inc.
Videotek Inc.
Viewsonics Inc.
Vikimatic Sales Inc.
Wavelynx International
Wavetek
The Weather Channel
Wegener Communications
Westec Communications
White Mountain Cable Construction
Zenith



Digital encryption: Signal security at last?

The following was written exclusively for "Communications Technology" on behalf of Cable Television Laboratories Inc.

By Robert Wells

"Digital security systems are in most ways completely different from the analog scrambling systems cable operators have used in the past — completely different." That was how Claude Baggett, CableLabs' director of customer premises equipment, summarized a message he's been trying to spread lately to MSOs. His most resounding themes were three:

- Cable needs to re-educate itself about security.
- Removable, replaceable security modules may eventually work better in a digital world than modules embedded inside set-tops.
- The industry should consider embracing open standards "for at least the interface of that removable security module."

Cable "has not been doing a very good job of securing analog TV signals," Baggett said in a recent interview. Although it's not terribly easy to view unpaid-for signals, "the analog signal is readily available to the good RF engineer," spawning a huge signal-theft industry built on cloned set-top boxes. "The analog picture is hard to secure, easy to damage," Baggett observed.

The digital realm

As operators move toward overlaid digital channels, "cable has an opportunity to finally procure a level of security that will make the commercial pirating of signals not profitable," Baggett said. However, he added, digital security systems also bring with them a whole new set of problems, some of which could compromise security or adversely impact cost. MSOs "need to know what they're buying with these security systems, having specs that work and ways to certify the products."

Cable systems will be securing digital TV signals — standard and high definition ones — as well as a variety of voice and data services. (Baggett even believes MSOs can affordably encrypt voice telephony whereas traditional telco systems cannot.) Borrowing terminology learned during his years as a cryptographic systems expert with the National Security Agency, Baggett said digital systems must provide for "secure signatures" and the protection of customer "entitlement" information that are part of a secure transactional environment — a necessity in any on-screen teleshopping venture.

Piracy threat remains

In analog systems, the pirate's tactic is to directly attack the scrambling of the signal. But in a digital system, "attacking the cryptographic algorithm is probably not practical," Baggett said. It would require extensive code-breaking computers and considerable time for each compromise.

Rather, he said, the pirate's likely strategy will rely on cloning or some form of spoofing, Baggett explained:

- The pirate becomes a subscriber. He builds clone decryptors that do everything the legitimate one does, except that the illegals never talk back upstream.
- When a new "key" — the digital handshake that secures the dialog between headend and set-top — is downloaded to the pirate, all the clones get the same update, since they are identical to the pirate's legitimate set-top.

"The further threat is that the pirate in some way, almost like a computer virus, usurps control and is able to enter accounts or modify the entitlement in the billing machines for accounts, changing their authorization without changing their billing," Baggett said. "That's entirely possible in the bright new world of computer control."

Data about what services a subscriber has paid for are stored in an "entitlement matrix," part of which is in the upstream computer and part in the customer-premises equipment. While this matrix wouldn't be consulted each time a viewer changes channels, it would be consulted before delivery of pay channels or pay-per-view movies and events, Baggett explained.

"You can never stop someone from eventually breaking your security. But you can make it not cost-effective or not time-effective."

A clever pirate, he added, might be able to tamper with the subscriber unit's entitlement matrix so that it would authorize theft of services. To do so, he also would have to somehow defeat the key system — a nontrivial combination of feats, Baggett noted. The overall strategy of security "is to make it so costly that pirates can't be profitable. You can never stop someone from eventually breaking your security. But you can make it not cost-effective or not time-effective. In other words, they cannot commercially sell it because it costs too much, or it takes them so long to redo it every time you change it that their customers are without TV half the time."

Industry response

In a June 1994 CableLabs document, Baggett listed electronic countermeasures that MSOs could take against digital piracy, including out-of-band rekeying, using different keys for trunks in a system, requiring different conditional-access cards for every subscriber device, and some other more complicated techniques. Although using only one of the countermeasures "might be unwise," using two or more of them should be sufficient, he wrote.

Cable is not alone in its quest for digital security. The National Renewable Security Standards Committee was formed by the EIA/NCTA Joint Engineering Committee in April 1993 to address security challenges posed by the Cable Act of 1992. Members include MSOs and cable equipment vendors, telco-side operators and vendors, consumer electronics and microelectronics manufacturers, and organizations with encryption expertise. Baggett and Jack Chaney of Thomson Consumer Electronics co-chair it.

The group has devised a voluntary standard that includes data protocols and a physical and electrical interface for a removable conditional access device. Its approach specifies that the conditional-access function must reside outside any host set-top, TV set or VCR — a requirement to which the cable industry has adhered firmly, often challenging vendors' designs. But it leaves specifics of cryptographic algorithms and other features to be decided by the marketplace.

"The NRSS concept is that everything that deals with security — the key handling, the entitlement, the authentication for purchases, secure signatures for money transfers, the signal recovery — everything is in the card, in the module," said Baggett. The NRSS has drawn up and published a list of about 25 suggested attributes of a digital security system. Baggett says the list is still being revised but already is a useful tool for those contemplating security-system purchases. Copies of the list are available from Baggett at CableLabs, 400 Centennial Parkway, Louisville, CO 80027-1208; phone (303) 661-9100; fax (303) 661-9199.

Baggett questions some major vendors' claims that putting their "crypto" (encryption) algorithms on silicon inside their boxes would make them hard to find and thus hard to tamper with. Big-league pirates will have no problem delving inside the boxes, he said. And, he adds, replacing an $11 to $15 card (possibly through the mail) beats replacing or recycling a compromised MPEG-2 decoding set-top. A specific solution initially may be integrated on silicon in the set-top with a provision for an external renewable interface. This gives the cable operator the ability to replace an embedded, low-cost silicon solution with a higher cost external renewable security solution, if necessary, in the future.

Some changes to encryption codes can be downloaded over the network, Baggett said. "Ideally," he noted, "the whole crypto would be in software and you could change it easily. The problem we have is getting a software crypto that runs on an affordable processor that's fast enough to handle all of the other functions and do HDTV simultaneously."

Three form factors

The NRSS group is considering three different form factors for the removable card:

- An NRSS-designed fattened version of the credit-card sized ISO 7816 microprocessor card
- A PCMCiA module (already in wide use on notebook computers) and
- A General Instrument Corp. custom module.

The group considers the 7816 card probably the most cost-effective long-term, while still needing development work near-term. The NRSS has met with Europe's Digital Video Broadcasting (DVB) Project, together devising a physical interface accommodating all three of the mentioned control cards — in fact, more than one at once, such as a conditional access card for security and a "smart" credit card for external billing.

This interface is due to go before the International Telecommunications Union for consideration as a world standard. "Of course, it's a voluntary standard," said Baggett. In the laissez-faire U.S., "manufacturers and even cable companies could totally ignore it."

Then again, they may save substantial money by embracing it, he noted. Set-tops deployed in 1995 wouldn't use the standard in any case, Baggett said. "We're targeting 1996 or later." **CT**

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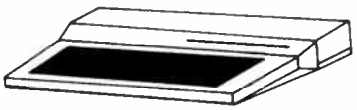

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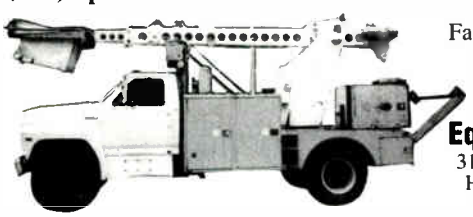

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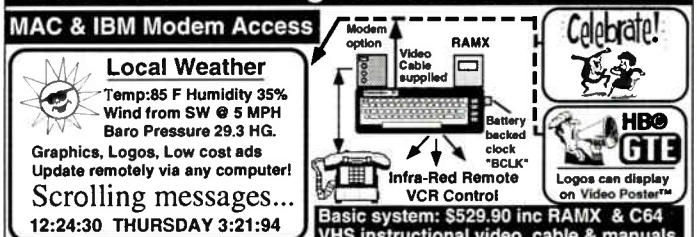

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30. ___ Amplifiers
31. ___ Antennas
32. ___ CATV Passive Equipment including Coaxial Cable
33. ___ Cable Tools
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50. ___ Telephone/PCS Equipment
51. ___ Power Supplies. (Batteries, etc.)
52. ___ Video Servers

E. What is your annual cable equipment expenditure?
53. ___ up to $50,000
54. ___ $50,001 to $100,000
55. ___ $100,001 to $250,000
56. ___ over $250,000

F. In the next 12 months, what fiber-optic equipment do you plan to buy?
57. ___ Fiber-Optic Amplifiers
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60. ___ Fiber-Optic Splicers
61. ___ Fiber-Optic Transmitter/Receiver
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BOOKSHELF

The following is a listing of some of the videotapes currently available by mail order through the Society of Cable Television Engineers. The prices listed are for SCTE members only. Nonmembers must add 20% when ordering.

- *Category VII Review Course: Engineering Management and Professionalism* — Category VII Curriculum Committee Chairman Wendell Bailey presents an in-depth discussion of this BCT/E certification category. (1 hr.) Order #T-1048, $45. (Reference for BCT/E Category VII)

- *Channel Deletion and Reprocessing Networks* — Microwave Filter Co. explains the construction of RF filters and their applications in cable system headend processing in this video produced by the company for the SCTE Product-Specific Tele-Seminar Program. (30 min.) Order #T-1051, $30.

- *Standby Power Supply Maintenance* — Alpha Technologies produced this in-depth program on this important topic, which features company representative Bob Bridge for the SCTE Product-Specific Tele-Seminar Program. (1 hr.) Order #T-1052, $35.

- *RF Field Strength: Principles and Practices* — An effective presentation of the basics of an RF field, relating what it is and how it reacts both inside and outside of a cable. Ron Adamson covers the principles of shielding, wavelength and the use of a dipole antenna for detection. In addition, the terminology of the FCC's "microvolt per meter" is discussed in relation to cable's "dBmV." (1 hr.) Order #T-1053, $35.

Note: The videotapes are in color and available in the NTSC 1/2-inch VHS format only. They are available in stock and will be delivered approximately three weeks after receipt of order with full payment.

Shipping: Videotapes are shipped UPS. No P.O. boxes, please. SCTE pays surface shipping charges within the continental U.S. only. Orders to Canada or Mexico: Please add $5 (U.S.) for each videotape. Orders to Europe, Africa, Asia or South America: SCTE will invoice the recipient for additional air or surface shipping charges (please specify). "Rush" orders: a $15 surcharge will be collected on all such orders. The surcharge and air shipping cost can be charged to a Visa or MasterCard.

To order: All orders must be prepaid. Shipping and handling costs are included in the continental U.S. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. To qualify for SCTE member prices, a valid SCTE identification number is required, or a complete membership application with dues payment must accompany your order. Orders without full and proper payment will be returned. Send orders to: SCTE, 669 Exton Commons, Exton, PA 19341 or fax with credit card information to (610) 363-5898.

Listings of other publications and videotapes available from the SCTE are included in the March 1994 issue of the Society newsletter, "Interval."

CALENDAR

April

3: SCTE Bluegrass Chapter testing session, Installer exams to be administered, Richmond, KY. Contact Max Henry, (502) 753-6521.

3: SCTE Cascade Range Chapter testing session, Installer exams to be administered, Portland, OR. Contact Cindy Welsh, (503) 667-9390.

3-6: Siecor training course, fiber-optic installation and splicing, maintenance and restoration for CATV applications, Hickory, NC. Contact (800) 743-2671, ext. 5539 or 5560.

4: Scientific-Atlanta training course, fundamentals of the hybrid fiber/coax network, Boston. Contact Bill Brobst, (404) 903-6306.

4-5: PCTA Cable Academy testing session, BCT/E exams to be administered, State College, PA. Contact Doug Hair, (717) 243-4918.

4-6: Philips mobile training course, Atlanta. Contact (800) 448-5171.

5: SCTE West Virginia Mountaineer Chapter seminar, RF and video FCC testing, Ramada Inn, South Charleston, WV. Contact Steve Johnson, (614) 894-3886.

5-6: Scientific-Atlanta training course, hybrid fiber/coax field test and measurement, Boston. Contact Bill Brobst, (404) 903-6306.

5-6: Scientific-Atlanta training course, interactive broadband delivery system overview, Boston. Contact Bill Brobst, (404) 903-6306.

6: SCTE Golden Gate Chapter testing session, BCT/E and Installer exams to be administered, TCI office, Hayward, CA. Contact Mark Harrigan, (510) 988-8600.

6: SCTE Shasta/Rogue Chapter testing session, Installer exams to be administered, Oroville, CA. Contact Mark McIntosh, (503) 476-6362.

6: SCTE Upper Valley Chapter seminar, fiber optics, Holiday Inn, Waterbury, CT. Contact Michael Reilly, (802) 893-1551.

6: SCTE West Virginia Mountaineer Chapter seminar, RF and video FCC testing, Holiday Inn, Fairmont, WV. Contact Steve Johnson, (614) 894-3886.

7: SCTE North Country Chapter testing session, BCT/E and Installer exams to be administered, St. Paul, MN. Contact Bill Davis, (612) 646-8755.

9-13: NAB '95, Las Vegas Convention Center, Las Vegas, NV. Contact (202) 429-5350.

10: SCTE Northern New England Chapter testing session, BCT/E exams to be administered, Brunswick, ME. Contact Bill DesRochers, (207) 646-4576.

11: SCTE Desert Chapter seminar, signal processing: BCT/E Category I tutorial, El Rancho, Beaumont, CA. Contact Bruce Wedeking, (909) 677-2147.

11-13: Scientific-Atlanta training course, hybrid fiber/coax operation and maintenance, Boston. Contact Bill Brobst, (404) 903-6306.

11-13: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.

11-13: Philips mobile training course, Raleigh, NC. Contact (800) 448-5171.

12: SCTE Bluegrass Chapter seminar, distortions and equalizing, BCT/E and Installer exams to be administered, Holiday Inn, Elizabethtown, KY. Contact Max Henry, (502) 753-6521.

Planning ahead

May 7-10: The National Show, Dallas. Contact (202) 775-3669.

June 14-17: Society of Cable Television Engineers Cable-Tec Expo, Las Vegas, NV. Contact (610) 363-6888.

Aug. 13-15: Great Lakes Cable Expo, Indianapolis. Contact (317) 845-8100.

12: SCTE Central California Chapter testing session, BCT/E and Installer exams to be administered, Turlock, CA. Contact Ballard Warkentin, (209) 473-4955.

12: SCTE Delaware Valley Chapter seminar, safety, Williamson Restaurant, Willow Grove, PA. Contact Chuck Tolton, (215) 657-6990.

13: Society of Cable Television Engineers Tele-Seminar Program, *Demystifying the New Technology*, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.

13: SCTE Michiana Chapter seminar, hands-on P-III cable splicing, standby power supply status monitoring, Comfort Inn, New Buffalo, MI. Contact Russ Stickney, (219) 259-8015.

13: SCTE Music City Chapter testing session, BCT/E exams to be administered, Nashville, TN. Contact Kenny Long, (615) 244-7462, ext. 392.

13: SCTE New Jersey Chapter testing session, Installer exams to be administered, Adelphia Cable office, Toms River, NJ. Contact Linda Lotti, (908) 679-3531.

14: SCTE Dakota Territories Chapter testing session, Installer exams to be administered, Sturgis, SD. Contact Michael Schmit, (605) 229-1775.

15: SCTE Central Indiana Chapter testing session, BCT/E and Installer exams to be administered, Indianapolis, IN. Contact Gordie McMillen, (317) 353-2225.

18-20: C-COR training seminar, cable TV technology, Wilmington, DE. Contact (800) 233-2267, ext. 4422.

19: SCTE Badger State Chapter seminar, powering and grounding regulation, Holiday Inn, Fond du Lac, WI. Contact Brian Revak, (608) 372-2999.

19: SCTE Dakota Territories Chapter seminar, transportation systems, Governor's Inn, Pierre, SD. Contact Michael Schmit, (605) 229-1775.

19: SCTE Heart of America Chapter testing session, BCT/E exams to be administered, Kansas City, MO. Contact David Clark, (913) 599-5900.

19: SCTE Inland Empire Chapter seminar, cable basics, BCT/E exams to be administered, Shep Rock Hanger, Coeur d'Alene, ID. Contact Roger Paul, (509) 484-4931, ext. 230.

19: SCTE Shasta/Rogue Chapter testing session, Installer exams to be administered, Redding, CA. Contact Mark McIntosh, (503) 476-6362.

20: SCTE Dakota Territories Chapter seminar, transportation systems, Mandan Service Center, Bismark, ND. Contact Michael Schmit, (605) 229-1775.

20: SCTE Northern New England Chapter seminar, FCC proof and standards, Ramada Inn, Portland, ME. Contact Bill DesRochers, (207) 646-2672.

24-26: Kentucky Cable Television Association annual convention, Holiday Inn North, Lexington, KY. Contact Randa Wright, (502) 864-5352.

24-27: Siecor training course, fiber-optic installation and splicing, maintenance and restoration for CATV applications, Keller, TX. Contact (800) 743-2671, ext. 5539 or 5560.

24-28: General Instrument training course, broadband communications network design, St. Louis. Contact Lisa Nagel, (215) 830-5678.

25: Scientific-Atlanta training course, fundamentals of the hybrid fiber/coax network, San Francisco. Contact Bill Brobst, (404) 903-6306.

25: SCTE Desert Chapter testing session, BCT/E and Installer exams to be administered, Colony Cablevision office, Palm Desert, CA. Contact Bruce Wedeking, (909) 677-2147.

26: SCTE Lincoln Land Chapter installer seminar, BCT/E and Installer exams to be administered, Best Western Suites-Eastland, Bloomington, IL. Contact Richard Rohm, (309) 467-5107.

26-27: Scientific-Atlanta training course, understanding hybrid fiber/ coax design, San Francisco. Contact Bill Brobst, (404) 903-6306.

28: SCTE Wheat State Chapter meeting, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.

Focus on dispersion

This month, our fiber expert examines dispersion and answers questions about its effect on long-distance, high bit-rate digital and analog transmission for cable TV applications.

By Don C. Vassel
Senior Market Development Engineer
Corning Inc.

What is dispersion and where does it come from?

A pulse of light in a optical fiber consists of more than one wavelength. The refractive index of the optical fiber, which determines the speed at which the light travels through the fiber, is a function of wavelength. Dispersion refers to the detrimental spreading of light pulses as they travel along the length of a fiber. This limits transmission because one pulse may become indistinguishable from the next, causing errors in detection. Reducing dispersion corresponds to increasing bandwidth, the information-carrying capacity of fiber. The lower the dispersion, the higher the transmission capability.

"The trick is to design a fiber with enough dispersion to suppress nonlinear behavior, and at the same time minimize dispersion so the fiber is capable of multiple high data rate channels (10 Gbs or more) over long distances."

In step-index single-mode fibers the limiting dispersive characteristic is called chromatic dispersion. Chromatic dispersion is dependent on the range of wavelengths being transmitted by the fiber.

In analog transmission, chromatic dispersion can lead to intolerable levels of composite second order distortion, which appears as rolling lines on a TV screen. In digital transmission systems, chromatic dispersion is capable of increasing bit error rates. A tolerable bit error rate is 1×10^{-9}. Anything higher may turn a clear digital video picture into a blank TV screen.

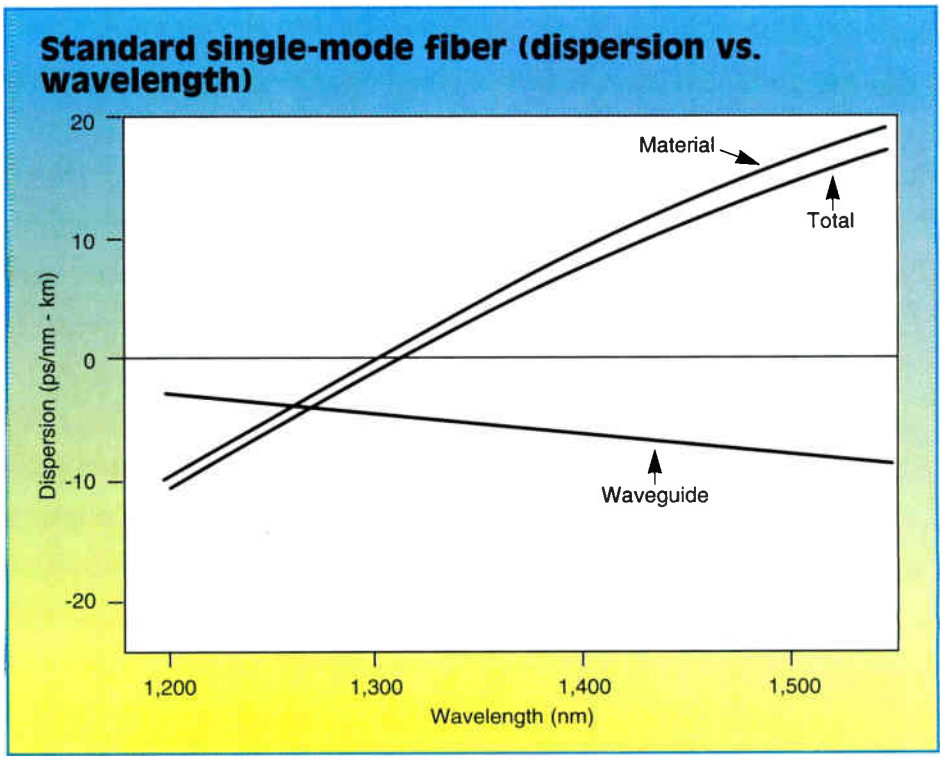
Chromatic dispersion is the sum of two kinds of dispersion: material dispersion and waveguide dispersion. Material dispersion is dependent on the refractive index differences within the fiber, while waveguide dispersion is dependent on the amount of light distributed between the fiber core and cladding. Material dispersion depends upon the intrinsic composition of the optical fiber and cannot be manipulated, so waveguide dispersion is the key parameter in designing fibers with different dispersive characteristics.

Fortunately, dispersion can be positive or negative because it measures the change in the refractive index with wavelength. So, material and waveguide dispersion can be opposite in sign, which allows fiber manufacturers to design fibers with minimal dispersion in a particular wavelength operating window.

How does standard single-mode fiber differ from dispersion-shifted fiber?

As mentioned earlier, fiber dispersion varies with wavelength and is controlled by fiber design. The region in which fiber has maximum information-carrying capacity is called zero dispersion. For standard single-mode fibers, this is in the region of the 1,310 nanometer (nm) operating window. (See the accompanying figure.)

Optical fiber also can be manufactured to have the zero dispersion wavelength in the 1,550 nm operating window. Known as dispersion-shifted fiber, it is created by manipulating the waveguide dispersion of the fiber.



Dispersion-shifted fiber coincides with fiber's low attenuation point, making it suitable for cable TV applications requiring delivery of AM video over long distances and high bit-rate digital applications, such as video-on-demand and two-way interactive multimedia services.

In recent months dense wavelength division multiplexing (WDM) has gained momentum in the cable TV industry. Dense WDM technology is where several narrowly spaced wavelengths in the 1,550 nm operating window are carried on a single fiber. To accommodate dense WDM operation, leading fiber manufacturers have developed a nonzero dispersion-shifted fiber designed to minimize potential fiber-optic transmission nonlinearities while maintaining a multiwavelength high data rate capability. The trick is to design a fiber with enough dispersion to suppress nonlinear behavior, and at the same time minimize dispersion so the fiber is capable of multiple high data rate channels (10 Gbs or more) over long distances. **CT**

Readers with fiber-related questions can send them to: Ask a Fiber Expert, c/o "Communications Technology" 1900 Grant St., Suite 450, Denver, CO 80203; fax (303) 839-1564.

The future is on cable" ... and SCTE

By Bill Riker
President, Society of Cable Television Engineers

The Society of Cable Television Engineers is constantly working to remain at the forefront of the broadband communications industry and be as involved in its activities as befits an organization of SCTE's size and prestige.

That is why I am delighted to let you know that SCTE is now a participant in a program that promises to revolutionize the CATV world — the national industry public affairs program, "The Future is on Cable."

At its recent meeting held in conjunction with the 1995 Texas Show, the Society's board of directors voted unanimously in favor of the Society's participation in this exciting program.

SCTE joins the organization that initiated the program, the National Cable Television Association, as well as CATA, CTAM, CTPAA, CableLabs, Cable in the Classroom, SCBA and CAB, in the development and administration of this valuable industrywide effort.

"The Future is On Cable" program was created to build customer confidence in the industry by making major new commitments to the areas of customer service, education and technology.

The latter area, technology, is one for which SCTE is recognized as a major contributor, particularly in the areas of training, certification and standardization. The Society's expertise in these disciplines will allow it to play a significant role in "The Future is On Cable."

Under the customer service initiative of "The Future is On Cable," participating cable systems will pledge to provide the following to their customers:

- That installation will be on time or it is free; and
- That service appointments will be fulfilled on time or the customer receives $20.

Tech personnel are key

Our Installer Certification Program, which certifies industry installation personnel through a series of practical and written examinations measuring job competency and skill, can be utilized as a means of training system employees to ensure compliance with these pledges.

THE FUTURE IS ON CABLE

I feel that the Installer Certification Program is the ideal training resource for "The Future is on Cable." Through its intensive agenda of training and testing, much of which is conducted by SCTE's 74 chapters and meeting groups (which are located throughout the United States), our Installer Program offers the industry a proven means of assuring that its employees will successfully fulfill the tenets of "The Future is on Cable" with their enhanced skill and knowledge.

Wendell Bailey, the NCTA vice president of science and technology, who also serves as an SCTE at-large director, commented, "SCTE members are the installers and technicians that will need to carry out customer service guarantees and they will therefore play an integral part in this public service campaign."

I couldn't agree more with Wendell's statement. These installers and technicians that he refers to are the people who will be responsible for ensuring that all cable installations and service calls are performed on time (and correctly). So, in a sense, the success of this endeavor is hinging on the performance of the industry's technical personnel — our membership.

What is the program?

Beyond the program's customer service guarantees, "The Future is On Cable" will encompass educational initiatives such as educational critical viewing workshops held by cable operators and local PTA members; a TV program on local, state and national policy makers; and "Cable in Focus," a series of education events to be held in cooperation with local schools or educational institutions that will target programming devoted to a certain event or issue.

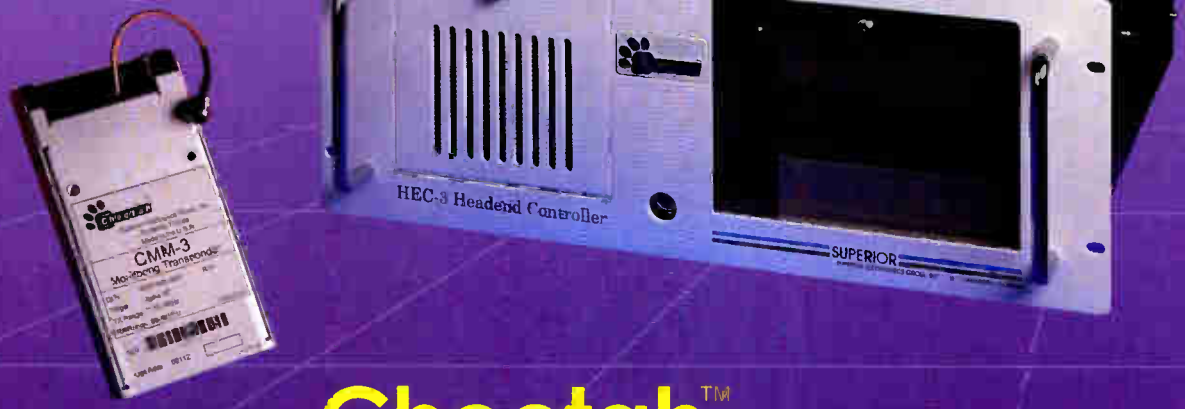
"The Future is On Cable" also will include demonstrations of cable's capacity to provide telecommunications services beyond television utilizing advanced cable technology already in place in much of the country. These demonstrations will

be provided through a multimedia traveling tour, short infomercials and a one-hour TV special.

Beyond SCTE's involvement with training employees to enable them to fulfill the customer service guarantees, the Society will contribute to this valuable effort by publicizing the program to its more than 13,000 national members, and keep them abreast of the campaign's progress through regular reporting in the Society's national newsletter, *Interval*, and other SCTE publications and promotional materials.

Our Society Chairman Tom Elliot, who is senior vice president of engineering and technology for TCI and an SCTE at-large director, commented, "The Society is pleased to be working with 'The Future is On Cable,' a program that will enhance the perception of our industry with consumers."

Perception is a very appropriate word to use in this case, because that's what "The Future is On Cable" is all about. How the industry is perceived by its customers, the opinions that they form about our industry and its service — these are the keys to our future. And if SCTE can contribute to this effort and help to improve and solidify their positive perceptions of cable TV, and help to improve their opinions through better-trained employees and subsequent enhanced service and performance, then the future truly will be on cable, and it will be a bright, positive future — a future in which our Society will play a major role. **CT**



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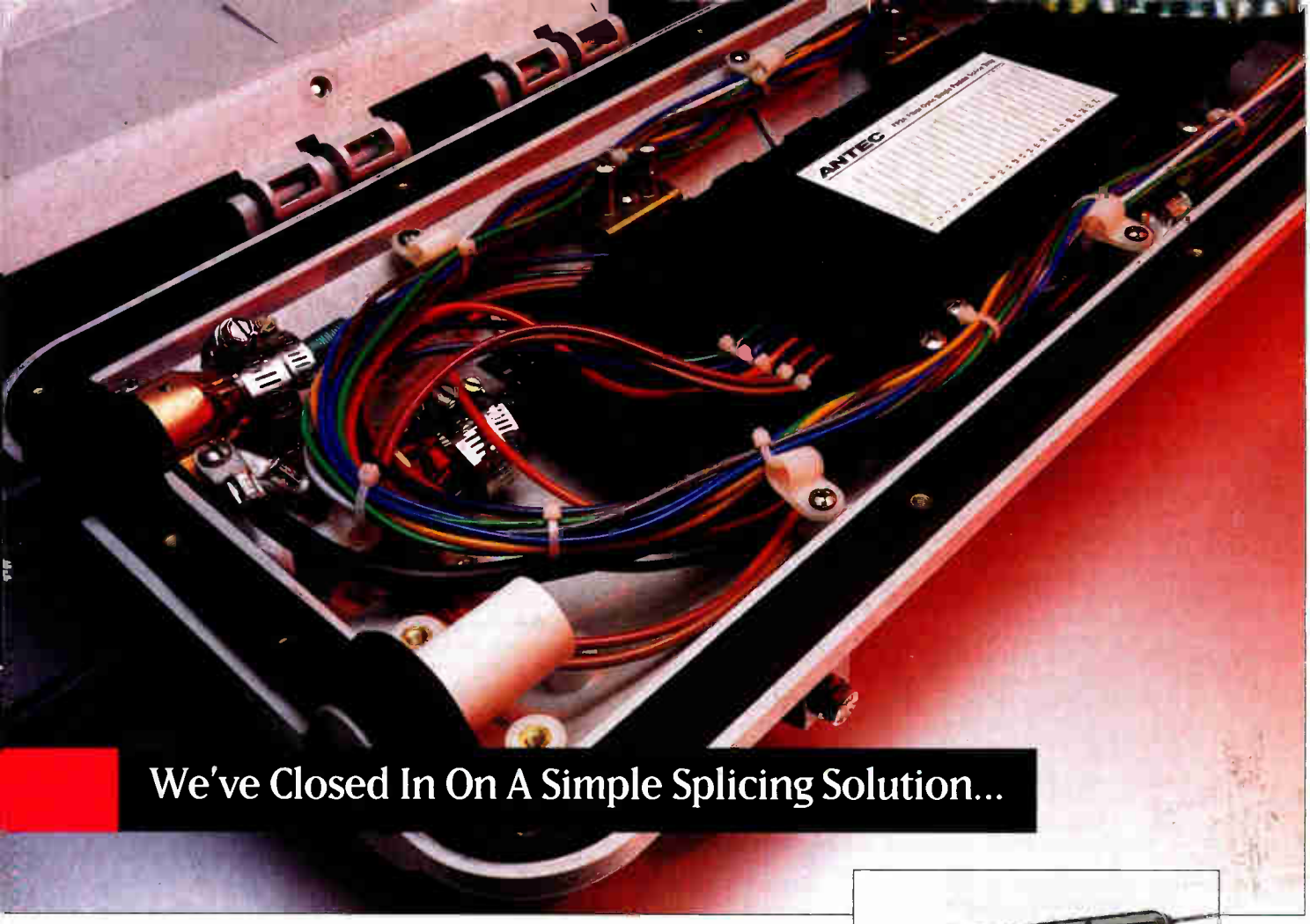

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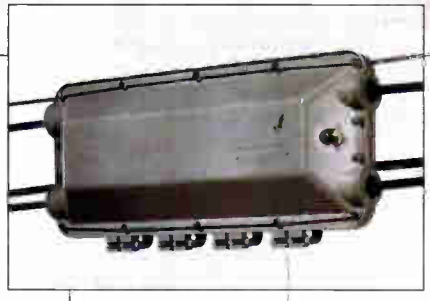
If you're adding fiber optics to your system, you need a splice closure that's easy to install. To learn more about the FiberPak, call your local ANTEC Representative or 1-800-TO ANTEC.



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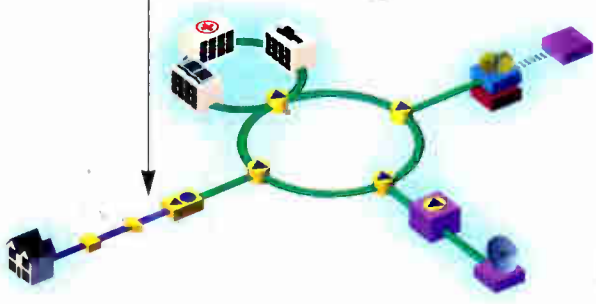

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