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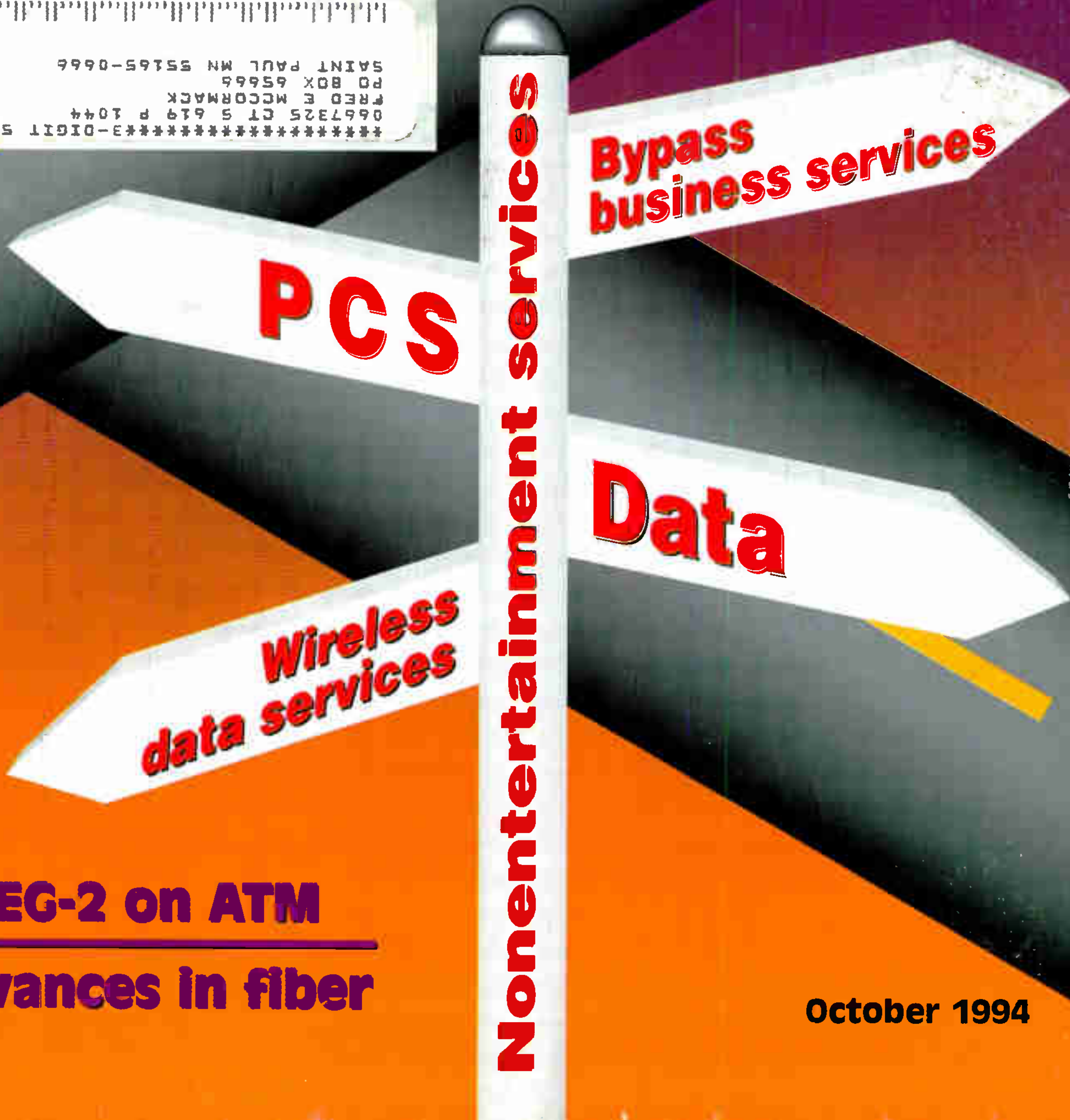

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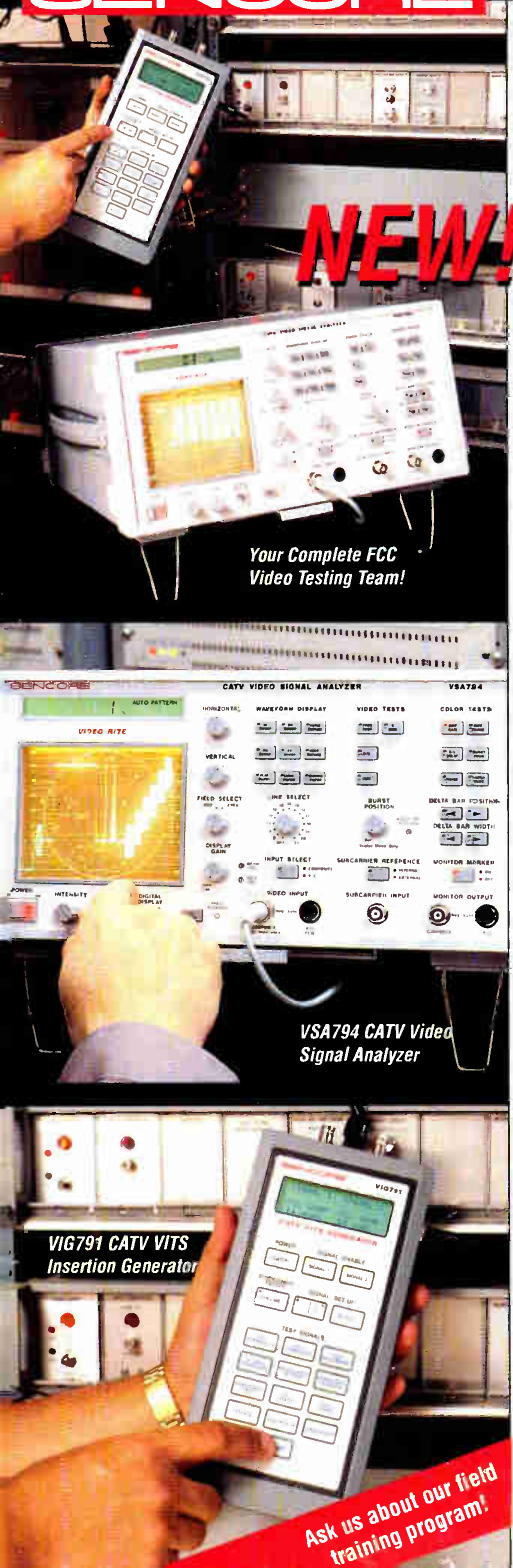

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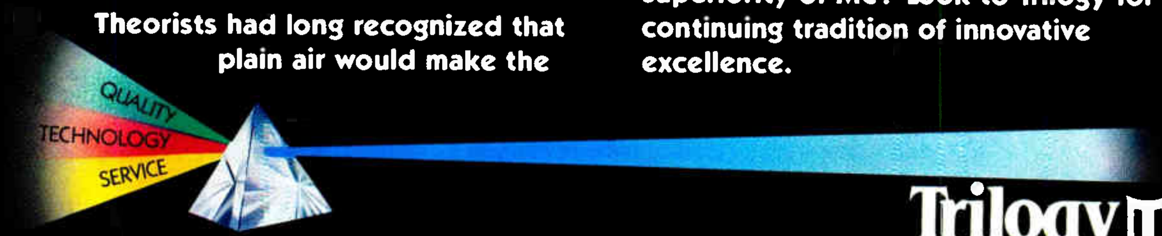

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EDITOR'S LETTER

DirecTv: They're heeeere ...

As I write this month's editorial, I'm in the middle of an extended overseas business trip. But the day before this trip began, DirecTv arrived in Denver. The night prior to the official launch, I visited two of the stores that would be selling the direct broadcast satellite dishes and receivers: Sears and a nearby audio/video specialty store. Neither store could sell the equipment that night, although the audio/visual store gladly took my money on the understanding that customers who prepaid could pick up the equipment the next day. I opted for the $699 basic package and self-installation.

To give you an idea of the public's initial interest in direct broadcast satellite (DBS), the package I paid for was one of four remaining out of the store's entire launch allocation. At least for now, people aren't finding the equipment's moderately high price to be a deterrent. According to the store manager, the public has been about 50/50 when it comes to choosing between the basic equipment setup and the $899 deluxe version, and many are paying an additional $199 for installation. The competition here, and we had better take it seriously. The competition is here and we had better take it seriously. Whether or not it's only a short-term concern remains to be seen.

All of the stores selling DirecTv (and companion service USSB) have impressive in-store demos, often on big-screen TV sets. As you might expect, clear sky picture quality on these compressed digital video services is quite good. I could tell which channels had higher data rates — typically fast-paced sports and similar channels — and which ones had lower data rates. The high data rate channels have excellent picture quality and lower data rate channels exhibit some slight motion artifacts.

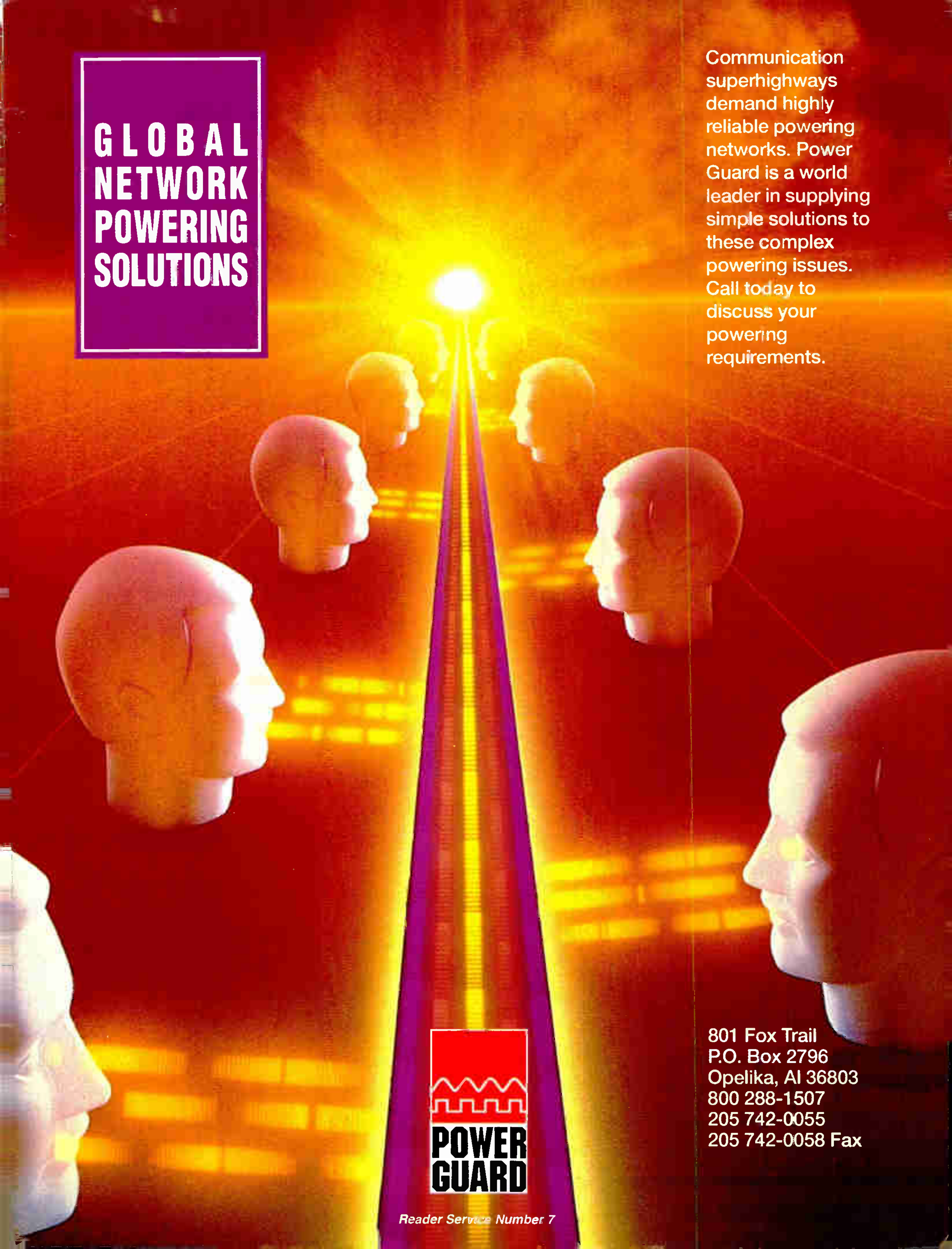
Although I didn't have time to do the installation before heading overseas, I did look through the accompanying documentation and tinker with the receiver a bit. It's pretty easy to set up and operate — there is no question

that this package was designed with consumers in mind. For example, if you're doing your own installation and dish alignment, you simply enter your ZIP code into the receiver and its on-screen display tells you where to point the 18-inch antenna.

DirecTv's basic channel lineup includes 24 channels for $21.95 per month. These are the same channels carried on cable systems: ESPN, CNN, Discovery, etc. The channel lineup is supposed to change a bit in a few weeks, after implementation of the recently launched second co-located satellite. As I understand it, a basic lineup will be provided, and the user will have a choice from an additional tier of channels, plus access to pay-per-view (PPV). I'll pass along the details as I get more information. I'll also keep you informed about long-term quality, reliability and overall operation.

The point of all this? Simply that we need to understand our competition. I personally believe that DBS has the greatest potential of any competitor to erode our subscriber base — perhaps by as much as 10%. It won't happen overnight and the more we know about it, the more we can do to avert that threat. Stay tuned.

Ronald J. Hranac
Senior Technical Editor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LETTERS

Installer pay observations

In response to Ron Hranac's editorial of July 1994 in *Communications Technology*, I wish to make the following observations and comments. The subject is the issue of installer wages and pay schedules for the cable TV industry in general.

The main thrust to the matter is the fact that the position of installer is about at the entry level for the industry. Not so with the telephone company. I wonder how many of us remember the day our telephone was installed. I am old enough to remember. The company truck was shiny and clean with a ladder and wire reel attached. The installer was pleasant and took time with the customer regarding the telephone location and the installation procedure. Work proceeded in an efficient manner followed by a thorough cleanup after testing the service. A quality job to say the least. Obviously, the telephone installer is regarded as an extremely important person (mainly because of customer contact).

This situation is not so with the cable TV industry. Often contract installers, not company employers (who are paid by the number of jobs they do per day) is the usual installer scene. Many cable operators do not monitor properly the contractors' work and often do not discover the poor quality of the installs until the problems occur.

The philosophy of operation between the two industries is markedly different. The telephone company designs equipment for a 40-year service life. Since many manufacturers had problems building such durable equipment the telephone company manufactured its own equipment (Western Electric). Also, a level of company profits were invested in research with many discoveries benefiting ourselves and our government. (The transistor being one that most of us know.) Telco management's attitude focuses on quality service and products with high system reliability.

The attitude of the cable TV industry's upper management and owners seem to be improving somewhat but many changes have to be made. Instead of being concerned with quality of service, survival of the enterprise was most important with cable management. The process of starting a cable system was to first win a franchise war, which caused financial hardships at the outset. Interest rates from borrowed money with startup costs and price escalations occurring before turn-on added more financial burden. No wonder management was watching pennies. Still even when systems matured and when finances were getting under control, cable management failed to realize that the people who had stuck with them through all those cold suppers were overdue to be paid back. Cable system owners and senior management instead sold some of their systems at the top price and got out or mortgaged same to buy more systems. The fact here is if cable is going to be a major player in the information superhighway, an attitude change is in order and cable system operators will have to examine their management style. If not, it will not be much longer before the telcos will start delivering video services to their customers and go it alone. All many telcos have to do is expand the bandwidth capabilities at the local exchanges to provide video and high-speed data services to homes and businesses.

Eugene R. Bartlett

Reliability definition

In the July 1994 issue of *CT* the authors of the article, "Network availability and reliability" state: "Reliability is the probability that a system will fail in a given period of time or it can be defined as the frequency of equipment or network failures as a function of time."

This is not correct. Reliability is "the probability that a system will perform its intended function for a given period of time under stated environmental conditions." (This is from *Reliability Training Text*, IRE-ASQC, March 1960.)

Ralph L. Auer
Lightning Eliminators & Consultants

FCC: Initial compatibility rules

The following report was prepared by the National Cable Television Association. It summarizes the FCC's First Report and Order and accompanying regulations on equipment compatibility.

On May 4, 1994, the Federal Communications Commission released its first Report and Order and regulations regarding compatibility between consumer electronics equipment and cable systems. Subsequently, on May 13, the commission released an erratum correcting certain errors and contradictory statements in the Report and Order.

The FCC decided to delay consideration of a "decoder interface" standard for new equipment for 90 days pending the outcome of work by the Cable-Consumer Electronics Compatibility Advisory Group (CAG), which is comprised of representatives from the cable TV and consumer electronics industries. The FCC also decided not to adopt digital transmission standards for cable at this time.

The new compatibility rules, which implement the statutory requirements in Section 17 of the 1992 Cable Act, generally incorporate the recommendations of the CAG. In summary, the rules require cable operators to:

1) Allow set-top devices that incorporate remote control capability to be operated with subscriber-owned remote controls by May 31, 1994;

2) Refrain from scrambling program signals carried on the basic tier of service by July 31, 1994;

3) Offer subscribers supplemental equipment to enable them to use the special features and functions of their TV equipment with cable service by Oct. 31, 1994; and

4) Provide a consumer education program to inform subscribers of potential compatibility problems and methods for resolving such problems by Oct. 31, 1994.

With regard to new equipment, the compatibility rules provide technical standards for "cable-ready" TV equipment and require that both "cable-ready" consumer TV equipment and cable systems use a standard cable channel plan.

In formulating the new rules, the FCC adopted the three-phase plan it recommended to Congress in an October 1993 report on compatibility. The first phase seeks to provide immediate relief for the existing base of equipment. The second phase would specify certain measures and new equipment standards for both cable systems and consumer equipment manufacturers in order to achieve more effective compatibility in the near future. The final phase would develop standards for the next generation of cable and consumer electronic equipment, including cable digital transmissions.

With the exception of the basic tier, the new rules allow cable operators discretion in determining the appropriate method of protecting their programming from theft. But the FCC intends to issue further notice of proposed rule making on whether to permit scrambling of any regulated services and to continue pursuance of policies to promote the use of "in the clear" signal delivery security systems, such as interdiction and multichannel descrambling.

Supplemental equipment

The rules require cable operators that utilize scrambling techniques to offer their subscribers supplemental equipment to enable operation of special features and functions of TV receivers and VCRs that make simultaneous use of multiple signals. This equipment includes devices such as bypass switches and set-top boxes containing multiple descramblers and/or timers that can be programmed to tune to alternative channels sequentially.

In an effort to further reduce compatibility problems, cable operators also are required to offer their subscribers the capability to receive "in the clear" all signals that do not need to be processed by descrambling of other special circuitry in a set-top device. This capability is generally accomplished through a bypass switch or internal bypass circuitry in a set-top box.

Recognizing that cable operators need the flexibility to tailor supplemental equipment to the needs of individual subscribers, the rules only identify general compatibility problems and types of supplemental hardware to address those problems.

Cable operators will be allowed to charge for this equipment and its installation in accordance with the applicable rate regulations for customer premises equipment used to receive basic service. Subscribers are permitted to obtain supplemental equipment from retailers, rather than from the cable system.

Scrambling of basic service tier

The rules prohibit scrambling of signals carried on the basic tier, including "nonmandatory" signals. This rule is designed to promote compatibility by eliminating the need for set-top devices for basic-only subscribers.

The commission stated that it will consider prohibiting cable operators from scrambling signals carried on any other regulated tier that were not scrambled prior to passage of the 1992 Cable Act in an upcoming Further Notice.

The basic tier scrambling prohibition provides for waivers to cover instances where cable operators may need to scramble basic signals to prevent theft of service. Under the waiver procedure, cable operators must send notices containing specific language to subscribers no later than 30 calendar days from the date the notification was mailed to comment on the waiver request.

Remote controls

The rules require cable operators to allow their set-top devices to be operated with subscriber-owned remote controls or otherwise take no action to prevent the use of such remote controls. According to the FCC, cable operators are obliged "to actively enable the remote control functions of set-top devices where those functions do not operate without a special activation procedure."

Cable operators also are prohibited from changing the infrared codes used to operate the remote control functions of their set-top devices so as to disable subscriber-owned remote controls.

Consumer education

The consumer education program requires cable operators to provide written information on compatibility to subscribers upon initiation of service and annually thereafter to all subscribers. These notices inform subscribers of potential compatibility problems and the methods for resolving such problems, including the availability of set-top converters and remote control units from third parties.

In an effort to protect cable security, however, cable operators are only required to notify subscribers of the availability of basic converters that do not contain descrambling or other access control functions.

With regard to informing subscribers about alternative sources for remote control units, cable operators must identify the models of set-top devices that they provide and include a representative list of the remote control units currently available from retailers that are compatible with these devices. This list must be current as of no more than six months before the yearly consumer information mailing. Operators will be held to a "good faith" standard in complying with this requirement.

The remote control notice requirement applies to all cable systems, whether or not they offer their subscribers the option of renting a remote control.

Cable operators were required to allow their set-top boxes to be operated with subscriber-owned remote controls by May 31, 1994. Cable operators are prohibited from scrambling basic tier signals, unless they seek a waiver, as of July 31, 1994. The other rules for existing equipment will be effective Oct. 31, 1994, except the requirement for cable operators to provide set-top devices with multiple tuners, which has been delayed until Oct. 31, 1995.

Decoder interface

The commission concluded that a standard interface connector, or decoder interface, should be employed in future "cable-ready" consumer TV equipment along with a component descrambler/decoder device to be provided by the cable operator. The decoder interface standard will update the current EIA/ANSI 563 MultiPort standard in order to accommodate cable systems that employ scrambling systems.

The set-back decoder interface device is expected to include 20 pins, plus both RF and IF connectors. The companion component descrambler/decoder that will be provided by the cable operator plugs into the interface and eliminates the need for a set-top box. The updated decoder is capable of serving all existing scrambling technologies and accommodating new cable transmission modes and services including analog, modulated digital and baseband digital technology. The commission advised that the device provide capability to separate access control function from other nonsecurity functions.

The commission gave CAG and the joint cable/consumer electronics engineering committee (JEC) an additional 90 days to complete the new standard. After that time, the FCC will adopt specific rules, including whether to allow cable operators to charge separately for component descrambler/decoders.

Cable-ready consumer equipment

The rules apply the technical standards for cable-ready consumer electronics equipment only to devices specifically marketed as cable-ready or cable-compatible.

In order to differentiate cable-ready products from products with features intended for use with cable service, the rules require that consumer TV sets and VCRs that meet some, but not all, cable-ready standards be labeled with an advisory on the device and its packaging. Any equipment that does not fully comply with the FCC standards may not be marketed with cable-ready or cable-compatible terminology associated with it. The labeling and advisory requirements do not apply to remote control units.

The FCC will require cable-ready consumer equipment to tune all cable channels specified by the EIA 15-132 standard up to a minimum frequency range of 806 MHz. This channel plan will not be required for reception of digital signals.

The rules also generally incorporate the CAG recommendations on cable-ready receiver performance standards, including adjacent channel interference, conducted emissions, radiated emissions and input selector switch isolation.

The rules subject cable-ready TV receivers and component descramblers/decoders to existing verification procedures, rather than to more strin-

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gent notification of certification procedures. The FCC believes verification is sufficient to show compliance with FCC technical standards.

As of Oct. 31, 1994, TV equipment manufacturers are prohibited from using "cable-ready," "cable-compatible" or other terms suggesting full compatibility with cable, in the labeling or packaging of consumer TV receivers and VCRs for the U.S. market, unless that equipment complies with the cable-ready technical standards. New TV receivers and VCRs marketed as cable-ready and cable-compatible after June 30, 1997, must comply with the FCC cable-ready standards.

Channelization standards

In order to promote consistency with new cable-ready equipment standards, the rules require cable systems built or rebuilt after May 31, 1995, to comply with the EIA 15-132 channel plan for all analog transmissions. All cable systems must comply with this channelization standard by June 30, 1997. The FCC intends to adopt a channel plan for digital cable service at an appropriate future time.

In light of ongoing developmental work on cable digital technologies and services, the FCC decided that it is too early to adopt cable digital transmission standards. It announced that it intends to issue a Notice of Inquiry on this and other issues related to digital video technologies in the future.

Bell Atlantic video dialtone challenged

The Atlantic Cable Coalition, consisting of the cable TV associations representing operators in Delaware, the District of Columbia, Maryland, New Jersey, Pennsylvania, Virginia and West Virginia, collectively filed petitions to deny two applications by Bell Atlantic to provide video dialtone service throughout its entire telephone service area. The coalition says its filing also is directed at legal issues concerning Bell Atlantic's attempt to provide video service by its own affiliate over the system and justify an expenditure of hundreds of millions of dollars as a first stage in an effort to have generic approval to spend hundreds of millions more to provide video dialtone wherever it wants. The coalition is concerned that these video systems will be unfairly paid for by regular telephone company customers and not the consumers of video services. Bell Atlantic will have the opportunity to respond to these allegations and the coalition will have an opportunity to file a reply.

GI obtains temp restraining order

The U.S. District Court for the Southern District of Ohio issued a temporary restraining order against FSK Products of Columbus, OH, a nationwide distributor of the Cube cable signal devices. The order was issued at the request of General Instrument, which filed suit in federal court against FSK Products for violations of several federal statutes, including the Cable Communications Policy Act of 1984 and the Lanham Trademark Act.

The Cube cable signal theft device is designed to allow cable subscribers to receive premium and pay-per-view cable programming without the authorization of the cable operator.

In other news, Continental Cablevision announced it will use GI's CFT-2200 addressable terminals in its St. Paul, MN, franchise. The purchase is valued at roughly $9 million.

NCTA, Adelphia appeal FCC ruling

The National Cable Television Association filed an appeal at the U.S. Court of Appeals challenging the FCC's recent Dover Township, NJ, video dialtone (VDT) ruling, following a similar petition by Adelphia Communications, *CableFAX* reports. The filings claim the commission's decision exceeds its statutory jurisdiction as well as being "arbitrary, capricious and otherwise contrary to [the] law." Adelphia contends the FCC's failure to reassess its existing accounting safeguards in light of substantial evidence of their inadequacy violates its VDT order.

TV/COM initiates digital consortium

TV/COM initiated the formation of a group of companies to openly discuss and agree upon digital compression standards for North America. The consortium, called the North American Digital Group (NADG), will be comprised of programmers, consumer electronic organizations, satellite and cable equipment manufacturers and component vendors, as well as cable and satellite users throughout North America.

The company is suggesting the establishment of the group, to be modeled after Europe's Digital Video Broadcasting group, to create and implement specifications for a modern, up-to-date digital compression system that is completely in compliance with the MPEG-2 standard. NADG companies would wholly endorse the international MPEG-2 standard and set additional system parameters essential to interoperability and multiple vendor sourcing. Interested parties can contact TV/COM at (619) 451-1500 for additional information.

☛ Scientific-Atlanta reached an agreement with General Instrument Corp. to license GI's proprietary system for controlling customer access to video and audio signals. The access and control system can be used in S-A's digital compression products destined for satellite and cable customers who utilize the GI system. As a result of obtaining the license, S-A will now be able to offer its customers GI's access and control system as well as its own system. Simultaneously, S-A obtained a separate license for GI's proprietary digital compression system.

☛ C-COR Electronics Inc. reported net income of $4 million on sales of $75 million for the fiscal year ended June 24, 1994. This compares to net income of $3.4 million for fiscal year 1993 on sales of $56 million. Earnings per share for fiscal 1994 were $0.86, compared to fiscal year 1993 earnings of $0.74 per share. For the fourth quarter, the company recorded net income of $1.4 million on sales of $26 million. This compares to net income of $805,000 on sales of $14.7 million for fourth quarter 1993. Earnings per share were $0.30 for fourth quarter fiscal 1994, compared to fourth quarter 1993 earnings of $0.18 per share.

Correction: In the August 1994 issue of "CT", we incorrectly reported in our CT Daily wrap-up of Cable-Tec Expo that Cable Link announced the Microtel ARU-100 automated response unit for pay-per-view. It should have read "Microtrol."

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Channell provides symbology template

Channell Commercial Corp. did a great service to the Society of Cable Television Engineers by sending a copy of its new Broadband System Mapping Template to each of the Society's active members.

The template, co-sponsored by SCTE and the Engineering Committee of the National Cable Television Association, provides symbols used in the design and mapping of broadband systems.

These symbols were recently standardized by the SCTE and NCTA Engineering Committees. Some of them are being presented in the form in which they have been used for many years, while others have been refined in the process of establishing them as standards.

The symbols that were commonly used five years ago had previously been reproduced on an engineering template that was developed by Channell Commercial Corp. and distributed throughout the CATV industry. The new template replaces the Channell's previous version. It has been revised and expanded and now includes the new standard symbols for RF/coaxial cable and optical fiber.

The new template can be used to create a basic system map (as well as to correct previously supplied maps), to map out system extensions, or for system walkouts. The information derived from the template can be utilized with AutoCAD software in the creation of broadband system maps.

The standardized symbols have been printed on the template, adjacent to the corresponding cut-out shapes that can be used in the drawing of the symbols. Users can place these cut-outs over the location where the symbol can be drawn to exactly match the printed version.

Channell Commercial Corp. also is offering this new symbology library for computer users on floppy disk. This disk version includes each of the newly standardized symbols, appropriate points of insertion, all attributes and suggestions for layering.

Also included in the floppy disk version are symbols for Channell and Carson-Brooks enclosures. This version offers users the opportunity to create a bill of materials of products that they may choose to specify within their broadband system and use for accurate location and placement on construction maps.

For further information, contact Channell Commercial Corp. at (800) 423-1863 (U.S.); (800) 387-8332 (Canada); and +44 71 589-3304 (U.K.).

SCTE announces 1994 scholarships

The SCTE Technical Scholarship Program, established with the goal of providing tuition assistance for technical training courses to industry personnel who show great potential for advancement, was established in 1986 through a donation by Rex Porter and subsequent fund-matching arrangement with the National Cable Television Institute. Deserving applicants have been awarded tuition assistance to pursue correspondence courses from NCTI since the inception of the program, and in 1988, the first grant for a college course was awarded. The broadening of the program's

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scope to include technical school and other industry-related courses has enabled many more technicians and engineers to advance their knowledge and careers since 1992.

In 1994, we thank CT Publications/ Phillips Business Information Systems, Jim Kuhns, as well as NCTI, for their generous support. SCTE also is proud to have been selected by the New York State Cable Commission to oversee the financial investment of its Ken Foster Memorial Scholarship Fund.

The 1994 recipient for NCTI courses was Douglas Thomas of Southwest Missouri Cable TV. For other courses the recipients were: Bud Evans, USAF Academy; Julie Hollon, Tele-Media Corp.; Jamie Horan, Greater Media Cable; Jeff Howcroft, TCI Cablevision; Dean Stauffer, Time Warner; and Eric Zwicky, Storer Cable Communications.

The recipient of Ken Foster Memorial Scholarship Grant was Ramald Chevrier, TCI of New York.

Future SCTE events announced

The following is a calendar listing SCTE national and regional events for the remainder of 1994, as well as upcoming Annual Emerging Technologies Conferences and Cable-Tec Expos. Included in this calendar are industry trade shows at which the Society will be sponsoring technical sessions.

- Oct. 4-6: Atlantic Cable Show technical sessions, Atlantic City, NJ.
- Oct. 17-19: Technology for Technicians II seminar, Columbia, SC.
- Oct. 20: OSHA/Safety seminar, Columbia, SC.
- Nov. 7-9: Technology for Technicians II seminar, Nashville, TN.
- Nov. 10: OSHA/Safety seminar, Nashville, TN.
- Nov. 30-Dec. 2: Western Cable Show technical sessions, Anaheim, CA.
- Dec. 12-14: Technology for Technicians II seminar, Albuquerque, NM.
- Dec. 15: OSHA/Safety seminar, Albuquerque, NM.
- Jan. 4-6, 1995: Annual Conference on Emerging Technologies, Orlando, FL.
- June 14-17, 1995: Cable-Tec Expo '95, Las Vegas, NV.
- Jan. 8-10, 1996: Annual Conference on Emerging Technologies, San Francisco.
- June 10-13, 1996: Cable-Tec Expo '96, Nashville, TN.
- Jan. 7-9, 1997: Annual Conference on Emerging Technologies, Nashville, TN.
- June 4-7, 1997: Cable-Tec Expo '97, Orlando, FL.

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Reader Service Number 35

MPEG-2 on ATM

By Lawrence W. Lockwood
President, TeleResources
East Coast Correspondent

Figure 1: TDM format of T1

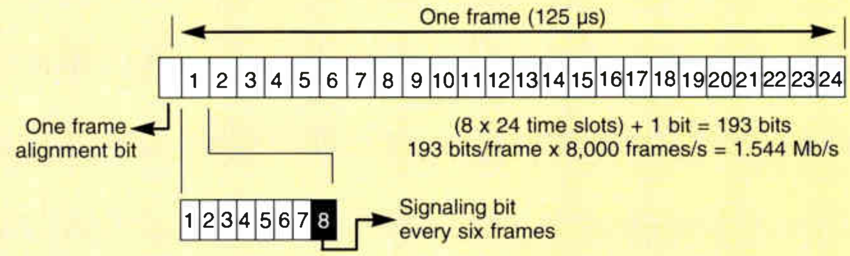
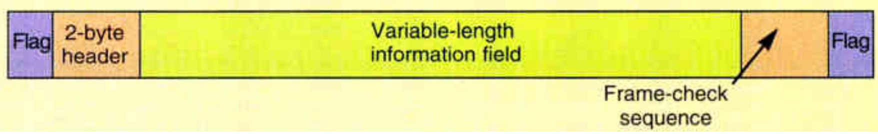


Figure 2: Frame relay structure



It is widely believed that in the networks of the future MPEG-2 compressed video will, in at least some portions of the network, be transported by ATM (asynchronous transfer mode). But how will the packetized MPEG-2 digital signal be loaded into the ATM cell structure? The ATM Forum is now working on creating a standard for this function. The ATM Forum, a group of more than 150 companies from all aspects of the public and private networking communities, is chartered with filling the holes in the specification and promoting interoperability among ATM products. But first a review of the developments in increasing transmission capacities.

Developments that increased transmission efficiency

In the 1930s a single voice call from New York to Los Angeles required its own contiguous physical circuit (comprising several tons of what after all is a semiprecious metal — copper) spanning an entire continent.

In a first step to alleviate such massive inefficiencies, communication researchers came up with a form of frequency-division multiplexing that allowed several voice calls to run over a single trunk line. However, the post-World War II years brought a huge expansion of the U.S. phone network demanding further improvements.

The first really adequate solution for handling the public network bandwidth problems was digital time-division multiplexing pioneered by Bell Labs in the early 1960s. The first TDM systems digitized 24 voice conversations into 24 separate 64 kbit/s channels, which were then multiplexed onto a single copper trunk running at 1.544 Mbit/s (T1). (See Figure 1.)

Each multiplexed channel was represented by an 8-bit voice sample placed in a frame with samples from the other 23 channels. The entire 24-byte frame (plus one framing bit) was then repeated 8,000 times a second. Channel banks at either end of the line used a byte's position within the frames to determine which call it belonged to.

TDM wastes bandwidth because individual time slots in each synchronous frame are dedicated to specific calls in progress. If a given call goes silent — for instance when the other party is talking — the first party's time slots remain empty.

Packets

The introduction of packet switching reduced such inefficiencies. Paul Baran is acknowledged as the developer of packet switching, which he devised in 1964 while an engineer at the Rand Corp. During the cold war of the 1950s and 1960s, questions were being asked regarding the U.S.'s ability to survive a pre-emptive nuclear attack. A Rand study determined that communications was the most vulnerable portion of U.S. command in the chaos after a nuclear attack. Baran determined that a network based on packet switching would be more robust than its constituent links and switches and would be solid enough so that enough parts could survive to talk to each other through the chopped-up mess of a nuclear attack.

In 1969 the Defense Advanced Research Agency (DARPA) commissioned a public net based on Baran's research — the first packet-switched net dubbed ARPANET. The Internet is the direct descendent of ARPANET.

Packet switching uses labels (packet headers) instead of time slots to identify separate connections. Packets are variable-length bundles of data that are generated — as an example by a process running on a host computer — and then wrapped in a frame with an address together with some housekeeping functions such as error corrections before transmission. See Figure 2 for an example of a frame relay packet structure. Because frame relay is not based on fixed length data information cells, it must use flags to denote the beginning and end of frames. →

ATM

At Bell Labs a handful of telephone company engineers had been experimenting since the late 1960s with the idea of blending label-based switching (the basis of packet networks) with TDM. Their idea was to put a short indicator, basically no more than a virtual channel identifier, at the start of each time slot. This method allowed a given traffic source to put its bit stream onto the line asynchronously, using labeled slots *as needed* rather than being compelled to march to the predefined time slots of TDM. Thus, the basis of ATM, the idea of building a network around short fixed-length units (now known as cells), had its origins in TDM.

It wasn't until 1988 that the CCITT formally defined the ATM cell formats (CCITT Standard I.361). The ATM cell format has a 48-byte payload and a 5-byte header. (See Figure 3.) The CCITT also defined the following layers of ATM:

- The physical layer, which is concerned with putting bits on the wire and taking them off again.
- The ATM layer, which handles cell multiplexing and assorted housekeeping functions (such as header error correction).
- The adaptation layers (AALs), complex sublayered protocols that package various kinds of higher level user traffic into 48-byte ATM cells.

Figure 3: ATM cell

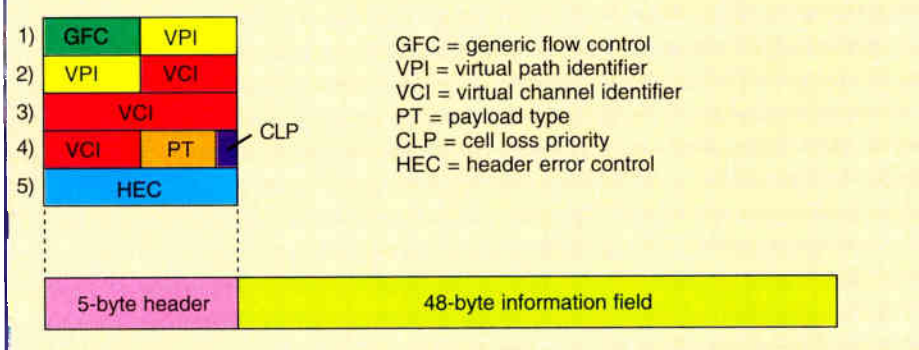


Figure 4: Functions of ATM layers

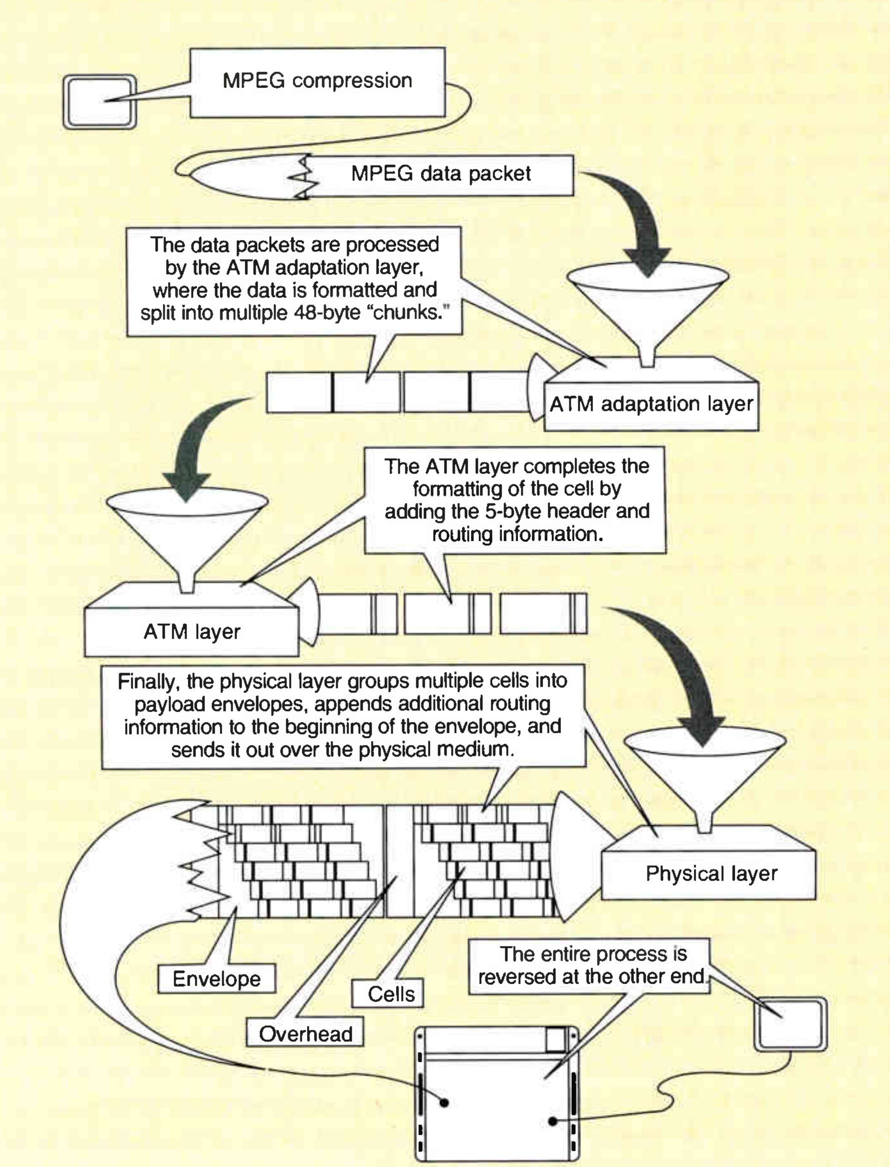


Figure 4 shows the path of MPEG-2 packets to ATM. However, since ATM is intended to carry voice, video and data services using a single-cell format, the data packet for other services (e.g., frame relay, T1, etc.) will not be in the same format as MPEG-2. To achieve the ability of converting various data formats into the ATM cell format the CCITT developed several classes of ATM adaptation layers — AAL 1, AAL 2, AAL 3/4 and AAL 5.

MPEG-2 to ATM

The MPEG-2 transport packet standard has been established at 188 bytes (often called octets) and unfortunately this standard was created with apparently little or no regard to the ATM standards. Thus the question becomes: How to get the MPEG-2 transport packets into the ATM cell format — i.e., use which AAL layer? The ATM Forum is now considering several methods that were presented in a January 1994 meeting. Three methods were presented by NYNEX using variations of existing AAL layers, while Scientific-Atlanta proposed a new AAL (AAL 6).

AAL 1 supports fields for SRTS (synchronous residual time stamp) values, ATM cell sequence number (SN) and error protection (SNP) for the above fields. One complete byte is

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used up to support the above functions, which leaves 47 bytes of payload. Thus, as shown in Figure 5 if AAL 1 were to be used, four ATM cells will be required to carry one MPEG-2 packet.

NYNEX said that although it's possible to use AAL 1, doubts remain whether AAL 1 is appropriate for the following reasons: 1) AAL 1 does not provide for a CRC (cyclic redundancy check) or FEC (forward error correction) field, meaning that bit errors cannot be detected (or corrected); 2) the number of bits assigned for SRTS may be inadequate for video-on-demand applications; and 3) AAL 1 was primarily standardized for CBR (constant bit rate) circuit emulation services (e.g., DS 1, DS 3, etc.).

AAL 5 was primarily defined for data traffic and requires that an 8-byte trailer be appended to the 188-byte MPEG transport packet. (See Figure 6.) The ATM cell payload for AAL 5 is 48 bytes, which means that five ATM cells will be required to carry one MPEG transport packet. This is inefficient since 44 bytes of the fifth cell will remain unused.

AAL 5 also could be used by adapting two MPEG-2 transport packets into eight ATM cells — Figure 7. Furthermore AAL 5 offers CRC-32 that can be used for both error detection and correction. (Parenthetically, in each of the NYNEX proposals, the 5-byte header of each cell is added to the ATM stream in the following layer — the ATM layer — as shown in Figure 4 on page 26.)

As to whether CRC or FEC is needed, the NYNEX view is that fiber-based networks are generally error-free and meet the specifications of maximum BER (bit error rate) of 10^{-9}. This means that at 3 Mbps, in the worst case, one bit error would occur every 5 to 6 minutes on the average. As long as it is detected that a cell has one or more errors and this information is communicated to the higher MPEG decoder, the effect of this error can be concealed. NYNEX notes that if AAL 5 is used, FEC is not necessary since CRC-32 in the AAL 5 should be adequate to detect errors — which then would be concealed by the MPEG-2 decoder. NYNEX voiced the view that "on selecting an MPEG AAL, preference should be given to using one of the existing AALs prior to defining a new AAL."

Michael Adams, Time Warner senior project engineer, said that in the Orlando test they are using a slightly different method of putting MPEG into ATM. They started their planning for this system before the MPEG transport packet was fully defined. Therefore, they are using the MPEG data stream (before any packetization) and since AAL 5 was designed for data service — such as frame relay — they are using the AAL 5 layer and treating the MPEG data stream as just another data stream. The simplicity of this approach is attractive — however the downside is that in the MPEG transport packet the audio and video are synchronized all the way to the TV set, but in this approach the audio and video are not synchronized and must be synchronized at the TV set-top.

Figure 5: MPEG transport packet adaptation using AAL 1

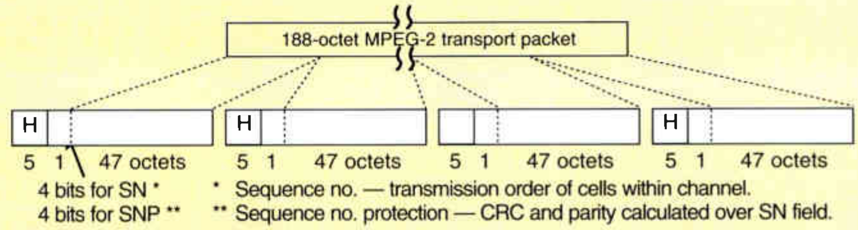


Figure 6: AAL 5 adaptation of one MPEG transport packet

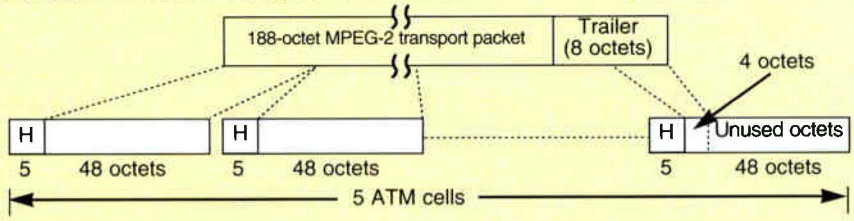


Figure 7: AAL 5 adaptation of two MPEG-2 transport packets

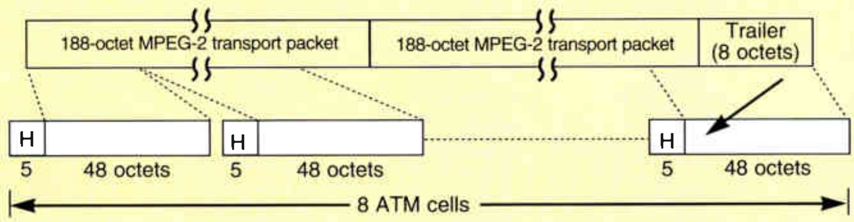
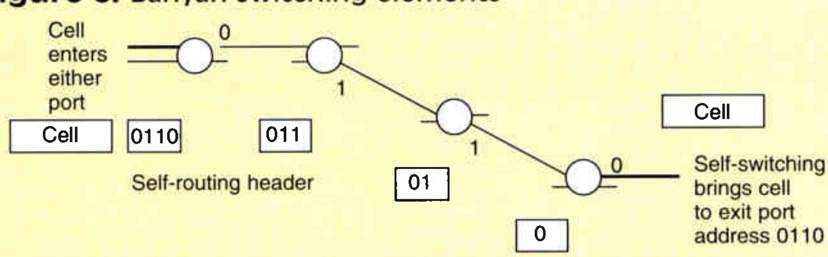


Figure 8: Banyan switching elements



ATM switching

ATM connections exist only as sets of routing tables held in each switch, based on the address in the cell header. The lookup tables identify an incoming cell by the header address and route it through the switch to the proper output port. The message is passed from switch to switch over a prescribed route, but the route is "virtual" since the facility carrying the message is dedicated to it only while the cell traverses it.

One interesting type of ATM switch is the Banyan Matrix. As in virtually all ATM switches today, the Banyan Matrix uses a self-routing header (SRH). This extra header tells the internal switch elements (Figure 8) how to move the cell

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from a given input through the fabric until it exits the targeted output port. When a cell arrives at an input card, the address is examined and compared to an on-card table that contains a specific SRH that corresponds to every expected cell address. This SRH is pre-pended to the cell and then shifted into the fabric. Each element in a Banyan switch uses the leading bit in the SRH to route the cell to one of two exit ports in the element — a 0 to the top port, a 1 to the bottom port. That leading bit is not passed on, making the next bit in the header the leading bit in the next switch element. The size of the header matches the number of switch elements so there is only the cell remaining at the final exit port. See Figure 9 for the Banyan fabric using these switching elements. The dotted and dashed line examples shown in Figure 9 demonstrate the capability of the SRH to send the input data to the correct output port no matter the input port. Try any input port with SRH — you will always come out at the same port.

Figure 9: Banyan switching fabric

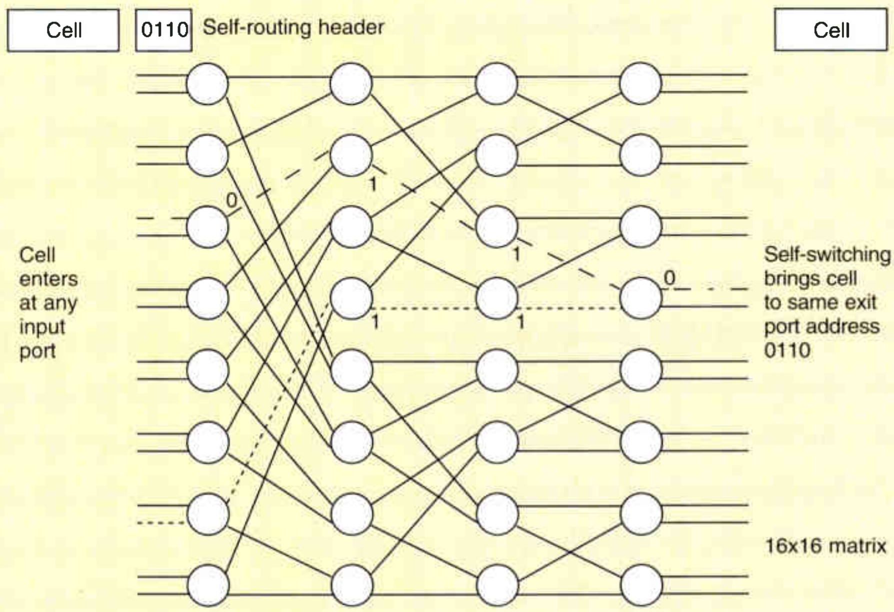

Figure 10 shows the AT&T GCNS-2000 ATM switch that is to be used in the Time Warner system in Orlando, FL. This switch does not use the Banyan switching fabric but uses an AT&T patented and proprietary scheme. It is capable of simultaneously handling voice, data and video transmission with a throughput rate of up to 20 Gb/s. The price varies dramatically depending on the capabilities in the ordered configuration. At its most bare bones configuration — $50,000 to over $1,000,000 for a full blown 20 Gb/s configuration. Figure 11 shows a smaller ATM switch from another manufacturer. It is the ASX-100, a 2.5 Gb/s ATM switch from Fore Systems Inc. This switch has been used for the past year by Cablevision Systems Corp., Woodbury, NY, in its four-site experimental research network. Its cost, reflecting lower performance than the AT&T switch, is less — about $36,000.

Conclusions

So as yet there is no standard established for loading MPEG-2 into ATM, but the ATM forum is working on a standard. Even without such a standard several experimental systems are being constructed throughout the country — the previously mentioned Time Warner system in Orlando, FL, the Castro Valley, CA, project by Viacom, the Omaha, NE, system by US West and the Cablevision Systems Corp.'s Long Island, NY, trials.

Dr. Jerry Lucas of TeleStrategies Inc. has noted that due to problems establishing tariffs for ATM on public carriers, it may be some time before there is widespread use of ATM on public carriers for compressed video used by CATV. In his reasoning he suggests considering the cost per bit transmitted for two services that could be popular.

- *Voice:* A long distance 64 kbit/s channel on today's PSTN (public switched telephone network) may cost anywhere from $0.09 to more than a $1 per minute, depending on who is buying. Carried on an ATM network, the voice connection at the 64 kbit/s rate would take about 80,000 cells per minute, and at the previously men-

Figure 10: AT&T GCNS-2000 ATM switch

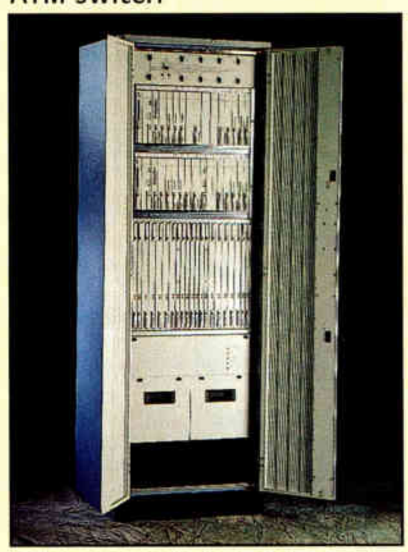

Figure 11: Fore Systems Inc. ATM switch

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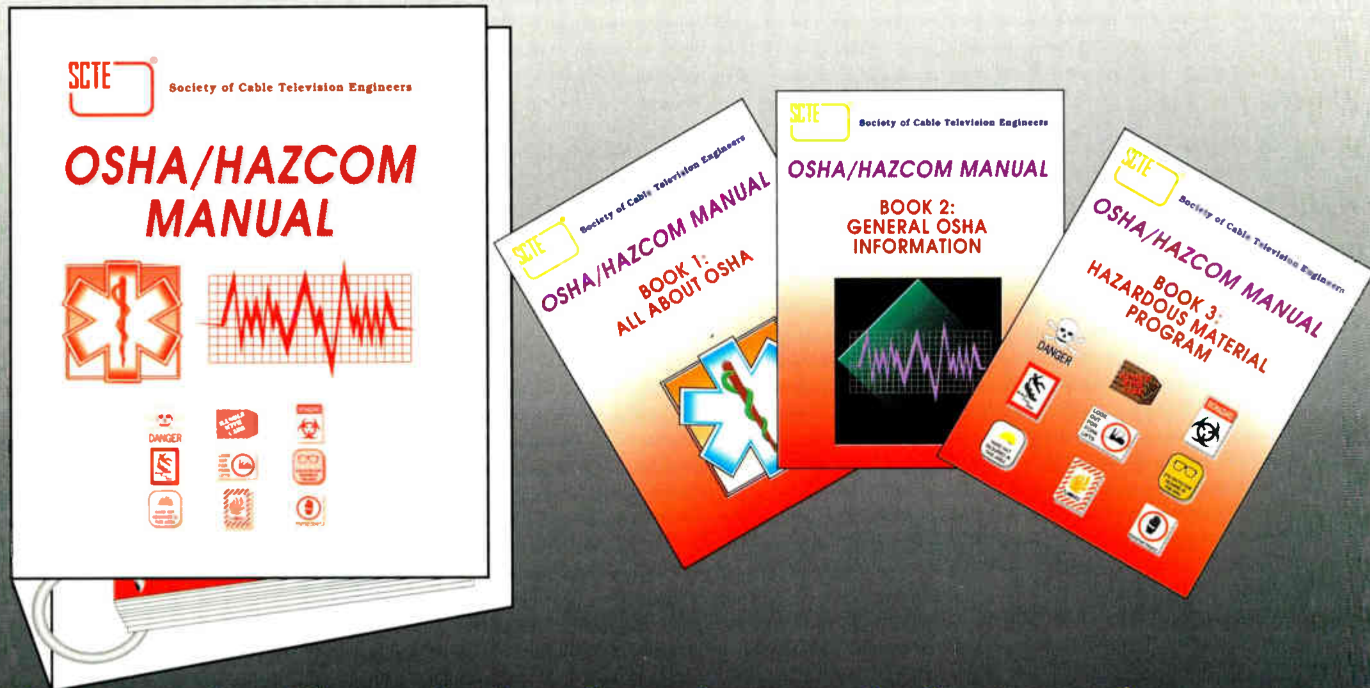

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tioned rates would cost from $0.01 to $0.10 per thousand cells.

- *Video to the home:* A 2-5 Mbit/s channel needed to produce picture quality comparable to a consumer-grade videotape must remain competitive with rented cassettes. The connection can't cost much more than $3 per hour or $0.05 per minute, which is half the lowest cost for voice.

For this calculation, assume 3 Mbit/s for the TV program. One million bits of voice (1/4 minute) now brings the carrier a revenue of $0.02 to $0.25. The same million bits on the video connection (1/3 of a second) would generate less than $0.0003 of revenue for the carrier.

The basic premise of ATM is that there is no difference between one kind of information and any other. If the video service determines the price, the voice traffic will be quick to follow the cost down — the loss of revenue to the carriers could be catastrophic.

All of this is another example of the necessity for expending the apparently endless effort to keep up with the continuous avalanche of technological advances. **CT**

Glossary of acronyms

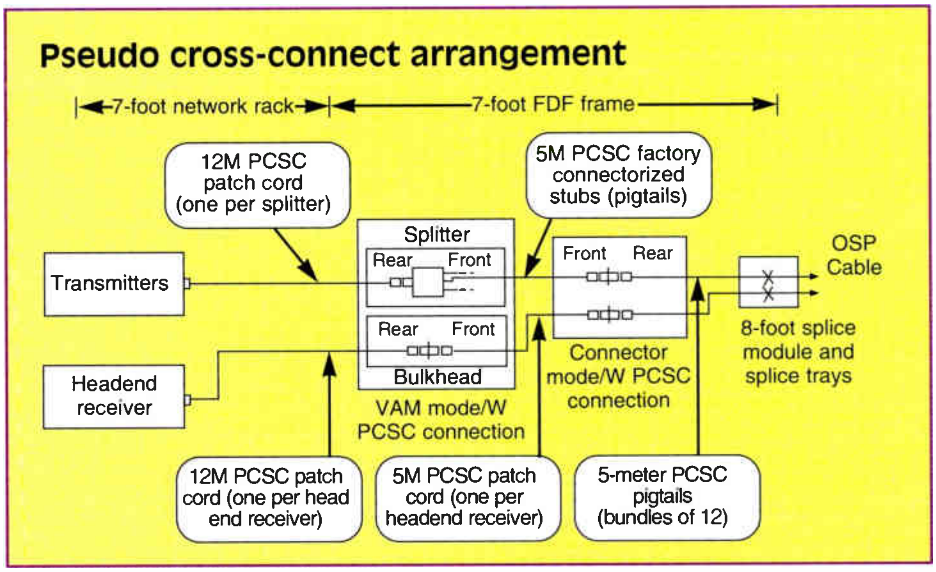
AAL	ATM adaptation layer.
ARQ	automatic repeat request for retransmission, an error correction scheme for data links, used with a CRC.
ATM	asynchronous transfer mode.
BER	bit error rate, errored bits over total bits.
CBR	constant (continuous) bit rate, channel or service in ATM networks.
CRC	cyclic redundancy check, an error detection scheme for ARQ or frame/cell discard.
FEC	forward error correction, allows receiver to correct transmission errors.
PSTN	public switched telephone network.
SN	sequence number, transmission order of frames or cells within channel or logical connection.
SNP	sequence number protection, CRC or parity calculated over SN field in header (AAL 1).
SRH	self-routing header.
SRTS	synchronous residual time stamp.
TDM	time-division multiplex.

References

1) "ATM Knits Voice, Data on any Net," J. Lane, *IEEE Spectrum*, February 1994.
2) "Digital Transmission Techniques," T. Filanowski, Cable-Tec Expo '94.
3) "ATM's Long, Strange Trip to the Mainstream," J. Gould, *Data Communications*, June 1994.
4) "ATM User's Guide," W. Flanagan, Flatiron Publishing Inc., 1994.

Hidden assets in CATV networks

By Todd J. Schieffert
Senior Manager, Market Development
ADC Telecommunications Inc.



Consider the transportation of eggs. They are fragile and oddly shaped, so we pack them into cartons, load the cartons into cases, palletize the cases and carry them very carefully. The process is slow and very inefficient in its use of space. To complicate the matter further we could vary the size of the eggs and the process would become slower still and more cumbersome. Add a demand for virtually instant delivery and the task begins to verge on impossible. Now, if we could just take a big funnel and a long garden hose ...

The demands for delivery of business data pose a lot of the same problems:

1) Data is "fragile." Delivery in approximately the same form as that in which it was sent is not acceptable.

2) Data comes in a variety of sizes (and shapes). It can be a voice, a fax, a burst of ASCII, a diagram or a moving image.

3) Much of the communication is in real-time, requiring immediate integration into the data flow.

4) Transport facilities are far too expensive to permit the waste of available capacity. In this case, however, the solution may actually be that funnel and garden hose — and if you are a CATV provider, you already own the "hose."

Never too much capacity

Experience has taught CATV providers that too much fiber is never enough. Whether it's additional channels, or video-on-demand (VOD), something will come along and quickly use up any excess capacity. In the meantime, look for someone who's willing to pay to use your capacity. Odds are, you'll discover that you've become a competitive access provider.

Access to what? The public switched network, primarily those long distance facilities operated by major interexchange carriers (ICXs) like AT&T, MCI, Sprint and Wiltel. ICXs make access fairly simple by bringing their facilities to a single point of presence (POP). There, an access provider — say your local telephone company — provides a switched connection to those facilities for their local business and residential customers.

In other words, when you precede a call with a "1" you are instructing your local telephone company to ship your call to the local POP, where it is loaded onto your long distance carrier's facility for transmission. The public has grown used to the battles of the long distance carriers for our business, but still assumes that the local carrier has a monopoly in the local loop. Competition at the local loop level, however, is definitely heating up. To understand why, glance at a typical phone bill. The non-long distance part of the bill (essentially access) can be substantial. If you're wondering why more companies aren't competing for the opportunity to provide access, remember how much it cost you to install your fiber/coax plant. You have a (possibly unused) asset and the time and effort involved in creating a network from scratch is a substantial barrier to competition.

Positioned to compete

When it comes to access, especially for business' data communication requirements, a cable service provider may actually have some advantages over the telco "experts." RBOCs (regional Bell operating companies) created by the phone company divestiture of the '80s have a huge stock of installed equipment. Much of that equipment was installed when phone call meant a voice call. The upgrading required to handle our new world of data-by-phone may not be completed for a generation.

Cable companies, on the other hand, are wired for video right from the start. Video requires a much broader bandwidth making it closer in size to the channels required for data communication. Add to the inherent bandwidth the overbuilding that many cable companies are doing in preparation for new, interactive offerings, and you've got — by telco standards — substantial unused capacity. It may look like table scraps to you, but to a corporate telecommunications manager it looks like a steak dinner.

Now all you need is the funnel that gets eggs into a garden hose without breaking them. The traditional solution, still widely used today, is to deploy a roomful of equipment including the following: T1/E1 converters, DSUs, CSUs, channel banks, voice compression devices, subrate data multiplexers, frame relay switches, SMDS and ISDN multiplexers, synchronizers, adapters and so on. It wasn't a pretty solution but was made necessary by the enormous variety of protocols and devices clamoring for access to the network.

The perfect "funnel"

In the last 15 years, business automation has emerged from the computer room like a pack of racing greyhounds. At the user end, automation has put personal computers on almost every desk. PCs are networked to other computers, both on-premises and off. Scattered among the PCs are low-speed modems and terminals, ISDN BRI, graphics and multimedia workstations, host computers, image processors, Group III and IV fax machines, PBXs, video compression devices, LAN bridges and more — each demanding access to the outside world. Each device is relatively accessible to the user but, in aggregate, they are a major headache for the telecommunications manager.

The result, of course, is the previously mentioned tangle of equipment connecting the various devices to the wide area network. If misery really does love company, telco managers can take comfort in the fact that this solution also is a headache for the corporate treasurer. The mix of services and protocols packs the network very inefficiently. Unused network time costs just as much as time used. The treasurer signs the checks, never knowing whether he or she is paying for full or empty boxes.

Today, there is a simple, cost-effective solution for both the telecommunications manager and the treasurer: integrated access servers. Coupled with a network access/transport platform, this is a simple and inexpensive solution for your business customer. At the same time, it turns your unused network capacity into immediate revenue.

The first generation of integrated access devices joined multiple functions in a single box. While reducing the number of devices required, they were limited in size, accessible bandwidth and number of simultaneous functions. They were still rather inflexible, requiring module swaps for service changes, and tended to use proprietary network management systems.

"With high demand and — for the time being — limited competition, competitive access may be one of the best and easiest ways around to finance expansion of your system infrastructure."

Nonetheless, they were embraced by users as a step in the right direction.

Breaking with tradition

The newest generation of integrated access servers provides true integration, allowing a single device to collect and concentrate the full range of business communications. The system uses a client-server architecture, in which functions are no longer dedicated to specific "users." Functions such as inverse multiplexing or frame relay switching reside in server cards. Their "clients" are individual interface cards (voice cards, V.35 super-rate DSU cards, etc.). Since any client can access any server depending on the service required, there are significant economies of scale, and expensive duplication of function is eliminated.

Ideally, an integrated access server will provide:

- Nonblocking architecture.
- Simultaneous support of multiple circuit, fast-packet and cell switching services. →

"As the industry moves ... to the new world of open competition, cable system operators are in the enviable position of being among the few nontelco entities with a workable infrastructure already in place."

- Internal handling of voice and data switching and signal conversion.
- Extreme scalability, from small and inexpensive to large and richly featured.
- Optional redundancy.
- Built-in diagnostics.
- The option of a nonproprietary (industry standard) network management system.
- And, of course, the ability to fully utilize the available transport media.

Putting it all together

Each of these capabilities can be critical to a CATV provider considering competitive access.

Blocking occurs when the bus or matrix that connects ports has a limited capacity. This limitation in connecting capacity can hold up communication even when the desired service or capacity is available. A nonblocking parallel bus architecture ensures that available servers can be accessed immediately.

Support of voice and data switching, signal conversion and multiple switching services (circuit, fast-packet and cell-based) frees you from having to install multiple boxes with the resulting gaps and overlaps in service. This is both cost-effective today and your assurance that you will be positioned for emerging services, such as ATM (asynchronous transfer mode).

Scalability is critical. Affordable entry preserves your capital. Affordable growth protects your investment and maximizes your revenue. The whole point of integrated service is scaling service to fit demand, allowing you to optimize both service and returns.

Redundancy is critical (sometimes). It also adds cost. Having redundancy available as an option allows you to deploy capital where — and only where — it is needed.

When you put all your eggs in one basket, it has been said, you have to watch that basket very carefully. Critical communication demands a reliable system. An industry standard network management system ensures thorough control of every aspect of the system's function. Robust self-diagnostics allow the system to monitor its own function, even when you can't.

Bringing it home

Collecting all of those business communications is only half of the perfect solution. The other half is transporting them to your headend and/or master headend and then accessing the switched network to speed them on to their various destinations. For this, you need an access and transport platform designed to handle larger data pipes than the access server can handle. They provide network access in bandwidths of T1 and greater, typically interfacing to DS3, STS1 or OC3 facilities.

In telco applications, the transport platform functions equally well in central offices, at remote hubs and even at customer sites. Depending on the load in a CATV application the transport system could be configured at both the headend and the master headend, and at customer sites. Like the access server, its modular design lets you put function and capacity where needed and change or expand them as necessary.

Requirements for a transport platform are similar to those of the integrated access server:

- Flexible multifunctionality.
- Support of a wide variety of facilities.
- Positioning for future technology.
- Scalability.
- Remote access and self-diagnostics.

The accompanying figure back on page 34 shows how the combination of an integrated access server and a transport platform offers a great deal of flexibility. A loop extender located at a customer site can bring the entire load of an access server (fax, PBX, PCs, modems, etc.) back to your headend or master headend. On the other hand, access servers can be located right in the headends as hubs or concentrators and accessed directly from those locations.

A transport system at the headend or master headend can function as a hub, front-ending existing headend-to-headend transport (DS3 or OC3). In this application, the transport system does not replace or even modify any of your existing network between headends. It functions as a "portal," providing access for the T1 and optical DS2 signals it receives from the access servers with which it is configured and from its own remote terminals and the access servers with which they communicate.

As a first step, CATV operators can use access servers for communication in internal operations. As in competitive access, they concentrate signals from faxes, PCs, modems and the like for transport on the existing fiber network. Once the internal network has demonstrated its value and served its training function, CATV service providers can easily roll out the concept for business service customers.

Motive, opportunity, means

There is no question that competitive access providers stand to make a great deal of money. Between the push of a rapidly expanding demand for data communications and the pull of long distance providers locked in a seemingly endless price war, those who can provide access are in great demand. As the industry moves from the traditional predivestiture telco monopoly to the new world of open competition, cable system operators are in the enviable position of being among the few nontelco entities with a workable infrastructure already in place.

The missing link has been the ability to interface users' sub-T1 applications with the existing fiber network. Integrated communications access servers, paired with access/transport platforms, provide that link. The systems are easy to deploy, easy to maintain and promise ease of future migration. With high demand and — for the time being — limited competition, competitive access may be one of the best and easiest ways around to finance expansion of your system infrastructure. **CT**

Infrastructure for PCS telephony

The following is reprinted from the "1993 NCTA Technical Papers." This article discusses infrastructure issues and requirements for the provision of personal communications services (PCS) by nontraditional telephony providers such as cable TV operators. PCS infrastructure includes items such as switching, operations, administration and maintenance (OAM) and mobility management. Many nontraditional PCS providers do not currently possess such switching, network and OAM capabilities as are currently in place for LEC and cellular systems.

By Heather A. Sinnott
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Bell Northern Research

The objective of this article is to discuss the infrastructure requirements for CATV-provided wireless telephony, touching briefly upon potential deployment options and evolution strategies. It is important to realize that the North American telecommunications industry is undergoing tremendous change as PCS spectrum becomes available, as wireless/fiber/coax technologies are deployed, business alliances occur and the regulatory environment unfolds. As recent CATV PCS trials and Federal Communications Commission filings have proven, cable TV companies are poised to enter the telephone business.

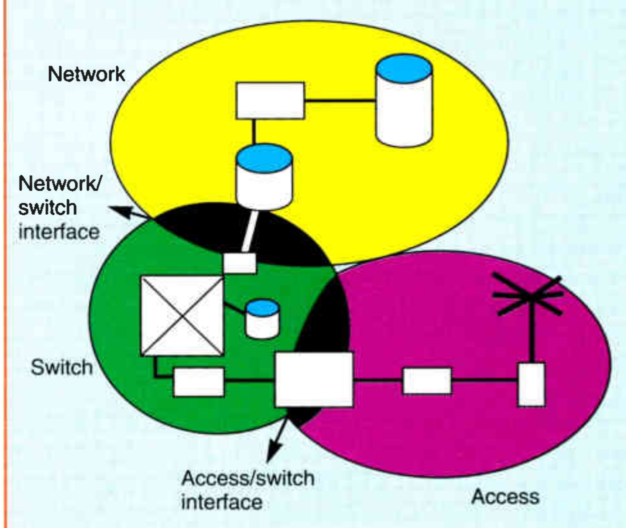
There are many aspects to providing telephony and PCS services. While PCS is often equated with wireless access, this is not necessarily the case. PCS is oriented toward allowing users to originate or receive calls anywhere on the network and have some measure of control over their service parameters. For the new entrant, providing PCS will first involve dealing with basic telephony areas such as acquiring directory numbers, selecting subscriber features, billing and switch operation. PCS is instrumental to this basic telephony infrastructure including aspects such as mobility and enhanced service management.

PCS telephony infrastructure can be divided into the areas of switching, OAM, mobility management, auxiliary services and "other." The switching function requires consideration of PSTN connectivity, routing, directory numbers and features. OAM includes maintenance, provisioning, inventory billing and performance. Mobility management concerns radio hand-off between cells as well as tracking the user between switches and across the network. Examples of auxiliary capabilities are directory assistance, voice mail and operator service. "Other" areas not directly related to making or receiving calls are overhead activities such as yellow pages, bill collection, staffing and vehicles. All of these infrastructure items may be the direct concern of the CATV PCS provider or handled by leasing or partnership arrangements. This article will focus upon the switching, OAM and mobility aspects of PCS infrastructure.

PCS telephony is expected to involve a multiplicity of players, each bringing a different set of advantages and capabilities to the PCS industry. The types of companies expected in the business include local exchange companies (LECs), cellular companies (cellcos), cable TV companies (CATV), interexchange carriers (IECs), paging companies and new entrants. Alliances are forming, as could be expected, between players having complementary capabilities. Examples are IEC/cellco/CATV alliances where the IEC provides the toll network, the cellco provides switching and the CATV operator provides the access distribution. A PCS provider also may choose to lease facilities from a nonallied company, perhaps until such time as they could purchase their own facilities.

The multiplicity of players involved in the PCS industry requires capability at several levels. These levels are the access area, the switching area and the network area. (See Figure 1.) Access providers require wireless, coax, fiber and interface technologies. Switching providers need wireline, wireless, local mobility and possibly partitioning capability. Network providers need PC data bases and interswitch PCS signaling.

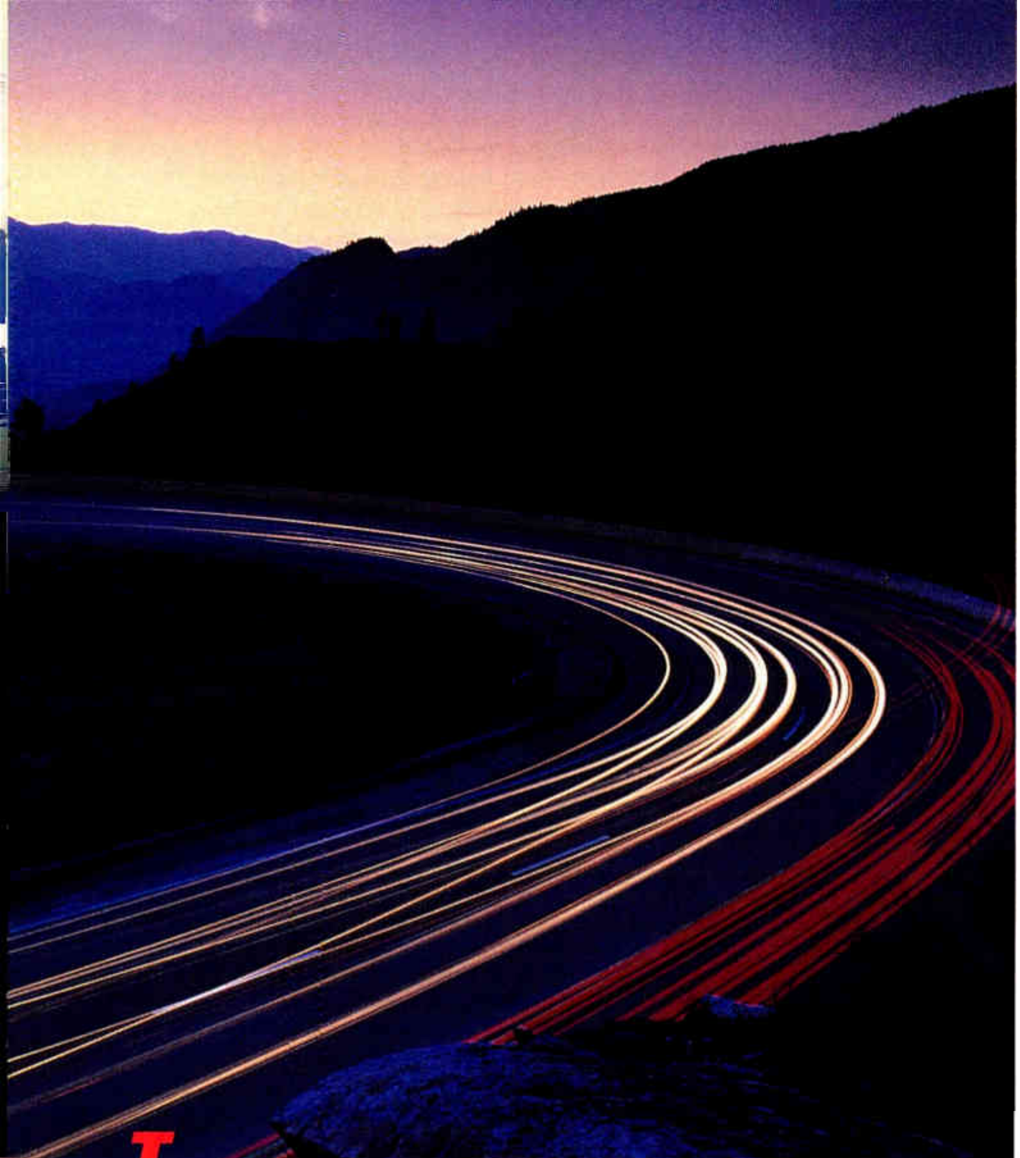
Figure 1: General PCS architecture



Furthermore, each player in the PCS business will not accept unnecessary dependencies upon other players. For instance, a CATV company will desire the ability to change out RF technologies without waiting for network standards development. An optimum partitioning between network, switch and access areas is essential to provide this decoupling. Such a decoupling will allow PCS providers to work with a variety of switch and network configurations, allow multivendor solutions and provide high-performance systems. Careful interface definition is critical in this regard.

Switching characteristics (e.g., translation, routing, billing and features) for basic telephony are well understood. What is significant are those requirements particular to CATV PCS. An initial view of CATV PCS switching requirements is as follows:

• Shareable. There may be several new entrants in a given city that wish to share the startup costs of a switch or there may be a separate company that would own and partition the switch for interested



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parties. The switch also should be shareable in the sense of regulatory collocation.

• Scaleable. Initial low subscriber penetrations will have a higher per subscriber cost. It would be desirable that this could be mitigated by a modular approach. Initial subscriber densities will be sparse as well, which would mean that the switch would be serving a large geographical area.

• Wireless service mix. A reasonable subset of the hundreds of residential and business features should be available to the wireless PCS subscriber.

• Applicable to both wireline and wireless users. The PCS concept covers both fixed and mobile terminals. Wireline services are still required in those areas where spectrum is not available or where the CATV company is providing services such as high-speed data.

• Decoupling from access media and air interface detail. The subscriber's switched services should be independent of whether the access back-haul is copper, fiber, coax or wireless. The OAM overlay concerning access hardware detail should be layered away from subscriber services.

• OAM overlay. OAM should be layered and provided via common channel signaling so that the CATV PCS provider is not forced to integrate all OAM (especially access maintenance) with switching.

• Standard interfaces. Switch interfaces should be layered, standardized and use generic modern instruction sets.

Mobility

PCS mobility is complex. However, there are still fundamental requirements that can be derived. Mobility should be layered. There are three general layers:

1) Mobility inherent in radio management. This is neighborhood hand-off. It may be caused by the user moving between adjacent cells of the same base station, by shadowing (e.g., a truck drives between hand set and primary antenna) or by interference. Such handoffs may occur rapidly and their messaging does not generally percolate up to the switching layer.

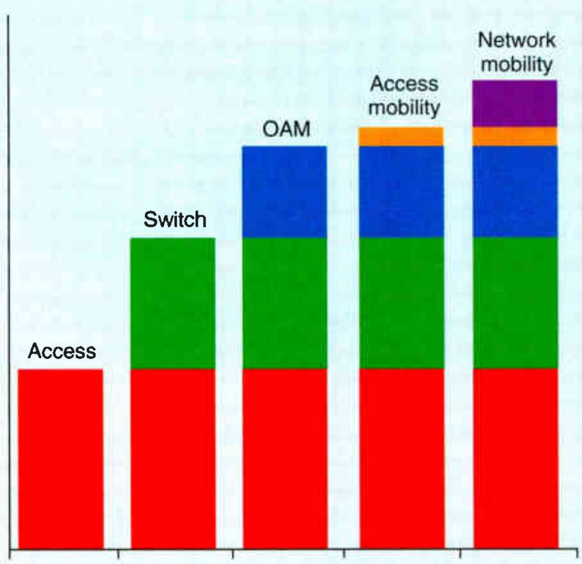
2) Access mobility. This is hand-off where more intelligence is required because the user is moving between some sort of system boundaries although still subtending a single switch/PBX. An example would be campus mobility.

3) Network mobility. Hand-off between switches that involves the use of network level protocols and data bases.

Mobility should be provided via optional layered modules. For instance, a PCS provider may not choose to provide network level mobility as a service but may very well wish to acquire neighborhood or campus mobility products. It should be realized that network and national mobility are not synonymous. Interswitch mobility within a single large city would still require network level signaling.

"While PCS is often equated with wireless access, this is not necessarily the case."

Figure 2: Relative cost components per subscriber



Operations, administration and maintenance

OAM involves all aspects of running the system to provide service. Operations includes items such as customer management, installation and performance monitoring. Administration includes functions such as provisioning service, provisioning equipment, inventory and billing. Maintenance includes repair and preventative activities.

The extent of PCS OAM performed by the CATV company depends upon the access implementation chosen as well as by the CATV company's decision to operate its own switching and auxiliary functions. For instance, choosing to provide in-home cordless telephone coverage would require dedicated attention on a per-household basis, whereas outdoor shared neighborhood coverage would involve a reduced number of units to administer. However, outdoor units (subject to weather) could be individually more expensive to maintain.

OAM is computing-intensive. The ability of CATV PCS platforms to evolve and to interwork with those of potential business partners is critical. Standards and layered implementations are required. Common channel signaling (CCS) is required so that OAM messages specific to a given service/transport provider can be routed to the appropriate center. CCS-based OAM also allows the CATV company some autonomy as opposed to being locked into one vendor's or partner's OAM system.

Economics

Economics for CATV PCS are based upon figures from several sources. Many models are available to determine PCS system costs. Relative values illustrated in Figure 2 are based upon average representative figures.

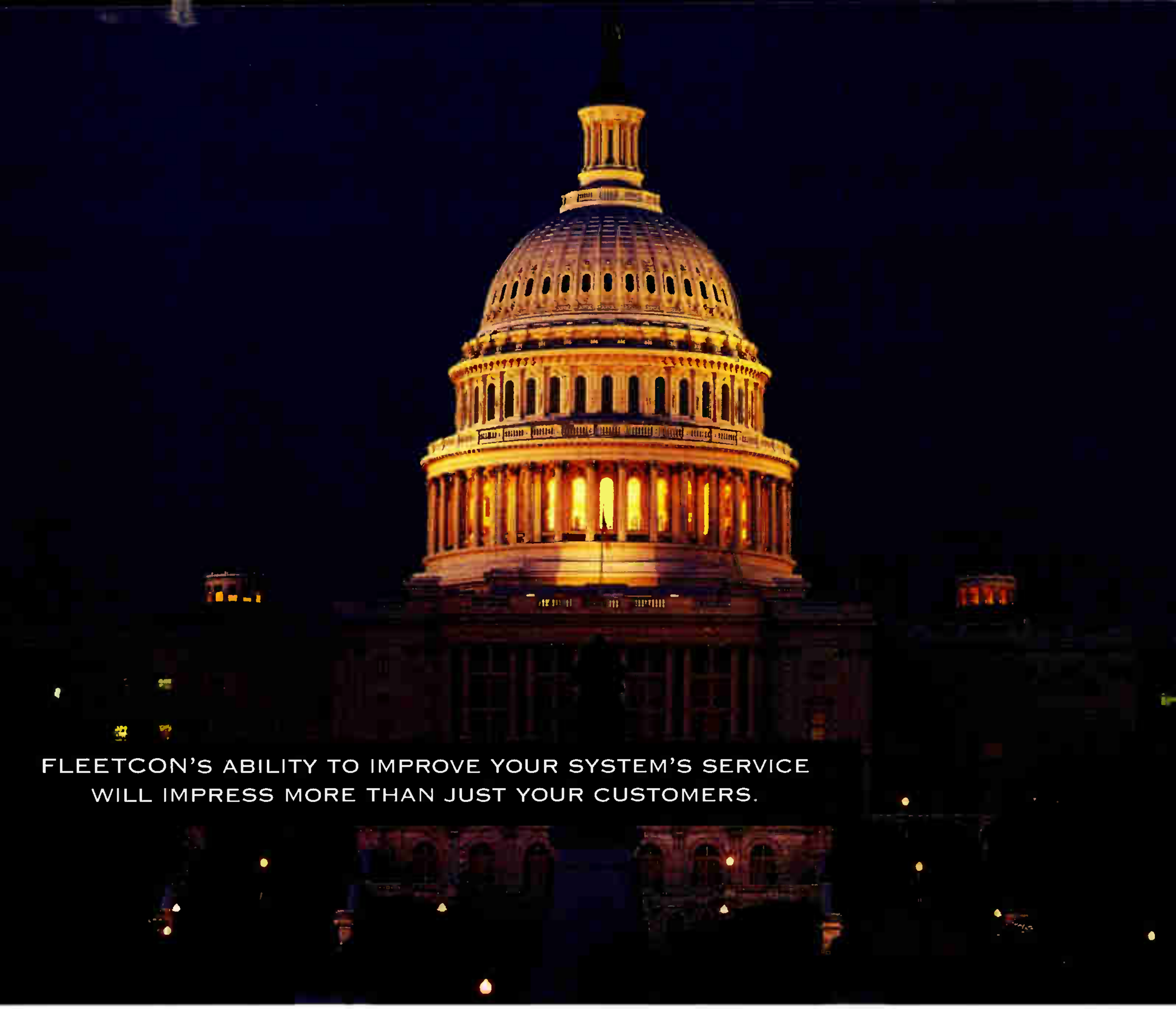
Switching costs

One of the initial questions that the PCS provider must decide is whether to buy or lease local switching products. Leasing is assumed to be from a nonaffiliated company.

An examination of public domain telecommunication company annual report data (i.e., LEC or cellco) provides you with some of the inputs that would be required to decide what potential leasing charges would be. Parameters such as the cost of goods and services (COGS) provide the operating costs that a leasor would hope to recoup. It is critical to consider whether the leasor would provide OAM and other overhead services since these are costs that the CATV company would have to absorb anyway. It also is important to consider the different traffic rates that CATV PCS may load onto a given type of switch as well as the increased OAM that may be associated with sophisticated PCS.

OAM costs

Operations, administration and main-



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tenance costs were based upon an average of public domain annual report data and other literature. This includes functions related to the cost of providing service and does not include other per-subscriber expenses such as depreciation.

One should be aware that literature showing wireless OAM costs to be lower than existing wireline does not take into account the additional investment and education that the new entrant would have to incur. Many overhead activities such as those mentioned at the beginning of this article are required in order to become a telephony provider.

Mobility costs

Costs for mobility are extremely variable as they depend upon the architecture chosen. The degree of layering between access, switch and network mobility functions will determine the amount of messaging, processing and speeds required. Even the particular air protocol chosen impacts the cost of mobility as a comparison between AMPS and GSM interfaces will show.

Mobility costs were divided into access mobility and network mobility. Access mobility is that subtended by a single switch. Network mobility is interswitch. The model chosen assumed that access mobility did not interact with the network. This is not necessarily the case with some systems currently under standards development.

"The cost of switching and OAM could be greater than or equal to the access hardware capital investment."

Economics conclusions

A comparison of cost components for CATV PCS is shown in Figure 2. The key result is that switching and OAM costs are, in general, equal to or greater than the access portion. Mobility is a smaller cost element and could perhaps be left as a service option until revenues are sufficient to drive this additional investment.

General conclusions

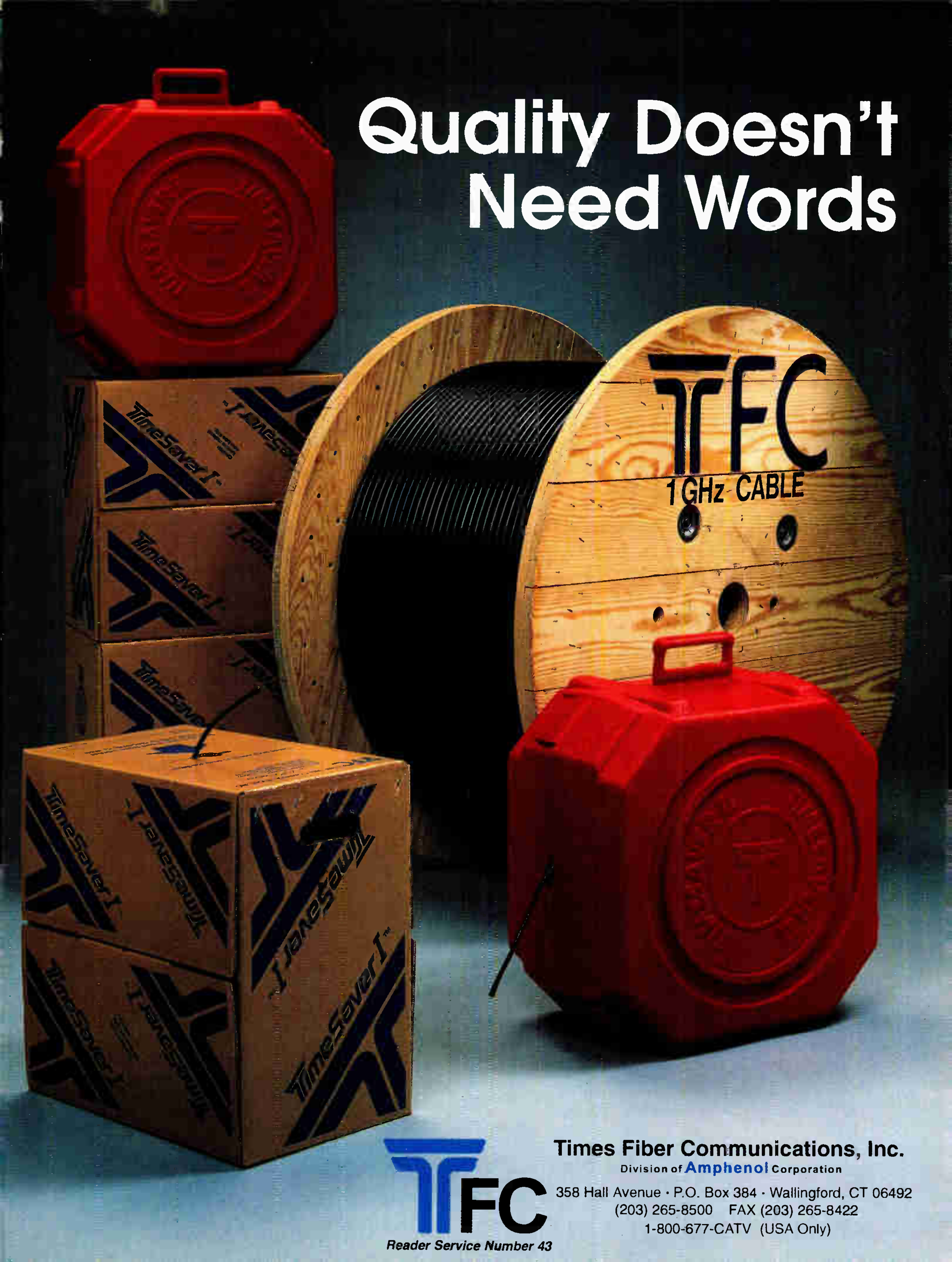
Conclusions arising from an examination of the infrastructure requirements for new entrants in PCS telephony are that:

- The cost of switching and OAM could be greater than or equal to the access hardware capital investment.
- Standard PCS switch interfaces are essential.
- The feasibility of switch ownership during initial deployment will depend upon the leasor's strategy to recoup investment and offer overhead services.
- The OAM costs of PCS for a new entrant could potentially be lower than existing wireline. However, PCS services will require more intensive administration and the new entrant will have to learn overhead activities associated with telephony service.
- Mobility capability should be layered, optional and standardized. **CT**

References

1) Telesis, Issue Number 94, "Personal Communications Services," Bell Northern Research Ltd., 1992.

2) OPP Working Paper Number 28, "Pulling It All Together: The Cost Structure of Personal Communications Services," D.P. Reed, November 1992.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Wireless data services: The ticket into emerging PCS markets

By Bob Sellinger
Director, Personal Communications Systems
AT&T Network Wireless Systems

The promise of personal communications services (PCS) is to have an integrated vertical set of services that are truly personalized. Subscribers, no longer attached to a piece of equipment, will have access to all of the voice, data and video capabilities of landline, wireless and cable TV systems. For new PCS carriers to compete successfully in this highly competitive and lucrative new market — where wireless services already have been defined by the cellular incumbents — they should be prepared to enter early, be creative and exploit niche opportunities.

But, how do start-up PCS carriers or cable TV service providers cost-effectively run in the PCS race when the competition seems to have a substantial head start? Simple. Initially offer a wireless data service known as cellular digital packet data (CDPD) and adhere to North American-based standards for PCS.

The ultimate success of PCS will depend on nationwide ubiquity with other (wireline and wireless) communications systems. In the United States, this level of compatibility can be accomplished only through the adoption of existing North American standards. Upbanded CDPD, already the accepted standard for wireless packet data in the cellular industry, is a good example of the viability of these emerging standards for PCS. It is the only wireless data standard in the world that provides all the virtues of a full packet network with open interfaces — facilitating easy integration with existing landline data applications.

Standing out in the crowd

For certain types of PCS carriers, a business strategy that leads with data as opposed to voice may make the most sense. And, CDPD is a perfect example of how start-up carriers and cable service providers can take advantage of the emerging PCS market by introducing a set of vertical applications targeted at a variety of niche markets.

The entrepreneur or cable TV operator could gain an immediate foothold in the PCS market by pursuing applications, like data services, that their larger competitors have yet to offer. Directing capital to the deployment of a PCS component in a cable TV system that initially serves niche applications would allow for affordable and rapid time-to-market. Then, as market share expands and financial position improves, the PCS component could be evolved to offer more complete voice (and data) capabilities. Why try to offer plain old telephone service (POTS) and compete with deep-pocketed rivals when the entrepreneur or cable TV operator could be far more successful quickly exploiting niche markets that would generate fairly immediate revenue?

And, wireless data service can be deployed with fewer cell sites than are required if a carrier tried to blanket an entire area in order to provide complete voice coverage. Instead of investing time and capital working on the numerous zoning and property acquisition issues required to deploy the 300-400 cell sites necessary for a large metropolitan area, the entrepreneur could start with far fewer cell sites and target a data community with specific applications.

Meeting market needs

One of the most exciting applications of CDPD may be the use of wireless data as an alternate signaling channel

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for interactive video. Mature cable TV systems, while exceptional broadcast devices, are challenged with signaling upstream from the subscriber back to the headend or video server. PCS wireless data standards, like CDPD, provide a technology base for the cable TV service provider that would be synergistic in solving a number of current interactive video challenges.

For example, as the cable TV service provider looks for a way to introduce subscriber interaction with home shopping networks or video-on-demand services, wireless data may be the solution. Applying upbanded CDPD — and its open, connectionless packet handling capabilities — as a wireless data signaling path for cable TV systems would facilitate easy integration with video servers to provide a graceful and inexpensive evolution to interactive video applications.

Building vertical applications on CDPD also addresses the marketing problems facing existing wireless data services. Until now there has been a concern in the industry that selling wireless data as a horizontal application is merely selling wireless modems and laptop computers with no practical, immediate use. By implementing alternate signaling paths using CDPD, cable TV service providers bypass this hurdle and can take immediate advantage of existing marketing channels for cable service to pull through the sale of new wireless data offerings.

"Why try to offer plain old telephone service (POTS) and compete with deep-pocketed rivals when the entrepreneur or cable TV operator could be far more successful quickly exploiting niche markets that would generate fairly immediate revenue?"

Another example application is portable point-of-sale devices, which would allow credit card verification for any type of retail market located away from a traditional store. This could include the mobile customer who might be operating a home delivery business or have an arts and crafts booth at the local art fair or mall. The portable point-of-sale device would generate the occasional packet of information back to a corporate server, which would then verify the credit worthiness of the credit card holder. This is all accomplished without a dedicated circuit or transmission channel. The market potential for this application is tremendous because numerous mobile retail vendors are waiting to be served.

The security and environmental monitoring market, requiring only the generation of an occasional packet of information from a burglar alarm or monitoring system, is yet another example of a market that could be quickly tapped via CDPD technology.

Affordable wireless system

One of the biggest virtues of CDPD — in addition to the ease of integration through open standards — is its cost-effectiveness for both the subscriber and the service provider. Because CDPD is a truly connectionless service, a subscriber can generate occasional data packets at any time and then only pay

for what is transmitted or received. And, there is no call setup delay in transmitting any of these packets. The cable TV service provider can engineer a wireless data system based on CDPD independent from any voice system. There is no need to deploy a central office switch or multimillion dollar cell sites. And, CDPD provides the access path to facilitate new interactive video services without needing to engage in the costly re-engineering of existing cable distribution plants.

In fact, there is no less expensive wireless infrastructure available today than the wireless data components required for CDPD. A CDPD-equipped cable TV system based on North American standards would consist of two fundamental stand-alone pieces: a mobile data base station (MDBS) and a mobile data-intermediary system (MD-IS). The MDBS, or cell site, is a single shelf of equipment providing coverage within a 30 kHz channel. This shelf is connected to the MD-IS, which performs the packet routing, manages the subscriber data bases as well as providing authentication, encryption and protocol arbitration services. Because the MD-IS is constructed from standard, open UNIX-based systems, it enjoys all the price virtues that go with commodity computing as well as allowing for easy expansion to accommodate future growth.

The subscriber could interact with the cable TV system through an in-home "subscriber unit" embedded in the set-top controller. This unit would contain all the wireless data capabilities necessary for relaying and receiving CDPD packets of information. And, because the cable TV service provider already has a presence in the home, this wireless data-enabled set-top box would provide the platform for introducing new applications like environmental or security monitoring.

Setting high standards

Nobody wants to build a wireless system — or any communications system, for that matter — that's an island. Yet, as the industry prepares to select standards that will ultimately define the framework for the emerging PCS network, that's exactly what could happen. Today's North American wireless systems are compliant on federal, state and local levels, because they have to be. If the industry evolves those systems to PCS, there is a much better chance of getting it right if it's based upon North American standards as opposed to using a technology that was never planned for this market.

For example, code division multiple access (CDMA), a leading North American air interface standard for PCS, is the lowest cost voice technology upon which to build PCS systems. CDMA is spectrally efficient, the easiest to maintain and works best with the lowest powered mobile equipment. In addition, all of its PCS supporting systems — from subscriber management to bill processing to network engineering — can be based on proven North American technologies. As a result, all the systems an entrepreneur needs to deploy, manage and evolve to a wireless PCS system already exist and can be immediately drawn upon.

By adopting domestic standards for PCS and exploiting the existing wireline and wireless infrastructure, the cable and telecommunication industries are expected to travel the most expeditious path to deploying PCS equipment and services. The prime technology competitor of North American standards is DCS 1800 — a derivative of the European global system for mobile commu-

nications (GSM) — which doesn't "plug and play" with the North American network and uses a different set of protocols for signaling and roaming.

Because its origin is in Europe, DCS 1800 also won't provide the same array of services (like packet data services) or level of integration needed for PCS to realize its full potential in this country. That's not to say that this technology is of lesser quality. It's just that PCS services and requirements, as they relate to the needs of the American consumer, are bound to be substantially different than what is found in other parts of the world.

The fact that the number of wireless data subscribers in the United States is expected to rival wireless voice subscribers within the next five to seven years further underscores the opportunities awaiting entrepreneurs in the emerging PCS market. One thing is for sure — PCS will be the most competitive and rapidly evolving segment of the industry. With the possibility of five to seven competitors in any given market, service differentiation is the road to success for new PCS carriers. And, with upbanded CDPD, it could be a quick trip. **CT**

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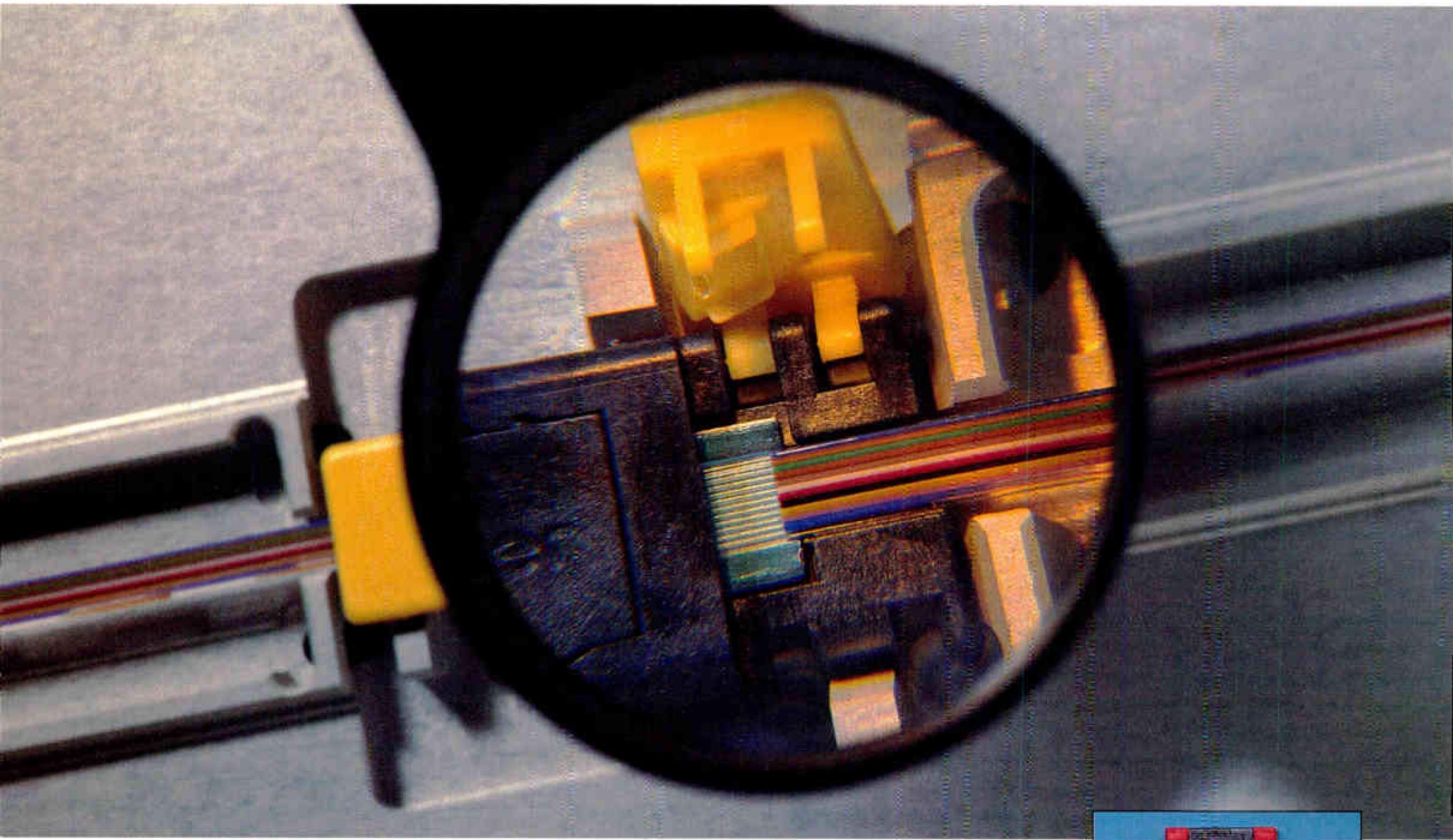
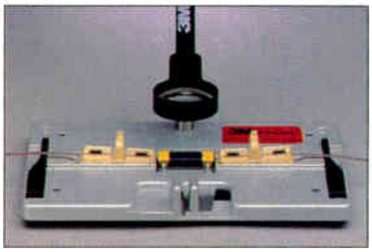
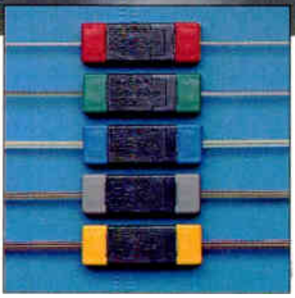




Fibrlok Multi-Fiber Splicing Assembly Tool



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The low cost assembly tool is lightweight and portable, perfect for most real world applications.

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Digital video servers: Storage technology and applications

The following is adapted from a paper that ran in the "1994 NCTA Technical Papers."

By Richard F. Annibaldi
Director, Product Engineering
Pioneer New Media Technologies

How can cable operators help prepare themselves for the introduction of compressed digital video into their systems? This article describes the technologies available for one important area — mass storage used in digital video servers. With this information, operators can better evaluate their alternatives in relation to planned applications.

As cable system operators strive to implement the "national information infrastructure" in the coming years, they will face many new challenges. In particular, the use of digital compressed video requires that cable systems implement unfamiliar technologies. Although some compressed video sources will probably be provided by satellite, the opportunity exists to provide other sources either directly in the cable system or within a multiple system interconnect. These locally provided sources of digital video will take the form of a digital video server.

The basic function of such a server is to provide appropriate streams of digital information to the subscriber of the cable system. Depending upon the specific services that the operator wishes to offer, each of these streams may be interactively controlled by a subscriber.

Video server architecture

Let's begin by examining a typical structure of a server. Although the exact form used may vary for each cable system, digital video servers will likely contain several common building blocks. The three most basic blocks are a central processing unit (CPU), an input/output (I/O) system, and digital storage. (See Figure 1.)

Our interest is in this third block used to hold large amounts of digital information. To allow for rapid movement of data into and out of the storage system, most devices use the small computer system interface (SCSI). SCSI, pronounced "scuzzi", and the improved version called SCSI-2, allow transfer of data at up to 20 megabytes per second (MBps), equivalent to 160 megabits per second (Mbps). Although this is substantially higher than the bit rates needed to support full motion video, remember that this interface must supply enough data to support multiple subscribers simultaneously.

Digital video formats

To evaluate storage systems, it is helpful to review the variety of digital video formats in use today. The storage system should be flexible enough to handle any combination of the video formats likely to appear on the network. Formats to be considered include:

- *MPEG-1* — Compressed full motion video at about 1.5 Mbps.
- *MPEG-2* — Compressed full motion video using several different profiles and levels at up to 60 Mbps. Typically uses 3 to 4 Mbps for NTSC and 10 Mbps for HDTV.
- *H.261* — Video telephony and conferencing at bit rates up to 1.92 Mbps.
- *JPEG* — Compressed still pictures.
- *Others* — Proprietary standards including General Instrument's DigiCipher.

Each of these formats may find a specific niche application in cable. For example, while movies would require an MPEG or equivalent format, interactive home shopping might use JPEG with freeze frames. Each format was developed based upon the desired compression algorithms, resolution and data rate. As a result, the actual data format stored on the media differs.

In fact, there is even more variety. With three profiles available at several levels each, MPEG-2 alone has many variations. The data may need to match a particular transmission format such as asynchronous transfer mode (ATM). Although the video server processor can convert formats, storing the video in the final transmission format can increase throughput. The storage technology should be flexible enough to handle all these possibilities.

Figure 1: Basic server architecture

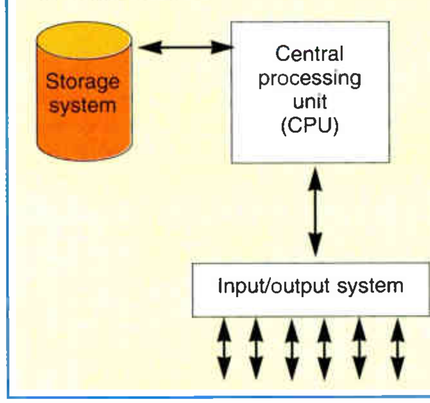
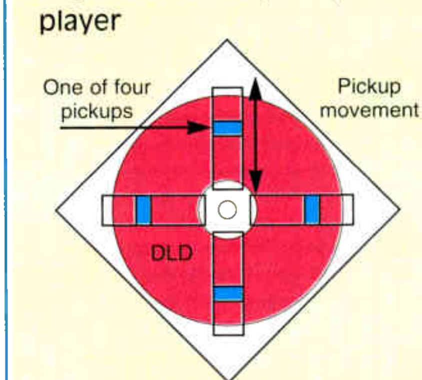


Figure 2: Four pickup DLD player



As a rule of thumb for later comparisons, consider the typical amount of data needed for a two-hour movie. With a 3 Mbps data rate, this movie requires 2.7 gigabytes (GB) of storage. Higher resolution such as HDTV would need much larger storage.

Storage technologies

We can classify storage technologies into four basic groups: random access memory (RAM), magnetic tape, hard disk drives and optical disc drives. Table 1 on page 54 summarizes characteristics of each type described as follows. Because these types often complement each other, it is most likely that servers will use some combination of them. →

Table 1: Comparison of storage technologies

	RAM	Magnetic tape (computer formats)	Hard disk	CD-ROM	DLD-replicated	DLD -WORM
Write capability	√	√	√			√
Erase capability	√	√				
Removable media for archive		√		√	√	√
Simultaneous outputs	1	1	1	1	4	4
Estimated total equipment cost per megabyte per output (includes complete electronics, drive and all removable media, if any)	$25-$40	$20 on cartridge (more for faster formats)	$1-$2 on SLED $3-$16 on RAID	$50 for 1 to 6 disc changer (less for larger changers)	<$1 on single disc drive (<$0.10 on changer)	< $1 on single disc drive
Average access time to any data location	< 1 µsec (processor access time)	50 secs for cartridge (tens of seconds for faster formats)	15.6 msec	<500 ms within single disc	2 seconds within single disc	2 seconds within single disc
Sustained data rate for read operation	Limited only by processor speed	0.5 Mbps cartridge; up to 120 Mbps for others	16 to 40 Mbps; higher for RAID	1.2 Mbps	Up to 15 Mbps	Up to 15 Mbps
Typical storage increment	Variable	0.13 GB per cartridge	Up to 1.6 GB per drive	0.54 GB per 4.75-inch disc	0.54 GB per 12-inch disc	5.4 GB per 12-inch disc
Advantages	Fastest	• Inexpensive media • Good for creating archive copies	RAID improves access time and data rate	Well-suited for multiple copies	• Largest capacity • Well-suited for multiple copies	Largest capacity
Disadvantages	Most expensive	Very slow access time for random locations on tape	Need RAID or backups for data protection	Set-up cost for single disc copy	Set-up cost for single disc copy	Moderate cost for single disc copy

Random access memory

The oldest, fastest and most flexible method of storage is RAM. Unfortunately, RAM also is the most expensive for large storage size. Nevertheless, its advantages make it desirable to use in conjunction with other types of storage. After loading a RAM buffer from any other type of storage, the processor can quickly access bursts of data destined for multiple users.

Magnetic tape

There are several digital video recording formats such as D1 and D2 in use today. However, these machines record data in rigid formats and provide digital outputs primarily for duplication and editing. For more flexible data formats, magnetic tapes for computer applications are a better choice. Virtually all of these computer tape formats can store digital video. However, these tape formats share several disadvantages in video server applications. The two most important of these are long access time when positioning the tape to a random point and the reliability problems of tape wear from repeated playback.

The availability of both hard disk and optical storage makes extensive use of magnetic tape in server applications less desirable. Nevertheless, magnetic tape can still be valuable for creating inexpensive archive copies of digital material that is no longer in regular use.

Hard drives

This is now the dominant technology in the computer industry for large capacity storage, especially on personal computers. Hard drives combine the ability to read and write data at relatively high speed with nonvolatility.

There are two general types of hard drive systems: the traditional single large expensive disc (SLED) and the newer redundant array of inexpensive discs (RAID). A SLED can now have capacities of 1.6 GB of data with larger drives planned.

Groups of drives are combined with appropriate control software to form RAIDs. The different types of RAID configurations are classified by six levels numbered 0 to 5. These "levels" do not indicate their relative merits; they simply identify different configurations that have different advantages and disadvantages. Table 2 (page 58) summarizes the different levels. The characteristics of the various levels are improved speed and, more importantly, error detection and correction.

RAID redundancy for error detection and correction permits continued operation even after one drive fails. In addition, with many RAID controllers, an operator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THE CHALLENGE

The subscriber of the 90's is perhaps the most discriminating in the history of cable, demanding higher quality pictures, more channels and increased customer service. With the advent of fiber optic distribution systems, time-sequenced pay-per-view services, and a dramatic improvement of the C/N ratio at the subscriber's tap, the onus is now placed heavily on the headend. It must now be able to perform to new and exacting standards in video and audio quality, channel capacity, and reliability. It was with these design objectives in mind that the Series 2000 was developed.

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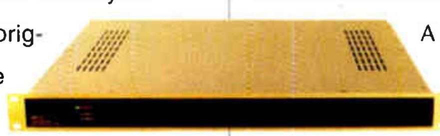
Nexus' innovative technology has produced a new generation of headend equipment, the Series 2000, which has been specifically designed to meet the exacting standards of today's large urban cable systems. It is a high performance headend system that's able to process and switch a variety of RF, optical, and digital signals while at the same time remaining virtually transparent to the original signal, regardless of its source. The Series 2000 provides the ultimate in ease of operation, flexibility, and reliability in a headend, including remote status monitoring and control.

The VM-2000 Television Modulator: At the heart of this revolutionary technology is the VM-2000, designed to accept, process, and deliver television signals in the 50 MHz to 1 GHz frequency range. With a C/N ratio of 70 dB at the modulator, the VM-2000 can provide a system with 150 channels of clean, high quality pictures effectively and reliably.

The UC-2000 Up converter: Typically used at hub sites, it is designed to convert IF signals to standard RF television channels. These are delivered with virtually no degradation from the original IF signal. A single UC-2000 chassis can contain two fixed channel upconverters. These are available at frequencies from 50 MHz up to 1 GHz. **The SU-2000 Standby Up converter:** An agile IF to RF up converter, the SU-2000 is designed to work with the Intelligent Headend™ to automatically back up a UC-2000 in a cable distribution system. When used in conjunction with a VM-2000/IF, the SU-2000 provides the headend with full-function modulator back-up. Using the Intelligent Headend™ in conjunction with the SU-2000 can virtually eliminate loss of service to the subscribers.

The IH-2000 Intelligent Headend™: Providing the ultimate in ease of operation, its main function is to give user-defined emergency back-up of headend channels if a service interruption occurs. By utilizing an advanced Windows graphical environment, the operator can automatically or manually control the headend, allowing maximum flexibility for input switching and system configuration.

The AS-2000 Active Splitter: Through amplification and splitting of a multi-channel cable television signal, it provides the cable operator a flexible interface between the headend and the fiber transmission system. A maximum of 16 outputs can be split with an input from 50 MHz to 550 MHz.



The CN-2000 Combining Network: Combining up to 16 channels from 50 MHz to 1 GHz, it has a broadband flatness of ±1 dB.

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"Although some compressed video sources will probably be provided by satellite, the opportunity exists to provide other sources either directly in the cable system or within a multiple system interconnect."

can configure some RAID levels to support simultaneous accesses to different drives. This would require careful handling of contention among users for the same individual drive. Specific advantages and disadvantages must be weighed against the desired applications to determine the best fit.

Optical disc drives

Compact disc read only memories (CD-ROMs) and digital laser discs (DLDs) are the two primary types of optical disc technology. While CD-ROMs have been in use for many years, DLD is still under development. Details on DLD given in Table 1 are target specifications.

As the name states, CD-ROMs cannot be erased or rewritten. Like existing analog laser discs, CD-ROMs are replicated using a stamping process. Each 12 cm (approximately 4.75 inch) diameter CD-ROM can contain up to 540 megabytes of data. Drives are available for either a single CD-ROM or a magazine of six. Changers for much larger quantities also are anticipated in the future.

The 540 Mbyte capacity of the CD-ROM is much less than the 2.7 GB required by our rule of thumb movie. Also, the CD-ROM data rate is only 1.2 Mbps. For these reasons, vendors are introducing several variations on CD-ROMs specifically targeted toward the video storage market. Some are spinning the disc faster to achieve two, three or four times the standard data rate. Others are developing products that differ more significantly.

As an example, Pioneer's a (alpha) Vision System uses high-density recording and replicating techniques to place 2.12 GB on the same CD-ROM size disc. The data transfer rate for a Vision is 4.7 Mbps, nearly four times the usual CD-ROM rate. The result is a disc that can store 60 minutes of video equivalent in quality to analog laser discs. In addition to the video, this disc stores two full stereo, or four monaural, audio tracks. Other data can be included at a transfer rate of 130 kbps.

A 30 cm (approximately 12 inch) diameter DLD can contain up to 5.4 GB of data, 10 times that of a CD-ROM. DLD will support a variety of video formats including MPEG-2. A SCSI-2 interface carries the 15 Mbps data transfer rate.

A stamping process produces normal analog laserdiscs, called replicated discs. Currently planned playback drives for DLD will handle both replicated and write once read many (WORM) formats. WORM allows for digital storage of cable system specific content, while retaining all of the playback advantages of replicated laserdiscs. These advantages include non-contact reading to eliminate media wear, quick access to any location on the disc and the ability to place seldom used discs directly into archive storage.

Traditional analog laserdiscs contain video in either of two formats: constant linear velocity (CLV) and constant angular velocity (CAV). CLV allows for twice the storage capacity of CAV by varying the rotation speed depending upon read location.

By using the CAV format, however, DLD can use more than one pickup at a time. For example, locating a pickup at each of the four major compass points

Table 2: Redundant arrays of inexpensive discs (RAID)

	RAID 0	RAID 1	RAID 2	RAID 3	RAID 4	RAID 5
Data on original disc duplicated or mirrored on second disc		√				
Data striped across multiple discs using 1 byte per drive accessed	√			√		√
Data striped across multiple discs using full sectors on each drive accessed					√	
Error detection and correction codes stored on a separate check disc			√	√	√	
Parity interleaved with data and striped across several discs						√
Advantages	Increased speed	Full redundancy of data	Large data block efficiency	• Increased speed • Large data block efficiency	Increased efficiency for small data blocks	Allows multiple simultaneous writes
Disadvantages	No error detection/ correction	Only 50% of disc capacity usable	Unnecessarily redundant error detection/ correction	High overhead working with small amounts of data	Slow writing of data due to shared check disc	Most complex controller required

around the disc allows four simultaneous, yet independent, outputs. Figure 2 (page 52) illustrates this four pickup drive, showing the four pickups or heads, each reading a different part of the data on the disc. Each pickup moves across the spinning disc to the desired start position, from which it tracks the spirally recorded data.

There are plans for automatic disc changers with two independent players and up to 252 DLDs. These changers allow easy access to huge libraries of information.

A variety of support equipment also is under development for DLD. First, a four-channel MPEG-2 video decoder allows use of the DLD drive as an analog video source. This makes for an easy introduction of the DLD into today's cable system. Once digital transmission begins, the operator simply removes this decoder from the headend.

Second, a four channel MPEG-2 data synchronizer/multiplexer provides the steady data stream needed for reliable, flicker-free video decompression at the set-top decoder. Next, a combined encoding and authoring station handles preparation of both real-time and nonreal-time data for recording. Finally, the WORM recording system writes the data onto the 12-inch disc.

Cable services

Now that we understand the technologies available, we can apply this information to the cable system's video server. What services does the cable operator plan to offer? Let's look at each of these and see which technology fits best.

Near-video-on-demand (NVOD) consists of providing the same movie on multiple channels with staggered start times. For example, one two-hour long movie could start at 8 p.m. on the first channel, 8:30 p.m. on the second, 9 p.m. on the third and 9:30 p.m. on the last. NVOD is ideal for first-run movies because it can handle very large numbers of purchases using only a few channels. From our list of technologies, the four pickup DLD stands out as the best match for this example of NVOD.

Video-on-demand (VOD) provides individual access to a program. For example, each subscriber can purchase a particular movie, starting and pausing that movie whenever he or she wishes. VOD requires rapid response to subscriber requests. Also, the number of programming choices to be offered to the subscriber has a large impact on the selection of technology.

Hard drives are a possible approach to VOD, although relatively expensive when offering many program choices. A DLD changer with as many as 252 discs can provide maximum choice, containing over 1,300 Gbytes of data. Because the DLD changer contains two players with four heads each, it can handle multiple accesses to this library. In addition, data retrieved from the DLD changer could be buffered in RAM while a different disc is loaded into one of the players for use by other subscribers.

HDTV can easily replace standard compressed video on the cable system. Both NVOD and VOD can work with these HDTV signals. The only requirements for the server are the higher bit rate and specific digital format used for HDTV.

Interactivity can be very different from the full-length feature films mentioned before. Films are stored sequentially in memory and require only occasional VCR-like controls to interrupt the normal flow. On the other hand, interactivity can involve random access to very short sequences, such as still frames of video or even short blocks of text. When interactivity requires many random accesses, hard drives are the logical choice. If video sequences are lengthy, however, DLD may have some advantages. In either case, the best approach is to store subscriber inputs in RAM to avoid disturbing the source data on hard disk or DLD.

Evaluation steps

The following steps can help to determine the storage needs for a particular cable system. Simply answer each of these questions for your system:

1) Which services will you carry in the short term? What about long-term plans? Use these answers to match appropriate storage technology to each planned service. Most likely, you will want to phase in new services gradually.

2) What is the expected popularity of each service? Use this answer to help identify the relative quantities of each storage type needed.

3) Which technologies can support immediate applications without becoming obsolete when new services are introduced? Paying attention to this will ensure your system grows and adapts to your needs.

Provide these answers to potential video server vendors so they can propose suitable solutions to your requirements. With your guidance and feedback, they can provide a much better system for you.

Conclusions

To be ready to face the challenges of the digital age, cable system engineers must gain an understanding of many applicable computer technologies. One such technology is the storage of large quantities of digital video and other information. The ideal storage technologies for any cable system will depend upon the services offered. Knowing your applications and the capabilities of various technologies should help in equipment selection. **CT**

Acknowledgements

The author wishes to acknowledge the assistance of Koh Uchiyama of Pioneer Electronic Corp. in providing source materials for this article. In addition, thanks to many individuals at Pioneer New Media Technologies for helping review this work.

References

1) Alford, Roger C., "Disk arrays explained," *BYTE*, October 1992, pages 259-266.

2) Casey, M., "Disk arrays: Hype vs. reality," *Computerworld*, August 19, 1991, pages 54-55.

3) Ranade, Sanjay, *Jukebox and Robotic Libraries for Computer Mass Storage*, Meckler Corp., 1992.

4) Stone, M. David, "Hefty Storage on a Budget," *PC Magazine*, October 12, 1993, pages 247-264.

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Video Technology News®

The Executive Report on New Video Technology for Consumer and Professional Markets

Vol. 6, No. 10

Dear Executive:

CABLE COMPANIES ACCELERATE TOWARD DIGITAL SUPERHIGHWAY

The rush to develop the "digital superhighway" turned into a stampede in the last month, as both cable and telephone operators announced important hardware and software deals for their networks of the future.

The events demonstrate how rapidly the digital superhighway is moving from pipedream to reality. They also indicate that, despite having cornered the market so far in c … competition from other compani … ble services

Among the imp

•General Inst … and Microsoft technology into it … te receivers.

•Bell Atlanti … digital video encoders and decod

DIGITAL

ic-Atlanta … tion in its Full … Fla. The … 900 MHz to 1 GHz … width will permit two-way vid

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•Cablevision … onverters from S-A. The converte … per-view ordering, VCR programming, on-screen menus, downloadable software upgrades, add-on cards to upgrade memory and "virtual channels" for data services.

In what could be a momentous acquisition of software, TCI signed a letter of intent to invest up to $90 million in four Carolco Pictures films during the next four years.

In return, TCI will show the films three times on the weekend before theatrical release. The pact is the first chink in the Hollywood armor around the sacred theatrical release and was greeted by a storm of protest from exhibitor organizations. After the Carolco deal, TCI announced a $10 million investment in interactive services provider and developer, Interactive Network.

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FM induced noise in analog fiber-optic CATV links

The following is updated from a paper that ran in the "1994 NCTA Technical Papers."

By Yaron Simler
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Presently CATV systems are migrating from coaxial to hybrid fiber/coax distribution architectures, gaining increased forward transmission bandwidth, channel capacity, reliability and service option flexibility. Competition and the need for an increased nonregulated service revenue base are just a few of the driving forces behind this trend. One of the services that has been traditionally offered in most CATV systems is co-transmission of FM audio channels along with AM channels. In earlier days this service was used to increase penetration rate and revenue from basic service especially in rural areas.

Deregulation and expansion of the CATV market have been accompanied by the higher performance specifications imposed by the Federal Communications Commission at the subscriber TV set. In turn, these new performance criteria require multiple system operators (MSOs) and broadband fiber-optic equipment manufacturers to better understand and evaluate the detrimental performance effects of each of the added services on the analog channels performance. For example, they need to understand how the proposed requirement for upper 200 MHz digital loading might affect its analog channel loading counterpart. The purpose of this article is to examine the detrimental effect of FM channels loading on the AM channels performance in a lightwave link.

The article derives a model for the carrier-to-noise ratio (C/N) in the presence of unmodulated FM and TV carriers on an analog fiber-optic CATV link. Empirically, the intermodulation distortion generated by the FM carriers mixing with themselves and with the TV carriers cannot be distinguished from noise and therefore in the presence of FM carriers, a new noise contribution should be added to the C/N formula denominator, namely distortion-induced FM noise. It is the specific objective of this article to derive the modified C/N equation taking into account the FM effects.

Figure 1: Total induced CTB vs. frequency (35 PAL channels and FM channels)

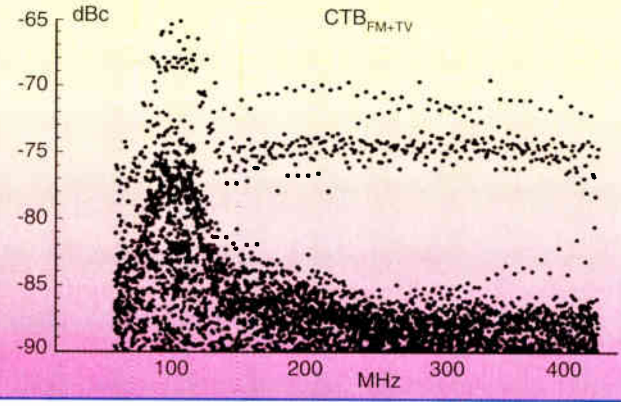


Figure 2: CTB vs. frequency (35 PAL channels)

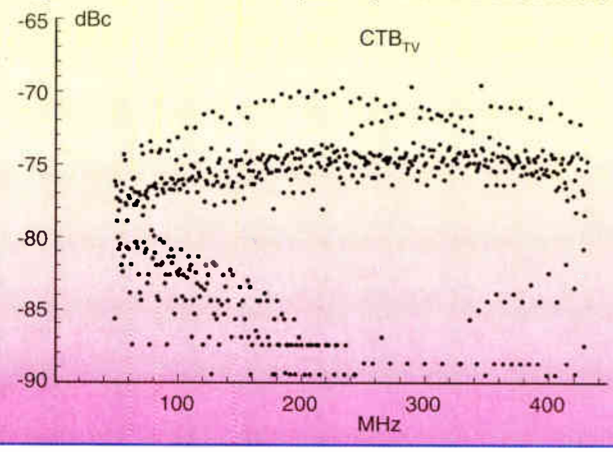
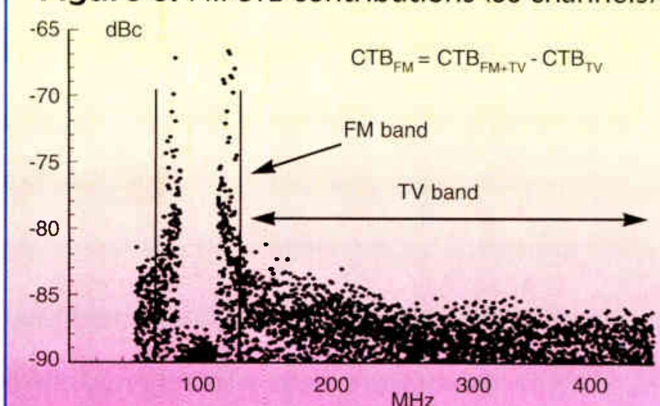


Figure 3: FM CTB contributions (30 channels)



Distortion induced FM noise

The C/N formula for an analog fiber-optic link is:

$$C/N = \text{Carrier/noise} = \text{Carrier}/(\text{Shot} + \text{Thermal} + \text{RIN}) \tag{1}$$

In the presence of FM carriers, a new noise contribution should be added to the C/N formula denominator, namely the distortion-induced FM noise:

$$C/N = \text{Carrier}/(\text{Shot} + \text{Thermal} + \text{RIN} + \text{FM}) \tag{2}$$

The normalized photocurrent in the receiver (including up to third order distortion terms and normalizing by the DC current generated by the CW light) is given by:

$$i = \phi + \alpha_2\phi^2 + \alpha_3\phi^3$$

Where:

$$\phi = m_{am}\sum_i \cos(\omega_i t + \psi_i) + m_{fm}\sum_j \cos(\omega_j t + \psi_j) \quad (4)$$

is the RF input (AM + FM carriers). Typically, the per-carrier AM modulation index (m_{am}) is 4 dB higher than its FM counterpart (m_{fm}). For clarity we will refer to the modulation index simply as m, the nature of which (m_{am} or m_{fm}) should be clear from the context.

The powers of the various distortion components (proportional to the squares of the currents) are given by expressions proportional to a_2 and m^4 for the CSO and a_3 and m^6 for the composite triple beat (CTB) terms, where a_2 and a_3 are the second- and third-order Taylor coefficient of the memoryless nonlinearity modeling the link, respectively. While it would be possible to evaluate a_2 and a_3 directly from CSO and CTB measurements at a given modulation index for a known TV frequency plan, this is really not necessary if the composite distortions due to the AM and FM + AM frequency plans are known.

The general functional dependence of the new FM "noise" term in Equation 2 (page 62) is given by:

$$FM = F_2 m^4 + F_3 m^6 \quad (5)$$

Where F_2, F_3 are constants to be determined below and the two terms correspond to the CSO and CTB involving the FM + TV channels, respectively. Once the general functional dependence of the various terms on m is understood, one can write a general expression for the total C/N (renaming F_2 and F_3 - C/N_{cso} and C/N_{ctb}, respectively):

$$C/N_{tot} = 10\log_{10} \frac{m^2}{m_o^2\left[c/n_o^{-1} + c/n_{CSO}^{-1}\left(\frac{m}{m_o}\right)^4 + c/n_{CTB}^{-1}\left(\frac{m}{m_o}\right)^6\right]} \quad (6)$$

Here, m_o is the nominal modulation index at which the C/N in the absence of FM effects is equal to the nominal C/N (at the modulation index m_o) as obtained using the regular C/N formula (Equation 1 — page 62). The next two terms correspond to the distortion power contributions represented as equivalent noise (i.e.,

$$c/n_{CSO} = 10^{C/N_{CSO}/10} \quad \text{and}$$

$$c/n_{CTB} = 10^{C/N_{CTB}/10}$$

are the FM-CSO and FM-CTB induced C/N contributions (in linear scale), respectively. Notice the use of upper and lower case terms. The upper case is used to indicate log (dB) scale while the lower case indicates linear (power) scale. Since m_o^2 is the (normalized) carrier power, then these expressions represent the (normalized) noise power contributions due to FM-CSO and FM-CTB respectively in the video channel bandwidth.

To determine these terms theoretically, one makes use of a beat counting or distortion modeling program and runs it at an arbitrary modulation index for both TV channels alone and FM + TV channels. The two distortions' distributions are subtracted

Figure 4: CTB due to FM over the PAL observation channel (carrier at 294.25 MHz)

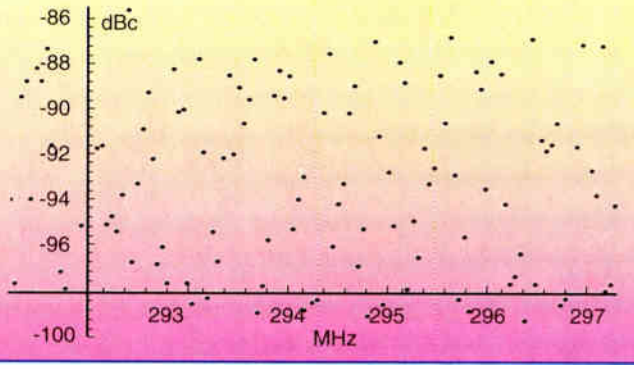
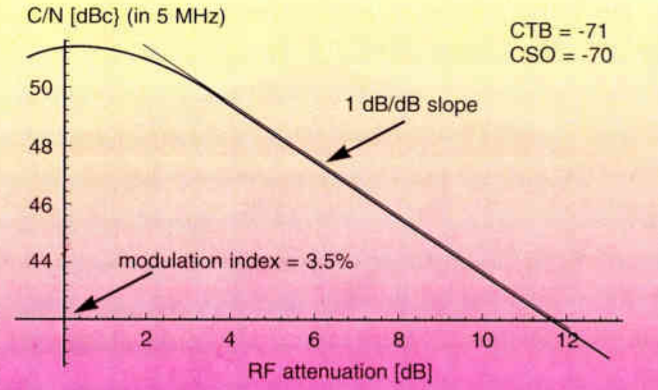


Figure 5: C/N vs. RF attenuation including FM induced noise



ter bandwidth is shown in Figure 4. Notice that the CTB contribution is scattered in random manner over the entire channel band at a level that is about -85 dBc. A similar noise-like behavior is observed for the CSO contribution of the FM channels.

The C/N equivalent degradation of the FM channels due to their CTB (C/N_{ctb}) is obtained by using Equation 8. Integrating the CTB contribution over the channel filter (containing in this case 100 discrete points) and using a CTB_{TV} (294.25 MHz)= -71 dBc (Figure 2) we obtain, following the similar procedure for CSO:

$$C/N_{ctb} = 62.1 \text{ dB}$$

$$C/N_{cso} = 70.4 \text{ dB} \qquad (9)$$

At the distortion levels shown, (CTB = -71, CS0 = -70), the C/N_0 at PAL filter bandwidth of 5 MHz is expected to be 51.4 dBc.

To understand the significance of the above numbers let us plot the C/N expression of Equation 6 (page 64) using the numbers obtained in Equation 9.

As is shown in the Figure 5, the predicted degradation of the FM-induced noise will cause a compression in the C/N performance with increase in modulation index. In contrast, the theoretical expression for C/N in Equation 1 predicts that the C/N will follow the RF attenuation on a dB/dB basis. From Figure 5 for example, the FM-induced noise is expected to degrade the theoretical C/N performance ("FM less") by as much as 0.5 dB at a modulation index of 3.5%

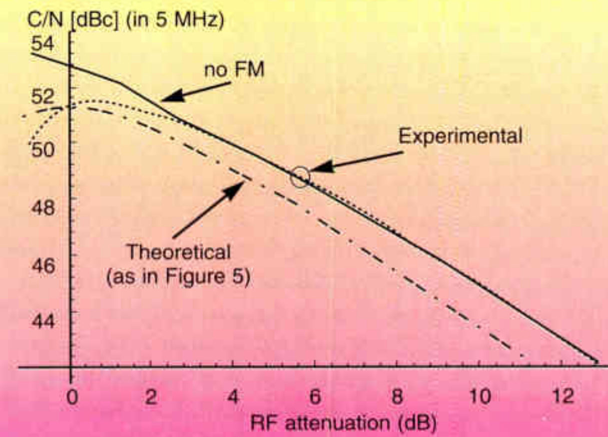
Comparison with experiment

To confirm the theoretical prediction of the FM noise contribution, an externally modulated YAG transmitter (Harmonic Lightwaves Model HLT 6720) was loaded with the same 35 PAL channels and its C/N was measured as a function of the RF input pad with and without FM channels loading. The results and a comparison with the theoretical prediction shown in Figure 5 are summarized in Figure 6.

The experimental results for the "FM less" case follow a straight line but the C/N curve starts bending in the region corresponding to modulation index of 4.5%. This seems to indicate clipping-induced noise, a mechanism not taken into account in the present analysis. The predicted effect of FM loading on the C/N performance is clearly seen in the figure by the deviation of the FM loading experimental curve from its "FM less" counterpart.

There is an excellent agreement between the theoretical and experimental results over most of the RF range. The excessive compression of the FM loading experimental results evident at high modulation index (at attenuation levels less than 0 dB), can be attributed to higher than third order effects. Recall that the assumptions of the model presented here include only the effects of second- and third-order distortion. No higher orders or clipping distortion are taken into account.

Figure 6: Experimental and theoretical C/N vs. attenuation



Conclusion

Using nonlinear (second- and third-order) analysis we have developed a model describing the effects of FM channel loading on a fiber-optic analog link. The FM channels loading is shown to degrade the C/N performance due to the nonlinear mixing of the FM channels with themselves and with the AM channels resulting in an increase in the noise floor of the optical link. A corrected C/N equation taking into account the distortion-induced FM noise is proposed.

To confirm the theoretical prediction a test that was comprised of 35 PAL channels and 30 FM channels was carried out and produced excellent agreement. As predicted, the C/N deviated from its 1 dB/dB slope due to FM channels loading as the optical modulation index increased. At very high modulation indexes, the C/N was compressed even further than theoretically predicted indicating higher order nonlinear contributions, contributions not included in the presented model. **CT**

Understanding the fiber transmission medium

By Dan Wasilko
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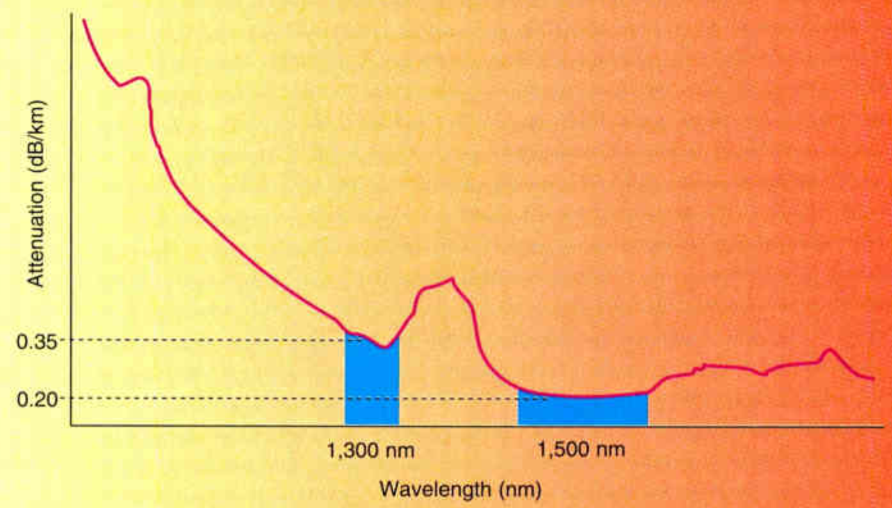
When CATV technicians begin working with fiber optics, many of them expect it to be a totally new technology to which nothing they know about coaxial cable applies. This is hardly true.

In fact, it helps to learn about coaxial cable even before learning fiber optics. Therefore, highly trained cable technicians should have no trouble working with fiber after a brief session on the particulars of optical cable. This article will present a lesson on fiber optics that has been used to teach cable technicians about this newer technology.

Fiber-optic cable has many of the same parameters of coaxial cable and some parameters that are at least analogous to coax. Both coaxial cable and optical fiber have insertion loss based upon frequency and length, they both exhibit a velocity of propagation, and in both media we can measure return loss. We will discuss how all of these parameters are related as well as look at signal reflections or standing waves in each and see how such reflections affect system performance.

Figure 1: Fiber attenuation vs. wavelength



Attenuation

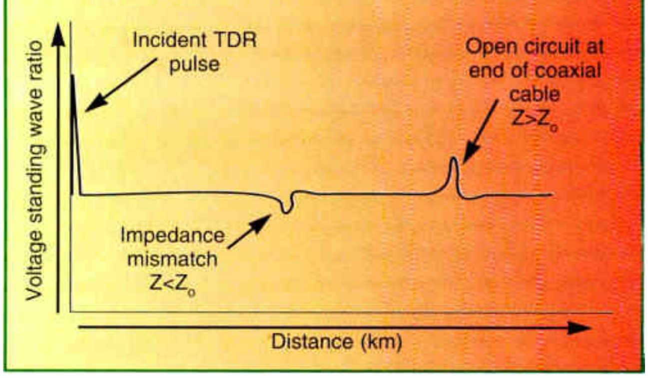
Insertion loss in both coax and fiber are frequency- and length-dependent. A typical 100-foot section of .500-inch coax has 1.63 dB of insertion loss at 450 MHz. As the frequency increases, so does the insertion loss per unit length. Fiber also has insertion loss based upon length and frequency. However, in optics we use the term wavelength instead of frequency, where wavelength is equal to the speed of light (approximately 300,000,000 meters per second) divided by the frequency. For instance, a 300 MHz signal has a 1 meter wavelength, while a 229,007 GHz signal has a 1,310 nm (0.000001310 meter) wavelength. Single-mode fiber has a typical loss of 0.35 dB/km at 1,310 nm and a 0.20 dB/km at 1,550 nm, where 1,550 nm is lower in frequency than 1,310 nm.

Figure 1 shows the loss of single-mode fiber vs. wavelength. The attenuation of the fiber tends to be greater as wavelength decreases (as frequency gets higher). In addition, there are regions where the attenuation does not follow that predictable line. At these wavelengths, the fiber absorbs the signals, thus causing high loss to them. Because of this high loss, these wavelengths are not commonly used for transmission. However, one of these peaks of high attenuation serves handily as a barrier that separates the usable bandwidth of the fiber into two "windows" isolated from one another.

Velocity of propagation

Signals traveling in either coaxial cable or fiber are reduced in speed

Figure 2: Copper-based TDR display



from that of signals propagating in free space. In coax we call this velocity of propagation. In fiber we use the term index of refraction.

In coax, there is a calculable delay in signals traveling through the coax when compared to signals traveling through the air. A visible example of this delay is direct pickup ghosting on a subscriber's TV set. In air, radio frequency signals travel at the speed of light, while in coaxial cable, the signal travels at 80 to 90% of the speed of light, giving us the velocity of propagation numbers 0.80, 0.90, etc.

In optical fiber, the optical signal also is reduced in speed from which it travels in free space. This reduction is given as an index of refraction number (n), found by:

$$n = c/v$$

Where:
n = index of refraction of fiber core material
c = speed of light in free space
v = velocity of propagation of the light in the fiber core

The index of refraction of a typical single-mode fiber core is 1.471, while the fiber's cladding is approximately 0.5% lower. The higher index in the core causes total internal reflection, confining the optical signal within the core as it travels through the fiber.

When using a time domain reflectometer (TDR) to measure a coaxial cable's length or to determine locations of characteristic impedance mismatches, one must enter into the TDR the velocity of propagation value of the coax. When using an optical time domain reflectometer (OTDR) to measure the length of fiber or distance to a mismatch, the operator must enter the velocity of propagation value (index of refraction) for the fiber being tested. The operation of both the TDR and the OTDR is similar. Each device measures the time it takes for an incident signal to be sent to and received from a point of mismatch, then it computes the distance to the mismatch based upon the velocity of propagation or index of refraction of the copper or optical medium.

Reflections in coax, fiber

What is a mismatch in either a coaxial cable or an optical fiber link? In coax the characteristic impedance (Zo) depends upon the ratio of diameters of the center and outer conductors, as well as the dielectric constant of the insulating material between them. As long as the characteristic impedance is constant throughout the length of the coax, RF signals are unaffected (except for attenuation) as

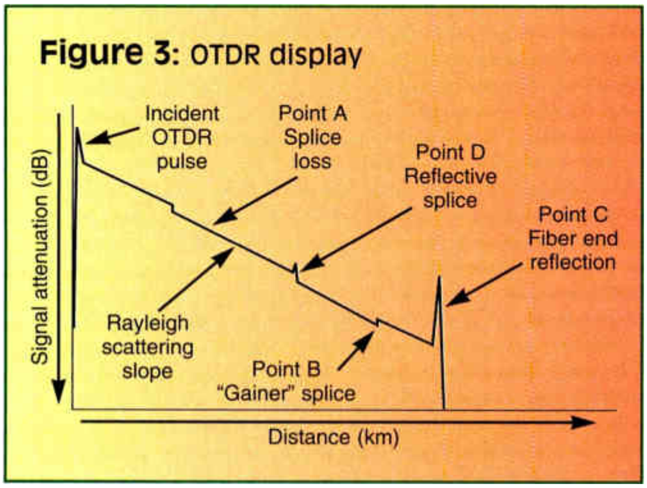


Figure 3: OTDR display

they travel through it. If there is a change to any of the parameters that set the cable's characteristic impedance, a reflected wave is created that travels back toward the source. The interaction of the forward and reflected signals form standing waves.

This reflection can be detected by the TDR as described before. If the impedance encountered is greater than the cable's characteristic impedance, as at the open or unterminated end of a coaxial cable, the TDR shows a pulse in the positive direction. If the mismatched impedance is lower than the characteristic value (such as a short at the end of the cable) the pulse goes in the negative direction. Either way, the TDR only measures the distance to a mismatch or the end of the cable. Refer to Figure 2 (page 72).

In optical fiber, the index of refraction follows the same properties as the velocity of propagation of RF signals in coaxial cable. However, the index of refraction of fiber is more analogous to coaxial cable's characteristic impedance. As long as the incident optical signal encounters no change in index of refraction (other than Rayleigh backscattering as described later), the light travels away from the source to the receiver. If there is a change in index of refraction at some point, such as the open end of a fiber, a portion of the light is reflected from that point back toward the source.

Throughout the optical fiber, there are minute but evenly distributed changes in index of refraction due to impurities in the fiber and unavoidable index changes along the crystalline structure of the glass material. These minute index variations reflect a small portion of the transmitted light back to the source, an effect known as Rayleigh back scattering. On the OTDR this appears as the sloped line across the screen and gives an accurate measurement of the attenuation of the fiber per unit distance or absolute attenuation at any point in the fiber link. Therefore, the OTDR plots attenuation (in dB) on the vertical axis, and distance (usually meters or kilometers) on the horizontal axis as shown in Figure 3.

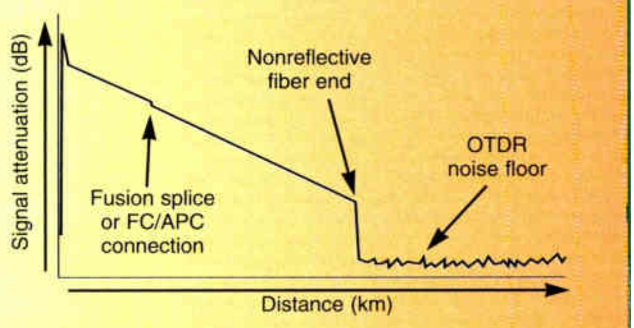
"There are enough similarities, or at least analogies, between coax and fiber that coaxial testing techniques for both installation and troubleshooting can become the basis for understanding fiber-optic links."

Measuring losses with an OTDR

The OTDR provides an easy way to measure the loss through fusion splices, mechanical splices or connector pairs. These locations where two fibers are joined cause the OTDR trace to drop suddenly at a single point on the distance scale, producing a vertical line at the location of the splice. The length of this vertical line, measured in dB, is the loss of the splice at that location. (See Point A of Figure 3.) Many OTDRs have the ability to automatically measure the splice loss, providing a numerical output to the operator. This is unlike the copper-based TDR that cannot show splice losses and only shows where discrete impedance mismatches occur relative to distance.

When using an OTDR to test a fiber link, one may encounter a splice that appears to have a negative loss value, sometimes known as a "gainer" splice. (See Point B in Figure 3.) This apparent gain of signal is a function of the reflective properties of the two fibers being joined. The second fiber will have a higher Rayleigh scatter-

Figure 4: OTDR trace for fiber end terminated with FC/APC connector



ing percentage than the fiber nearest to the OTDR. In this case the link should be tested from both ends and the loss measurements for this splice be averaged together to find the actual loss of the splice. Additionally, all fiber measurements with an OTDR should be made from both ends of the fiber and averaged together. This provides the most accuracy in length and loss measurements.

When testing a fiber link with an OTDR, the end of the fiber usually produces a positive spike on the trace much like the open end of a coaxial cable produces on a TDR. In the fiber, this reflection is caused by the change in index of refraction as the light transitions from the fiber to the open air. The fiber's index of refraction is approximately 1.47, while the index of refraction of the air is nearly 1. This is a significant index change, causing a large reflection, which the OTDR shows as a large vertical spike on the trace at the point corresponding to the end of the fiber. (See Point C in Figure 3 on page 74.)

Another possible location of a reflection is in a mechanical splice or optical connector pair with an undesired air gap between the two fibers. This is known as a Fresnel reflection. The index of refraction of the air between the fibers is, again, nearly 1. Therefore, the light traveling in the link encounters the change in index of refraction from 1.47 to 1, causing nearly 4% of the light to be reflected back to the source. The remaining 96% of the light enters the next fiber. On the OTDR screen the reflection appears as a spike at the location of the splice. (See Point D in Figure 3 on page 74.) In addition to the reflection, there also is a loss of optical signal at the splice, illustrated by a vertical drop in the OTDR trace at the splice location. This loss can typically be 0.4 dB or more because of the reflection and optical modal redistribution, along with the attenuation of the short air gap. If a fiber has an attenuation specification of 0.35 dB/km at 1,310 nm, the connection loss has effectively shortened the link by more than 1 kilometer.

AM fiber link performance

Most multichannel, AM fiber-optic links cannot tolerate optical reflections. The optical signal reflected back into the laser transmitter has the effect of degrading the carrier-to-noise ratio (C/N) of the link. The link C/N is the sum of four components: the noise contribution of the laser; the noise due to the photodiode in the receiver; the noise due to the RF amplifier in the receiver; and the interaction of light within the fiber itself. *(Editor's note: See the article "FM induced noise in fiber-optic links" on page 62 for a discussion of yet another contributor to link C/N.)*

The laser noise is a constant dependent upon the relative intensity noise (RIN) of the laser and the modulation index of the RF signals directly modulating the laser diode. The photodiode noise (shot noise) and receiver amplifier noise contributions depend upon the optical power reaching the receiver as well as the channel loading on the link.

The noise contribution of the fiber, known as interferometric noise, is a function of the optical reflections in the fiber link. As light is reflected back into the laser from both Rayleigh scattering and Fresnel reflections, the delicate production of light within the laser diode is disrupted. The light created within the laser is coherent, meaning all the photons produced have the same frequency and phase. If light is allowed to be injected into the laser, as from a reflection, the out-of-phase light from the reflections causes the intensity output of the laser to vary randomly. This variation arrives at the receiver and is passed on to the output RF signal as a noise component. In addition, multiple reflections in the fiber can cause portions of the transmitted signal to arrive at the receiver out of phase (time) with the main incident sig-

nal. This also contributes to the interferometric noise.

Reflections and return loss

The reflections in a fiber link contribute to the link's overall optical return loss. Return loss is a ratio of how much light is reflected back toward the transmitter compared to how much is transmitted into fiber. In coaxial cable, return loss is a measure of how well the coax maintains uniform characteristic impedance throughout its length. In fiber, the return loss is a measure of the reflections in the fiber caused by Rayleigh scattering and Fresnel reflections. A fiber link for AM or digital signal transmission should have an optical return loss of 45 dB or greater.

Reflections can be minimized by using only fusion splices for connecting fibers together or by using high-quality optical connectors. Mechanical splices should only be used for emergency restoration of fiber links. Generally, when connectors are used in a link, better performance is achieved when FC/APC connectors are used near the transmit end, while FC/PC or FC/Super PC connectors are used at the receiver end of the link.

Fusion splices and FC/APC connections in a fiber link typically do not create significant reflections and hence do not produce a positive spike in the OTDR trace. Mechanical splices with near-perfect mating between the two fiber ends and effective application of index matching gel within the splice also will not cause a significant reflection. Mechanical splices that are not perfect will produce a spike on the OTDR screen at the location of the splice causing a Fresnel reflection in the link. Again, these connections should be considered temporary.

"Once a cable technician understands the basics of the optical fiber link, making OTDR measurements is fairly simple."

The open end of a fiber link will usually produce a reflection, especially if the fiber end has been cleaved or is connectorized with an FC/PC-type of connector. This reflection is caused by the change in index of refraction the light encounters as it travels from the fiber's index of 1.47 to that of air, 1.

If the end of the link is connectorized with an FC/APC connector, the reflected signal is directed into the cladding of the fiber. This is because the end of the fiber has been polished with an 8° angle, rather than no angle as with non-APC types of connectors. Having no reflected signal being sent back to the source makes the fiber end appear to have no reflection and the trace merely drops off to the noise floor of the OTDR at this point. (See Figure 4 on page 76.) Therefore, APC connectors protect the laser from reflections in a functioning link.

Fiber ends left uncleaved and not connectorized will usually produce a reflection spike. However, the fiber end may be uneven enough to scatter the reflected light into the cladding rather than back to the source, thus creating no or little reflective spike on the OTDR trace.

Index of refraction experiment

The reflections, again, are caused by the change in index of refraction the light encounters when traveling from one medium to another. A method of demonstrating the effect of change in index of refraction is to connect a test reel of fiber-optic cable (at least 2 km in length) to an OTDR. Then observe the end of the fiber on the OTDR trace. If the fiber end is connectorized with an FC/PC connector or no connector at all, the trace should show a large spike at the end of the fiber.

Now place the end of the fiber into a small glass of isopropyl alcohol. The spike should be reduced in level by about one-half. This reduction is caused by decreasing the change in index of refraction at the end of the fiber. Instead of the light encountering an index change of 1.47 to 1, the change is now only from 1.47 to about 1.33, the index of refraction of the alcohol. When the alcohol evaporates or is dried off of the fiber end, the reflection will return to the original level. This experiment illustrates the importance of maintaining index of refraction throughout the fiber link.

Once a cable technician understands the basics of the optical fiber link, making OTDR measurements is fairly simple. There are enough similarities, or at least analogies, between coax and fiber that coaxial testing techniques for both installation and troubleshooting can become the basis for understanding fiber-optic links. **CT**

Video testing step by step — Part 4

The new Federal Communications Commission-required "video tests" are less than a year away. Remember that systems subject to the new rules are required to pass and document the tests by July 1, 1995. This article is one approach to fulfilling the testing requirements. Part 1 covered FCC reporting requirements and baseband video basics. Part 2 focused on two specific recommended tests — in-channel frequency response and percent modulation. Part 3 tackled signal-to-noise ratio (S/N) and hum modulation. This installment examines the "color tests" — differential gain, differential phase and chrominance-to luminance delay. Following installments will continue to detail each of the FCC-required tests, plus include information on a few tests that may benefit picture quality and system troubleshooting.

By Jack Webb
Product Manager, Sencore

The following information is taken from various reliable sources and is believed to be accurate at the time of printing. Please refer to the FCC Rules and Regulations Part 76.601 through 76.605 to be sure that you fulfill the legal requirements. Listed with each recommended test and the FCC-required tests is information on the FCC regs, a definition of the test, a description of the picture effect, a measurement procedure and many helpful hints and precautions when making and interpreting these measurements.

Figure 21: Differential gain measurement

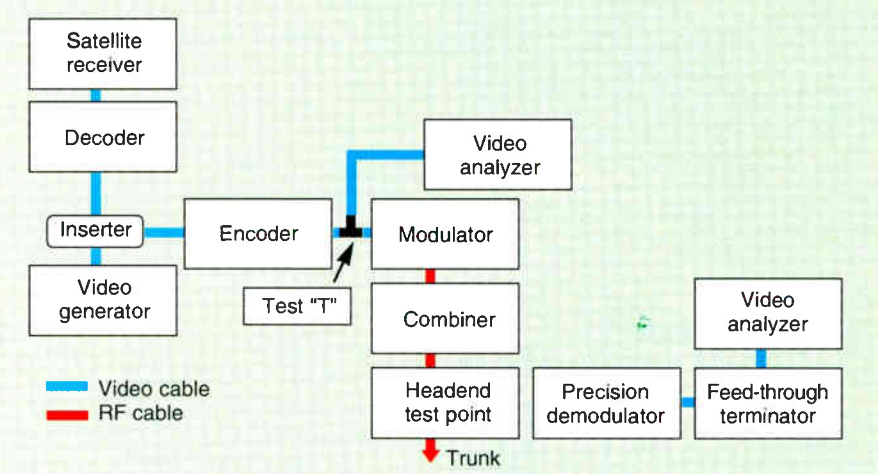
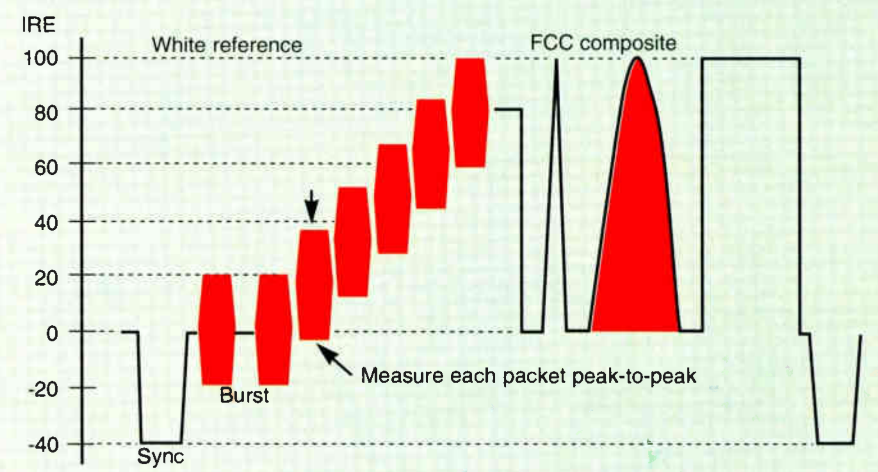


Figure 22: FCC composite test signal



Differential gain

As of June 30, 1995, additional FCC proof-of-performance (POP) tests require measurement of the differential gain characteristics of the headend through the modulators or processors. These measurements must be made and documented every three years. Differential gain is a measurement of the variation in amplitude of the chrominance as the luminance level varies. Poor differential gain causes poor color picture reproduction. Newer CATV video analyzers provide a one-key test that automatically takes the measurements, makes the calculations required for this complex measurement and digitally displays the differential gain on the LCD. The following sections provide detailed information on the FCC Rules and Regulations, a definition of the test, a measurement procedure and many helpful hints and precautions.

• 76.601 (c)(1): For cable systems with 1,000 or more subscribers, but with 12,500 subscribers or less, POP tests conducted pursuant to this section shall include measurements taken at six widely separated points within each mechanically continuous set of cables within the cable TV system. Within the cable system, one additional test point shall be added for every additional 12,500 subscribers or fraction thereof. Such test points shall be balanced to represent all geographic areas served by the cable system. At least one-third of the test points shall be representative of subscriber terminals most distant from the system input in terms of cable length ... An identification of the instruments, including the make, model number and most recent date of calibration, a description of the procedure utilized, and statement of the qualifications of the person performing the test shall be set forth.

• 76.601 (c)(2): POP tests ... shall

Figure 23: Measuring differential gain

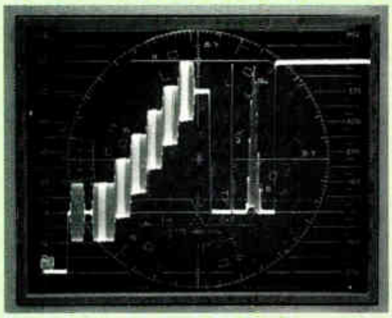
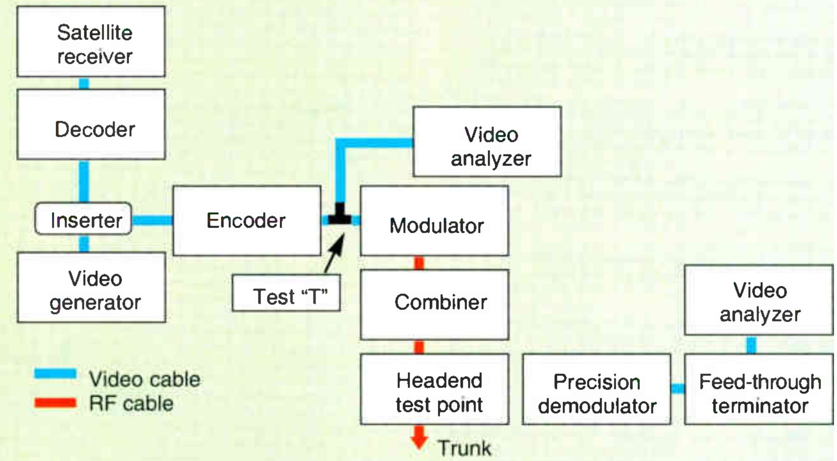


Figure 24: Differential phase measurement



be made on a minimum of four channels plus one additional channel for every 100 MHz or fraction thereof of the cable distribution system upper frequency limit ... The channels selected for testing must be representative of all the channels within the cable TV system.

• 76.605 (a)(12): The differential gain for the color subcarrier of the TV signal, which is measured as the difference in amplitude between the largest and the smallest segments of the chrominance signal (divided by the largest), shall not exceed 20%.

Again, while the FCC requires documenting only a few channels and only every three years for the "color tests," you are responsible for all channels at all times should a complaint arise. The differential gain test is often referred to as one of the "new or color tests" along with differential phase and chroma-to-luma delay. Although this specification is typically easy to meet, careful attention must be paid to the % mod. Overmodulation will result in severe degradation to differential gain.

Definition: Differential gain is the measure of the system's ability to linearly reproduce the high frequency chrominance signals at all levels of luminance. This amplitude distortion of the chrominance signal is dependent on the luminance level. Differential gain is measured as the percentage of the difference between the largest and the smallest burst packet divided by the largest packet amplitude when the packet levels are varied at all luminance levels. Both peaking and attenuation can occur as the luminance level is varied. For the CATV definition, the maximum variation is used and is not referenced to the blanking level. Typical system deficiency occurs at the higher luminance levels.

Picture effect: High differential gain results in color (intensity) variation dependent on the picture luminance level. This manifests itself as unwanted changes in color saturation as the brightness of the picture changes.

Measurement procedure: The total differential gain includes the effects of the headend processing equipment, demodulators, descramblers, encoders, video switches, modulators, etc. If the programmer supplies a vertical interval test signal (VITS) that you will use as a reference to test your system, each chroma burst at each luminance level must be measured at the satellite receiver and be used in calculating the differential gain of your system. This may not be necessary if you pass the FCC requirements without this calculation since it is unlikely that the uplink and satellite receiver will "help" your system, but they definitely will contribute to errors.

If you use the programmers' test signals and fail the test by a small margin (or get marginal results), measuring the satellite receiver output and subtracting these measurements from the system measurements will give you a better measure of your system performance. Remember to keep the data for each packet separate, since the distortion may be different in each piece of equipment and at different stairstep levels.

To measure the differential gain of a channel without interference to the system's operation you will need to insert a VITS in the VBI of the channel to be tested. This should be done at the satellite receiver output or following the decoder, if used. Note the insertion diagram in Figure 21.

Choose a VITS with a modulated staircase pattern. The FCC composite test signal shown in Figure 22 is preferred since it can be used to make our other key tests. Other VITS patterns may be used such as modulated ramp. Be sure that the test signal chosen is compatible with the measurement device and the equipment under test. Again, see Figure 22.

Test signals such as the NTC-7 composite, which have signals above the 100 IRE level, can overmodulate the carrier, generating excessive differential gain and phase errors. Modulators and demodulators generally contribute most of the differential gain to any system. Strip amps and processors also can contribute differential gain, but typically much less than modulators and demodulators. Video switching and commercial insertion equipment typically contribute very little differential gain. Differential phase and differential gain are normally found together. If you have differential phase distortion you will likely also have differential gain distortion and vice versa.

Procedure:

1) Connect the test equipment as shown in Figure 21.

2) Test signal generator setup:

a) Connect the signal insertion device or loop-through as required.

b) Select the VITS insertion mode.

c) Select the desired test signal.

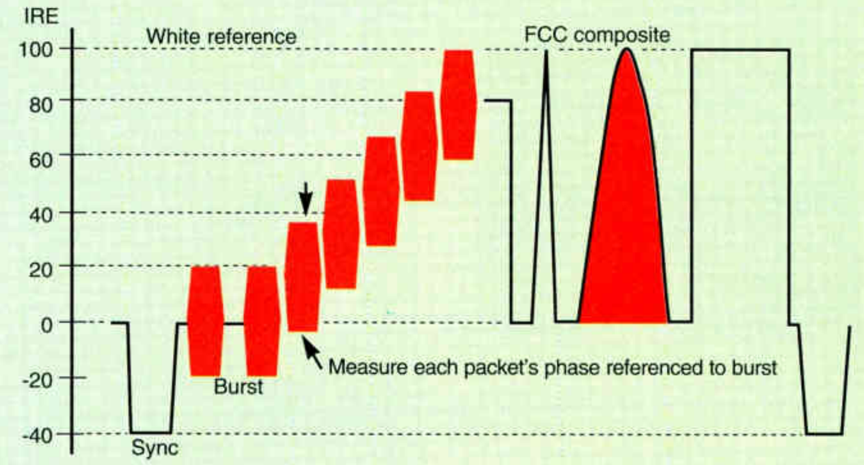
d) Connect to the insertion device, enable the generator output.

e) Using the CATV video signal analyzer, verify the test signal insertion.

3) Demodulator setup:

a) Tune to the channel to be tested. →

Figure 25: FCC composite test signal



b) Use the synchronous detector mode.

c) Be sure the "zero carrier reference" mode is turned off.

4) CATV video signal analyzer setup:

a) Check the Cal signal and be sure the display gain and vertical position controls are properly set.

b) Set the line select to the line and field where the VITS is inserted.

c) Select the 1 H sweep mode so that one horizontal line is displayed.

d) Measure the % mod to be sure that it is set at 87.5%, or slightly under. Overmodulation will create excessive differential gain and phase distortion.

5) Press the differential gain key and read the display for the differential gain in %.

Or, for manual measurements:

a) Turn on the chrominance filter, adjust the vertical position and display gain control as required to position the largest chrominance packet for 100 IRE peak to peak display.

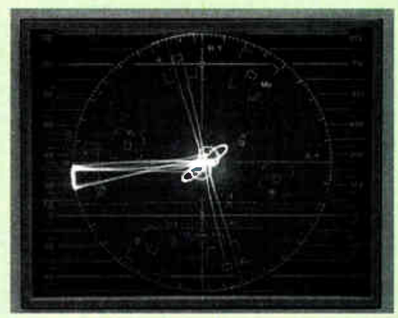
b) Identify and measure the "packets" with the minimum amplitude. The differential gain will be the difference between the largest and smallest packet expressed in percentage:

Differential gain = $\text{Maximum}_{p\text{-}p}$ - $\text{Minimum}_{p\text{-}p}$

6) Differential gain also may be measured in the vectorscope mode:

a) Switch from the waveform monitor to the vectorscope mode and adjust the vertical gain until the trace just reaches the graticule circle.

Figure 26: Measuring differential phase



b)Read the % differential in the box on the left side of the display. The total differential gain is the maximum deviation whether leading or lagging the burst reference (Figure 23 on page 81).

7) If unacceptable measurements result, troubleshoot the system back up the video path using the CATV video signal analyzer. Be sure to remove the feedthrough terminator where appropriate.

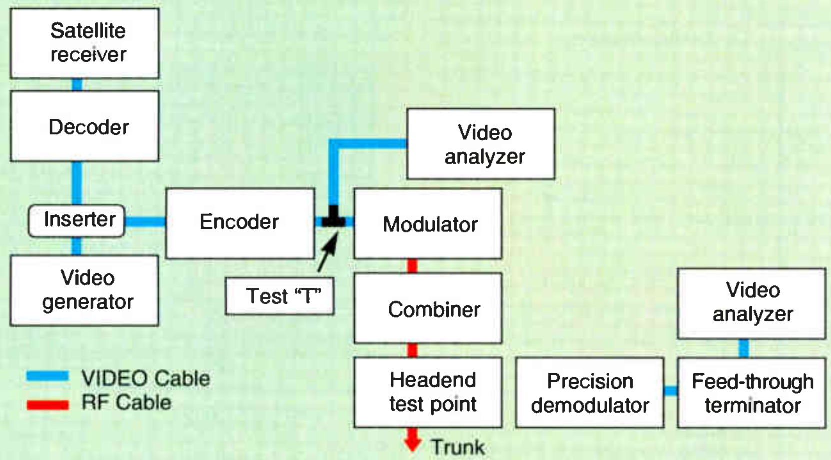
Precautions:

1) Since overmodulation is much more problematical than undermodulation, intentionally set the % mod at 83% to 85% on all channels.

2) Be sure that the satellite receiver output and all other video sources used for that channel are set for 1 V. Changing the input level to the modulator will change the % mod on most modulators.

3) Permanently install an insertion device in each channel's video path at the output of the satellite receiver so that test signals may be injected with-

Figure 27: C/L delay measurement



out interrupting the channel. Be sure that only a single 75 ohm termination exists on each video line.

4) Also, install a "T" at the input to any device in the video path of each channel. This provides troubleshooting test points without interrupting the channel. Be sure that only a single 75 ohm termination exists on each video line.

5) Before connecting the CATV video signal analyzer to any test point, be sure that it is in the high impedance mode (not using the feedthrough terminator).

6) If your modulators have a clipping circuit to prevent overmodulation ignore the measurements on or above the 90% luminance steps when measuring the differential gain.

Differential phase

As of June 30, 1995, additional FCC POP tests require measurement of the differential phase characteristics through the headend. These measurements must be made and documented every three years. Operators are still responsible for meeting the requirements on all channels at all times. Differential phase is a measurement of the variation in phase (hue) of the color as the luminance level varies. Poor differential phase will cause poor color picture reproduction. Newer CATV automated video analyzers provide one-key tests that automatically take the measurements, make the calculations required for this complex measurement and show the results on the instrument's display. The following sections provide detailed information on the FCC regs, a definition of the test, a measurement procedure and many helpful hints and precautions.

- 76.601 (c)(1): For cable systems with 1,000 or more (same as listed for differential gain).
- 76.601 (c)(2): POP tests ... shall be made on a minimum of four channels plus one additional channel for every 100 MHz (same as listed for differential gain.)
- 76.605 (a)(13): The differential phase for the color subcarrier of the TV signal, which is measured as the largest phase difference in degrees between each segment of the chrominance signal and the reference segment (the segment at the blanking level of 0 IRE), shall not exceed ±10°.

Again, while the FCC requires documenting only a few channels, and only every three years for the "color tests," you are responsible for all channels at all times should a complaint arise. Although this specification is typically easy to meet, careful attention must be paid to the % mod. Overmodulation will result in severe degradation to differential phase.

Definition: Differential phase is the unwanted change in phase of the chrominance signal as the amplitude of the luminance signal changes. Differential phase is measured as the greatest change in phase at any luminance level expressed in degrees, referenced to the burst at blanking level. Measurements should state the maximum phase error from the burst reference and the polarity. Note that to meet the requirements, 12° positive and 5° negative would not be considered less than ± 10°.

Picture effect: High differential

Set-tops: The user-friendly, revenue-generating interface

By Mark W. Happe
Product Manager, Domestic Set-Top Products
Zenith Electronics Corp.

The interface between the cable headend and the subscriber's TV set is essentially the set-top. To the subscriber, the set-top represents the cable company. The programming the subscriber watches is controlled through the use of this interface unit. As technology increases the power of the cable system, so does the complexity of its use. This complexity can lead to a subscriber who is an overwhelmed user, to one who gets so confused that he or she refuses to use it or worse yet for the cable operators, the loss of a subscriber. The importance of a user-friendly interface between the cable headend and the subscriber is paramount, particularly today as the "information superhighway" continues to evolve. Many new features and services are being offered to subscribers, including:

- Billing information
- Parental control (PC)
- Electronic program guides (EPG)
- Pay-per-view (PPV), impulse pay-per-view (IPPV)
- Favorite channel (FC)
- Sleep timer
- Sports scores
- Local shopping services
- Stock quotes
- Local, national weather
- Subscriber-selected AC outlet
- Messaging
- Telephony
- VCR programming
- Near video-on-demand (NVOD), video-on-demand (VOD)
- On-line services

Even for the highly technology-minded individual, this amount of service can be challenging. A user-friendly interface needs to be provided and this is accomplished through downloadable on-screen display (OSD) technology.

Downloadable

Downloadable refers to the ability of a system to dynamically load information from one location to another. Humans download information from handwritten notes to a computer via the keyboard. Another example is typing a report at home, copying this information to a floppy disk, taking the floppy disk to work and copying the updated report to your computer at work. The information at work was updated via a download of more current information from home.

In the cable system, certain information is updated in the headend and then the updated information is downloaded to all the connected and active set-tops in the cable system. This action allows dynamic changes to a system without a truck roll or subscriber participation.

Downloadability provides cable systems with various levels of flexibility. Flexibility at the system level includes the ability to change at any time the look of the OSD at the subscriber's set-top. The cable operator can change services with minimal effort. The subscriber has the flexibility to control the hardware and software that drives the set-top and the interfacing with the headend. The subscriber can choose different services on impulse.

Figure 1: Main menu with viewer guide highlighted

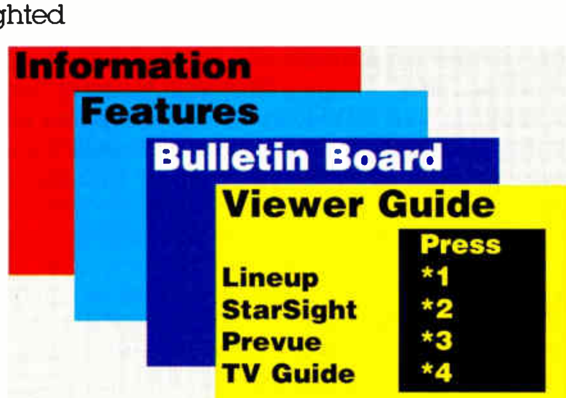
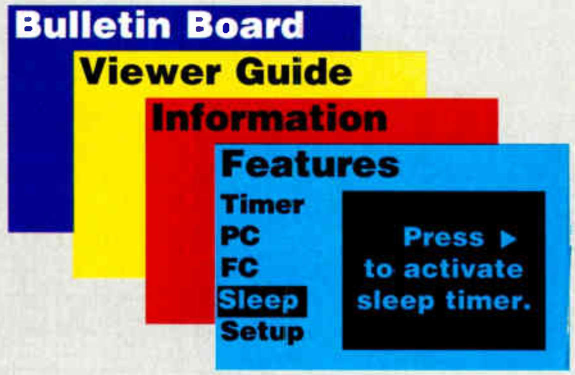


Figure 2: FC lineup with OSD

Figure 3: PC with OSD

Figure 4: Sleep option highlighted on main menu



On-screen display

OSDs are used in many consumer electronics products. Color TV sets and VCRs provide a wide range of OSDs. The OSD gives a visual representation of the control elements of the particular product. This visual element gives the subscriber a comfort factor. This translates into understanding and acceptance by the subscriber.

In cable, the OSD is a way of displaying the control of certain features of the set-top and providing simple menu access to information and services. The actual features are designed and manufactured into the set-tops. The services may or may not require interactivity with the headend. OSD allows subscribers to see the changes they make to the set-top's hardware or software (or both). Let's look at these features and changes and how they are enhanced and simplified by OSD.

VCR timer

A VCR programming feature allows the subscriber to set up recording of a specified channel by using the set-top. An external infrared (IR) transmitter is required. This IR transmitter connects to the set-top via a phono plug or other connector type. The other end has a small IR transmitter that the subscriber places near the recording VCR's IR receiver. The subscriber chooses a program to record by viewing it in the EPG.

In brief, the EPG is a downloadable program guide that the subscriber can navigate through various times and types of programming. A selection is made by highlighting the desired program and pressing the proper sequence of keys on the remote control. All the necessary information needed for recording is transmitted to the VCR via the external transmitter. The goal of this feature is to provide subscribers with a one-step recording of the desired program.

Prior to OSD control of this feature, the subscriber was required to tune the set-top to the desired channel and configure the VCR for recording. OSDs, advanced set-tops and EPGs provide the control to do all steps with one remote and one unit, the set-top. The benefits here are the ease of use, the visual representation of the program(s) being recorded and the fact that only one electronic device needs to be mastered by the subscriber. Figure 1 shows a viewer guide menu.

Favorite channel

FC is a feature that allows the subscriber (or cable operator) to select the channels that are scanned as the up or down arrow keys are pressed on the remote control unit or the set-top. The goal of FC is to give the subscriber the capability of scanning through a group of channels the subscriber deems entertaining. Subscribers may want to skip channels in order to scan just the ones they find the most useful or entertaining.

Prior to OSD, the subscriber used a series of tedious remote control or set-top key presses to affect an FC lineup. The only way for the subscriber to know what the FCs were was through the actual scanning of the channels. However, with OSD this feature becomes more readable and controllable and hence more acceptable.

The OSD of the FC lists each channel in the cable system. A check or other mark signifies the status of the channel as being on the FC list or not. The subscriber can select an FC by simply pressing the enter key or some other predefined sequence of key strokes. A channel can be removed from the list by the same method. The benefits of this type of system is the visual representation of the FC list. Additionally, the ease of selection makes this feature very subscriber-friendly. Figure 2 shows an actual line up and the channels selected for FC.

Parental control

PC is another option that works similar to the FC feature. However, a password is required to gain access to this option. The password can be set or reset by the subscriber or can be downloaded (for capable systems) from the cable headend. After the correct password is entered, the PC features screen opens. The remote control is used to select the channels to be locked out from viewing. The channel can be locked in the same manner. This allows the controller of the password to control what channels are allowed to be viewed.

The application here is obvious. It restricts programming for younger viewers. Prior to OSD, the subscriber had to use a key lock coupled with a series of set-top or remote key strokes, phone the main office or cause a truck roll to swap out, remove or insert traps. To determine what channels were blocked, a scan of all the channels was required. OSD shows all of the channels — those that are blocked and those that are not.

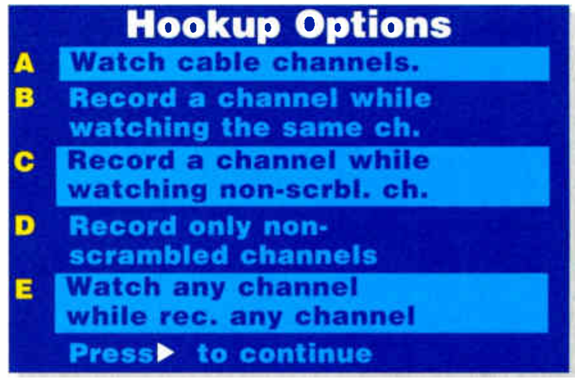
The OSD gives the subscriber the information all at a glance in a visual mode. Figure 3 shows the results of a PC screen with some channels blocked. Some are shown with locks and others are shown open for viewing with no locks.

Sleep timer

The sleep timer function allows the subscriber to schedule the TV set to shut off after a specified time. If the subscriber sets the timer for 30 minutes, then the TV set will shut off in 30

Figure 5: Sleep timer set on OSD

Figure 6: Hookup options on OSD



minutes. The goal of this feature is to allow the subscriber to turn off the TV set and set-top without being available to do it personally. An additional benefit is the one unit control. The subscriber does not need to worry about the setting of the TV set for sleep. It is all done through the set-top. This feature is relatively new to the set-top market.

The OSD will show the sleep timer screen and the subscriber enters the amount of time he wants the TV set to stay on. This feature allows subscribers to fall asleep with the TV set on and not worry about it being on all night. Figure 4 (page 81) shows the features menu with the sleep option highlighted and Figure 5 shows the sleep timer set for 30 minutes.

AC outlet control

The AC outlet on the set-top can be controlled with the newer set-tops. The goal of this feature is to eliminate the problems encountered with TV sets that have clocks and electronically stored information that is lost when the power is removed. The subscriber has not had this control before.

The OSD gives the subscriber a visual representation of choice between switched or unswitched power to the AC outlet on the set-top. Again, the benefit is the visual representation of the switch setting and the ease of controlling this feature. This feature is controlled through the use of the remote control. However, with the OSD the subscriber can see the status of the AC outlet by viewing the control screen for this option. This is a downloadable option as well.

Hookup diagrams

Hookup diagrams are a very handy feature for consumers, installers and field technicians. This feature allows the subscriber to view a particular hookup diagram for connectivity of various consumer electronics equipment with the set-top. In a cable system capable of downloading, the system operator can update and download these diagrams whenever necessary. The subscriber uses the remote control to select a hookup diagram type. From the TV screen the customer can draw the needed diagram or complete a hookup on another TV set from the display.

Prior to this, the subscribers had to call into the office and wait for a installer to come out and hook them up. This feature saves the cable company and the subscriber time and money. There are no service visits, no waiting for the service person or money expenditures for a simple VCR hookup or other diagrammed scenario. OSD gives the subscribers the diagram they need. Figure 6 shows the hookup options a subscriber has with this particular configuration and Figure 7 shows one of the actual diagrams. Remember, these diagrams can be added or altered via downloading from the headend.

Messaging

Messaging provides a message to the set-top where a message is generated in the headend and sent to the set-top. There are three categories of messages that can be transmitted: global, area and individual.

1) A global message is sent to all set-tops in a cable system. An example might be the upcoming community fair being held at the town square.

2) An area message is transmitted to set-tops in one area of the city. This messaging service is useful for planned maintenance in an area.

3) An individual message is sent to one particular set-top. This type of message might be a "happy birthday" message from a friend or a notice from the cable company that the subscriber's bill is past due.

The goal of this feature is to provide the cable operator with another revenue generator. It also provides the subscriber with a way to send messages to another in their service area. It provides the cable company with a way to provide customer service via messages.

OSD makes getting a message very easy. A small LED is illuminated on the front of a set-top when a message is pending. The subscriber presses the proper sequence of keys to access the messaging menu. It's that simple. All of these messaging schemes promote customer service and preserve or generate revenue.

Data

This feature allows the subscriber to access noninteractive low-rate data. A low-rate data channel is a low-bandwidth one that can be placed easily onto an existing cable system. Noninteractive indicates that the subscriber does not send information onto the network via a command. It's strictly one-way communication from the headend to the set-top. Some examples are text displays of local weather, national weather, sports scores and stock quotes. This feature gives the subscriber much more information than he previously had and gives the cable operator an opportunity for generating revenue.

Prior to OSD, the subscriber had to subscribe to a separate service for each of these services requiring hardwire hookups to the telephone company lines. With OSD, view-

The goal of this feature is to provide the subscriber with instant access to billing information.

ing sports or stock information is as easy as picking up the remote, pointing it at the TV set and pressing the required keys. This feature also gives the cable operator a chance to collect more revenue from the subscriber and gives the subscriber additional information with only one connection (the cable plant).

Rate information

The cable company can supply the subscriber with rate information via OSD menus. The subscriber chooses the screen designating the rate information screen with the remote control unit. The subscriber can look up the price (for example) for adding The Disney Channel, an additional outlet or a VCR hookup. The goal of this feature is to provide the subscriber with instant access to billing information. There are no more calls to the office or searching for a paper rate card as the subscriber has had to do in the past.

OSD provides a display of the service and the cost for the service on a page-by-page format. The subscriber uses the remote control keys to access the different service information pages. This allows him to know how much a particular service will cost. The cable company has less customer service calls because of this feature. This information can be a downloadable feature and thus the information can be changed whenever it needs to be. Figure 8 shows one page of the rate card. →

Figure 7: Example of connection diagram on OSD

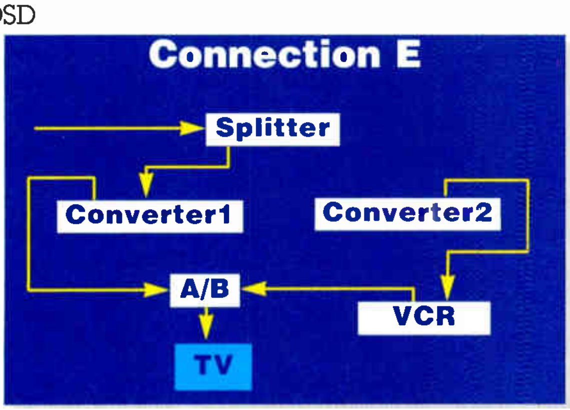


Figure 8: Rate card on OSD

Rates. Press ▶ for more	
Basic Cable	$ 8.87*
Basic Plus	18.50
WTBS/WGN	1.25
Standard Cable	11.23
HBO	12.50
Showtime	11.50
The Movie Ch.	5.95
Disney Channel	3.95
Cinemax	8.95
* Some cities may vary	

Figure 9: Bulletin board on OSD

Figure 10: Diagnostic screen on OSD

Shopping

This feature allows local merchants to advertise and sell their products on television for a significantly more economical cost. In this service the advertiser tells the cable company what he has for sale. The cable company personnel enter this information into the system and download that information to the set-tops. The subscriber chooses the shopping feature using the remote control. The subscriber can scan through the different companies and products listed until he finds something he likes. A subscriber can call the merchant up on the phone and order the item and have it mailed directly to his home. Another possibility is for the subscriber to order the product using the remote control.

This can be done on a two-way cable system. The subscriber would highlight the product to be purchased and press the buy button on the remote control. The order request would be sent to the headend. From there the request would be forwarded to the local merchant along with the needed information for delivering the sale. Payment could be COD or a credit card number that was delivered with the request.

The goal of this feature is to provide the cable operator with another revenue source. It also provides a high degree of subscriber satisfaction. A byproduct is the building of the local economy. Local merchants get business through a source they never had before. This feature was not available prior to the present generation of set-tops.

The remote control is used to access the shopping menu and the proper keys are pressed for the ordering.

"With the set-tops' downloadability, the functions and features are completely flexible, which leads to a happy subscriber through efficient menuing and feature implementation."

This feature allows the cable company to charge the subscriber for access and the advertiser for access. It allows the advertiser to sell his wares and the subscriber to purchase at home.

Event advertising

OSD provides an alternative to channel barkering to advertise for an upcoming event. Event advertising allows full screen advertising of a particular event. Some examples are a PPV fight, town meeting, community event or discounted HBO/Showtime package. This feature allows the subscriber to see information at a glance and the cable operator provides a service that may generate revenue.

Prior to OSD the only avenue for this type of advertising were barker channels. The OSD provides a second path for this information to be sent. Figure 9 shows the bulletin board menu with an advertised event displayed.

Diagnostics

Advanced set-tops have microprocessors inside them. These microprocessors perform many functions. One of these is diagnostics. OSD provides a way for the installer, technician or customer to examine what is going on in the set-top should a problem arise. Signal level, data reception, hardware characteristics and other important troubleshooting information can be easily viewed with the press of a button on the remote control.

OSD gives a visual picture of this kind of data. This enables the customer to contact the office with a problem and be able to offer some very important information. This added information can reduce truck rolls and save cable operators revenue. Figure 10 shows a diagnostics screen. Remember that this can be changed by downloading new information.

Summary

Subscribers and cable operators today have many needs. There's the need for user-friendly and user-affordable devices, the need for cable company-friendly devices, cable company-affordable devices, cable company revenue-generating opportunities and cost reductions. The solutions to these include: downloadability, OSD and advanced features control. These characteristics are part of some of today's set-tops.

With the set-tops' downloadability, the functions and features are completely flexible, which leads to a happy subscriber through efficient menuing and feature implementation. Service technicians' and installers' jobs are made fundamentally easier as well. The subscriber now has a visual picture of what the installer or technician is explaining to them. The customer service representative or telephone troubleshooter now have an additional tool in which to assist the subscriber with a problem. And, the cable operator has many more opportunities to generate new revenues. **BTB**

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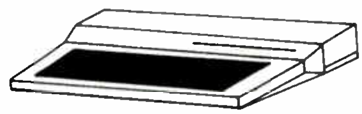

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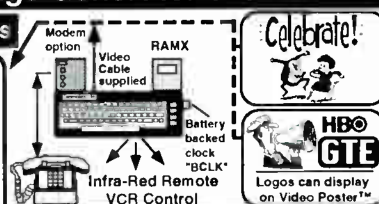

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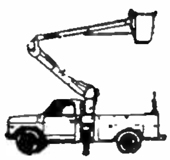
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02. ___ no

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16. ___ Advertising Agency
17. ___ Educational TV Station, School, or Library
18. ___ Other (please specify)____

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

19. ___ Corporate Management
20. ___ Management
21. ___ Programming

Technical/Engineering

22. ___ Vice President
23. ___ Director
24. ___ Manager
25. ___ Engineer
26. ___ Technician
27. ___ Installer
28. ___ Sales/Marketing
29. ___ Other (please specify)____

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

30. ___ Amplifiers
31. ___ Antennas
32. ___ CATV Passive Equipment including Coaxial Cable
33. ___ Cable Tools
34. ___ CAD Software, Mapping
35. ___ Commercial Insertion/ Character Generator
36. ___ Compression/Digital Equip.
37. ___ Computer Equipment
38. ___ Connectors/Splitters
39. ___ Fleet Management
40. ___ Headend Equipment
41. ___ Interactive Software
42. ___ Lightning Protection
43. ___ Vaults/Pedestals
44. ___ MMDS Transmission Equipment
45. ___ Microwave Equipment
46. ___ Receivers and Modulators
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48. ___ Satellite Equipment
49. ___ Subscriber/Addressable Security Equipment/ Converters/Remotes
50. ___ Telephone/PCS Equipment
51. ___ Power Suppls. (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
58. ___ Fiber-Optic Connectors
59. ___ Fiber-Optic Couplers/Splitters
60. ___ Fiber-Optic Splicers
61. ___ Fiber-Optic Transmitter/Receiver
62. ___ Fiber-Optic Patchcords/ Pigtails
63. ___ Fiber-Optic Components
64. ___ Fiber-Optic Cable
65. ___ Fiber-Optic Closures & Cabinets

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

66. ___ up to $50,000
67. ___ $50,001 to $100,000
68. ___ $100,001 to $250,000
69. ___ over $250,000

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

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

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

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

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

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

K. What is your annual cable services expenditure?

91. ___ up to $50,000
92. ___ $50,001 to $100,000
93. ___ $100,001 to $250,000
94. ___ over $250,000

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

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

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

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

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16	42	68	94	120	146	172	198	224	250	276	302
17	43	69	95	121	147	173	199	225	251	277	303
18	44	70	96	122	148	174	200	226	252	278	304
19	45	71	97	123	149	175	201	227	253	279	305
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22	48	74	100	126	152	178	204	230	256	282	308
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26	52	78	104	130	156	182	208	234	260	286	312

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

01. ___ yes
02. ___ no

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

Cable TV Systems Operations

03.___ Independent Cable TV Syst.
04.___ MSO (two or more Cable TV Systems)
05. ___ Cable TV Contractor
06. ___ Cable TV Program Network
07. ___ SMATV or DBS Operator
08. ___ MDS, STV or LPTV Operator
09. ___ Microwave or Telephone Comp.
10. ___ Commercial TV Broadcaster
11. ___ Cable TV Component Manufacturer
12. ___ Cable TV Investor
13. ___ Financial Institution, Broker, Consultant
14. ___ Law Firm or Govt. Agency
15. ___ Program Producer or Distributor
16. ___ Advertising Agency
17. ___ Educational TV Station, School, or Library
18. ___ Other (please specify)____

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

19. ___ Corporate Management
20. ___ Management
21. ___ Programming

Technical/Engineering

22. ___ Vice President
23. ___ Director
24. ___ Manager
25. ___ Engineer
26. ___ Technician
27. ___ Installer
28. ___ Sales/Marketing
29. ___ Other (please specify)____

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

30. ___ Amplifiers
31. ___ Antennas
32. ___ CATV Passive Equipment including Coaxial Cable
33. ___ Cable Tools
34. ___ CAD Software, Mapping
35. ___ Commercial Insertion/ Character Generator
36. ___ Compression/Digital Equip.
37. ___ Computer Equipment
38. ___ Connectors/Splitters
39. ___ Fleet Management
40. ___ Headend Equipment
41. ___ Interactive Software
42. ___ Lightning Protection
43. ___ Vaults/Pedestals
44. ___ MMDS Transmission Equipment
45. ___ Microwave Equipment
46. ___ Receivers and Modulators
47. ___ Safety Equipment
48. ___ Satellite Equipment
49. ___ Subscriber/Addressable Security Equipment/ Converters/Remotes
50. ___ Telephone/PCS Equipment
51. ___ Power Suppls. (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
58. ___ Fiber-Optic Connectors
59. ___ Fiber-Optic Couplers/Splitters
60. ___ Fiber-Optic Splicers
61. ___ Fiber-Optic Transmitter/Receiver
62. ___ Fiber-Optic Patchcords/ Pigtails
63. ___ Fiber-Optic Components
64. ___ Fiber-Optic Cable
65. ___ Fiber-Optic Closures & Cabinets

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

66. ___ up to $50,000
67. ___ $50,001 to $100,000
68. ___ $100,001 to $250,000
69. ___ over $250,000

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

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

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

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

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

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

K. What is your annual cable services expenditure?

91. ___ up to $50,000
92. ___ $50,001 to $100,000
93. ___ $100,001 to $250,000
94. ___ over $250,000

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

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

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

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

AD INDEX

It's so simple! To obtain additional information from any of the display advertisers appearing in this issue of ***Communications Technology***, please use one of the **Reader Service Cards** on the facing page (pass the others along). The ad index below has been expanded to include not only the page number of each advertiser, but also each corresponding reader service number to be circled on the **Reader Service Card**.

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Video testing

(Continued from page 85)

all times should a complaint arise. Although this specification is typically easy to meet, careful attention must be paid to in-channel frequency response.

Definition: Chrominance-to-luminance delay, also called chroma delay, is the measurement in time that the chrominance component of the video signal is delayed through the system, referenced to the luminance signal and stated in nanoseconds. The NTSC system M uses 170 ns precorrection.

Picture effect: Chroma-to-luma delay causes a misregistration in the color and luminance information in the picture. Picture distortions appear as color smearing or bleeding at the edges of objects in the picture. Sharp luminance transitions also may become fuzzy.

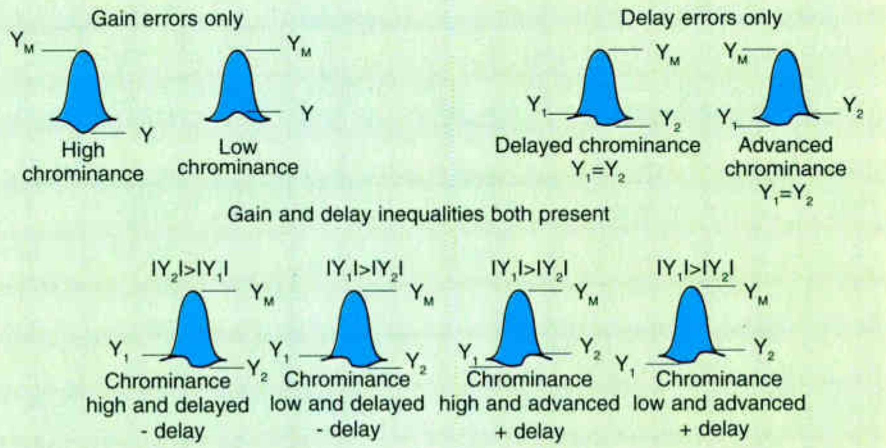
Measurement procedure: The total chroma-to-luma delay includes the effects of the headend processing equipment (demodulators, descramblers, encoders, video switches, modulators, etc.). If the programmer supplies a VITS that you will use to test your system you will want to measure the delay at the satellite receiver and subtract the delay from the total system delay measurement. This may not be necessary if you pass the FCC requirements without this calculation since it is unlikely that the uplink and satellite receiver will "help" your system, but they definitely will contribute to errors.

If you use the programmers' test signals and fail the test by a small margin (or get marginal results), measuring the satellite receiver output and subtracting these measurements from the system measurements will give you a better measure of your system performance.

Remember to subtract vectorially. If the satellite receiver output measures - 50 ns and the total system measures 100 ns, then the actual system performance is 150 ns. In addition, chroma-to-luma gain inequality will limit the ability to measure chroma-to-luma delay. Amplitude inequality of 2 dB will limit the minimum delay measurement to 50 ns. This is a good case for inserting your own test signals.

To measure the chroma-to-luma delay of a channel without interference to the system's operation you will need to insert a VITS in the VBI of the channel to be tested. This should be done at the satellite receiver output or the encoder if used. Note the insertion diagram in Figure 27 on page 83.

Figure 30: C/L delay sign and convention



Use the FCC composite test signal with a modulated 12.5T sine squared pulse in the VITS shown in Figure 28 on page 84. Be sure that the test signal chosen is compatible with the measurement device and the equipment under test.

Modulators and demodulators generally contribute most of the chroma-to-luma delay to any system. Strip amps and processors also can contribute to chroma-to-luma delay, as can defective over-the-air antennas, preamps and bandpass filters. Filters and traps used to reduce TI, prevent pre-amp, overload, separate broadcast signals, etc., are the second most common cause of chroma-to-luma delay. Video switching and commercial insertion equipment typically contribute very little chroma-to-luma delay. Any part of the signal path — baseband or RF — that affects in-channel frequency response can cause C-L delay.

Procedure:

1) Connect the test equipment as shown in Figure 27.

2) Test signal generator setup:

a) Connect the signal insertion device or loop-through as required.

b) Select the VITS insertion mode.

c) Select the desired test signal.

d) Connect to the insertion device, enable the generator output.

e) Using the CATV video signal analyzer, verify the test signal insertion.

3) Demodulator setup:

a) Tune to the channel to be tested.

b) Use the synchronous detector mode.

c) Be sure the "zero carrier reference" mode is turned off.

d) Turn on the demodulator's "sound trap" if a switch is provided.

4) CATV video signal analyzer setup:

a) Check the Cal signal and be sure the display gain and vertical position controls are properly set.

b) Set the line select to the line and field where the VITS is inserted.

c) Select the 1 H mode so that one horizontal line is displayed and expand the horizontal so that the 12.5T pulse covers approximately one-fourth of the horizontal display.

d) Measure the % mod to be sure that the % mod is set at 87.5% or slightly under.

5) Press the C-L delay key and read the display for the chroma-to-luma delay in ns.

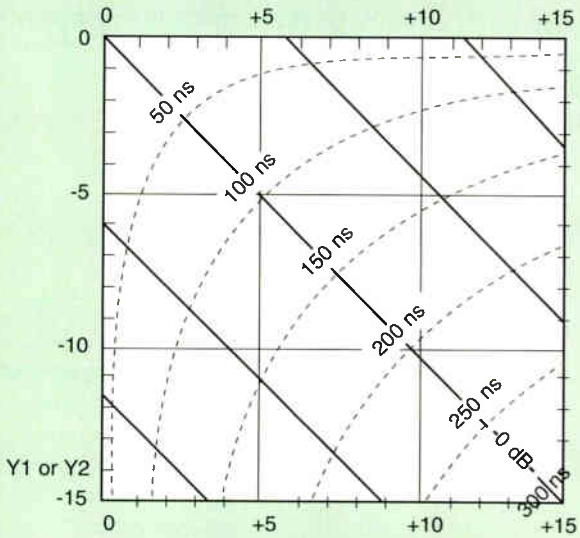
Or, for manual measurements (Figure 29 on page 85):

a) Adjust the vertical gain so that the 12.5T pulse is 100 IRE on the display and the baseline is on the 0 IRE graticule.

b) Note the bottom peaks of the 12.5T pulse, measure the maximum variations above and below the 0 IRE reference. Gain distortions are indicated by variations above or below the 0 IRE reference.

c) Delay distortions are indicated by equal variations above and below the 0 IRE reference. Unequal variations indicate both gain and delay distortions.

Figure 31: Chroma-to-luma delay nomograph



d) Assign the first half of the pulse's base line the variable Y1 and the second half the variable Y2, then apply the chart in Figure 30 to determine the sign for the measurement result.

e) After determining the value for Y1 and Y2, use the nomograph (Figure 31) or the equation below to calculate the chroma-to-luma delay.

$$\text{C-L delay} = 20\sqrt{(Y1 \times Y2)}$$

If multiple positive or negative going peaks are displayed, harmonic distortion is present and this procedure may be erroneous. No other method is recommended. Any distortion problem must be resolved prior to making the C-L delay measurement.

6) If unacceptable measurements result, troubleshoot the system back up the video path using the CATV video signal analyzer. Be sure to remove the feedthrough terminator where appropriate.

Precautions:

1) Remember that if you are switching video sources or using commercial insertion equipment that you will want to include these items in your analysis of system performance to comply with the FCC requirement to test channels "typical" of those on your system.

2) Set the % mod at 83% to 85% on all channels.

3) Be sure that the satellite receiver output, and all other video sources used for that channel are set for 1 V. Changing the input level to the modulator will change the % mod on most modulators.

4) Permanently install an insertion device in each channel's video path at the output of the satellite receiver so that test signals may be injected without interrupting the channel. Be sure that only a single 75 ohm termination exists on each video line.

5) Also, install a "T" at the input to any device in the video path of each channel. This provides troubleshooting test points without interrupting the channel. Be sure that only a single 75 ohm termination exists on each video line.

6) Before connecting the CATV video signal analyzer to any test point, be sure that it is in the high impedance mode (not using the feedthrough terminator). **CT**

TDR waveform storage

Riser-Bond Instruments' Model 1220 time domain reflectometer (TDR) cable fault locator now offers the company's Super-Store waveform storage that provides 1,500 times more storage and comparison information of the waveform than competitive TDR storage techniques, according to the company. With this feature, the horizontal resolution of the liquid crystal display is 3,000 to 12,000 samples per waveform. The vertical resolution is a minimum of 14 bits.

The entire waveform, both on- and off-screen, is stored for maximum versatility and resolution. All of the waveform specifications, such as VOP and cable impedance, are stored. Four waveform storage bins are standard on the unit, with the option of 16 total bins.

Once stored, a waveform selection can be enlarged to see small details that may not be visible at normal zoom levels. The user can view different sections of the waveform at any zoom level without switching between different waveform storage bins.

The TDR is ultra sensitive for locating minor faults. A high sensitivity and multiple pulse widths package, formerly available as an option, is now standard.

An on-board printer yields immediate documentation of the waveform. An optional RS-232 port provides downloading capability of stored information to a PC for comparison, manipulation, analysis and documentation. Wave-View software is included with the RS-232 option.

Reader service #208

Interactive service

Advanced Digital TeleCorp Inc. (ADT) introduced a low-cost interactive TV service. The demonstration phase of this new system for delivering information services to homes and businesses, utilizes the vertical blanking interval of a TV signal. The demonstration is being conducted in conjunction with WNET, the Public Broadcasting System station in the New York metropolitan area.

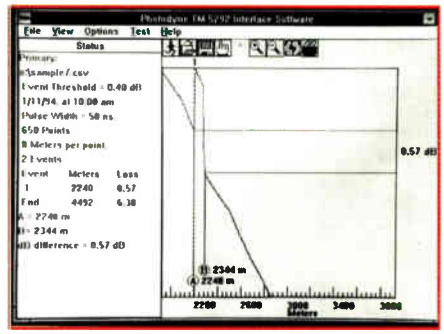
Beta testing has shown the system's versatility in delivering a medical service, financial service, video ordering service, news, weather, sports and local educational information. The system can direct any piece of information or service to a selected group of users, or even a specific user. Also, it can deliver an information service designed for general use or only for subscribers.

The system utilizes the vertical blanking interval of a TV signal to deliver the transmission to the Teledata Recorder, a smart receiver developed by ADT. The unit, which is about the size of a VCR, uses a chip developed jointly with ITT Intermetall in Germany. The unit is hooked up to a TV set where a custom remote control unit provides the user with access to the menu and various information screens. It also includes a feature that allows users to receive only topics of interest and filter out those of no interest.

Because information is transmitted over a TV signal, the information delivery cost is the same for 10,000 users as it is for 1 million, thereby making the system very cost-effective. Most of the time the user will not incur costs such as connect time, telephone charges or usage fees, unless a specific database application is used. The receiver also can be linked to a computer peripheral such as a printer. With a printer attached, it can be used to deliver coupons to consumers.

One of the many features of the receiver is its support for multilingual services. A service may be delivered in English or Spanish. The user can specify language preference. The unit can support up to 37 European languages, plus Russian.

Reader service #207



Fault finder software

3M Telecom Systems Division now offers Photodyne brand 5292 interface software, an enhancement package for the Photodyne 5242XF optical fault finder, enabling the low-cost, rugged test equipment to perform optical time domain reflectometer (OTDR)-type analysis during installation, maintenance and restoration of fiber-optic cable networks.

The software permits the fault finder to shoot and record traces on an IBM-compatible personal computer, connected via the RS-232 serial ports. This allows the operator to execute real-time and historical analysis of traces, store the data, and provide documentation of traces while retaining the ability to perform rapid analysis and comparison of fiber-optic cable faults. There also is an optional printer that lets trace graphics be printed directly from the display.

The information superhighway will result in a tremendous need for rapid, economical fault location, according to the company. This software package is said to give contractors and telco installation/maintenance crews a powerful and economical tool for fault location and analysis.

Reader service #206

Cable winch

Broyhill Manufacturing Co. introduced Cable Winch System, designed to improve manpower utilization and productivity and provide incomparable protection from cable overtensioning. Accessory kits facilitate rigging for aerial or underground winching. The sophisticated design provides for quick and easy setup in urban and rural construction. A single worker can set up safely and monitor winch operation.

Features include pulling speed coordination for multiple assist winches that occurs on demand, automatically following the end puller. The Auto-Lube System automatically reapplies cable lubricant at the recommended rate. As cable pulling speed changes, so does the cable lubricant delivery rate. If the cable stops, so does the pump, thereby reducing waste.

A unique force sensing system measures the total pulling force applied to the cable. The winch controller processes actual cable tension. The proprietary cable tension monitoring assembly prevents the transferral of pulling force from upstream winches to the cable.

Reader service #201

Power meters

Photon Kinetics introduced the 7100 Series fiber-optic power meters, part of a new line of rugged hand-held fiber-optic test and measurement equipment. The units are designed to measure the absolute power of light from a fiber-optic cable. The meters feature simple two-button operation and a large LCD display. The unit is ideal for telecom and datacom operations, and has a measurement range of +5 to -60 dBm.

The 7100C is specifically designed for CATV applications, as well as applications where measurement of high-powered sources is needed. Its measurement range is +20 to -35 dBm. The unit can operate either with rechargeable batteries, alkaline batteries or with the AC charger/adapter.

Reader service #205

Coaxial crimping kit

RF Industries Ltd. announced the RFA-4005 and RFA-4006 crimping tool and die kits. The RFA-4005 is supplied with one crimping tool frame and a die set used to crimp RG58 and 59U, RG142/U as well as RG8X, proflex and various video cables. This die features a .052-inch hex cavity to crimp mini UHF connector center pins and is the only die of its type, according to the company.

The kit also is supplied with a die set used to crimp RG8/U, RG213/U and RG214/U cables as well as the ferrule and center pin on Belden 9913 cable. The company says the .125-inch center pin cavity for 9913 cable also is the only die of its type in the industry. The RFA-4006 is identical to the RFA-4005, except that it comes with two crimping tool frames rather than one.

Reader service #203

Test instrument

The 1100 Series self-contained, combination waveform monitor, oscilloscope and vectorscope available for NTSC or PAL applications was introduced by CompuVideo Inc. The multifunctional instrument is designed for use in EFP/ENG operations, satellite communications, TV and cable TV stations, video editing studios and computer workstations.

The unit supports composite, component and S-VHS video signals while providing easy measurement capabilities with waveform overlays and on-screen timing references. It also features differential gain and phase, plus line select for monitoring and analysis of signals as required by FCC regulations. The vectorscope/waveform section offers display Lines 14 through 21 in Fields 1, 2. The built-in oscilloscope section permits the user to troubleshoot and analyze any signals including those from video heads, audio heads, stereo, audio, head switching and servo.

Reader service #204

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.

☛ *Video Signals and Their Measurement* — This four-hour seminar features instructors from Tektronix and provides an in-depth discussion of baseband video signals and their components, proper usage of video test equipment and recommended procedures for making measurements. (4 hrs.) Order #T-1022, $95. **(Reference for BCT/E Category II)**

☛ *dBs and dBmVs* — Veteran instructor Richard Covell discusses the mathematical theory behind the decibel and its use in basic engineering calculations. System performance measurements also are covered during this seminar. (1-1/2 hrs.) Order #T-1023, $45. **(Reference for BCT/E Category IV)**

☛ *Choosing Advanced Amplifiers for Your Cable Television System* — Herb Longware discusses the theories behind push-pull, feedforward and power doubling amplifier technologies. These three technologies are then evaluated as to their advantages or disadvantages in a wide variety of plant design applications. (30 min.) Order #T-1026, $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 or book. 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 (page 76) 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."

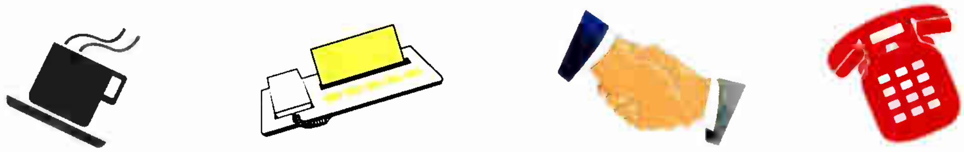
Reader Service Number 74

The International Lounge at The Western Cable Show '94
November 30 through December 2, 1994
Anaheim Hilton Hotel, Anaheim, California

WELCOME INTERNATIONAL DELEGATES!

International Cable magazine and the California Cable Television Association cordially invite you to join us in "The International Lounge" to be held in the Anaheim Hilton Hotel during the Western Cable Show. The Western Show is one of the largest cable shows in the U.S. drawing more than 15,000 attendees and over 250 exhibitors.

The lounge will offer business center services, phones and fax machines, convenient meeting and relaxing space, special events, translation services and complimentary food and beverages throughout each day to international delegates at the show.



INTERNATIONAL LOUNGE SPONSORSHIPS

A limited number of sponsorships are available for the International Lounge. A lounge sponsorship offers companies that are involved in, or developing, international business a wide variety of benefits including the opportunity to meet international delegates face-to-face off the show floor, the services of the lounge, convenient space for conducting business meetings, access to translation and secretarial services and much more.

Sponsorship increases your visibility at this important show in a number of ways. Your company logo is prominently displayed on international delegate registration bags, advertising, promotions and signage for the International Lounge. Additionally, special events in the lounge are hosted by sponsor companies.

INTERNATIONAL CABLE
Magazine

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at International Cable.

Telephone +1-303-839-1565 or
Facsimile +1-303-839-1564.

FASTEN YOUR SEAT BELTS
94
THE WESTERN SHOW

CALENDAR

October

3-6: Atlantic Cable Show, Atlantic City, NJ. Contact Wayne O'Dell, (410) 266-9111.
3-6: Philips Mobile Training Center, Cincinnati. Contact (800) 448-5171.
4: Hewlett-Packard CATV Measurements Course, Charleston, WV. Contact (800) 472-5277.
4-5: Tektronix cable TV measurement seminar, Raleigh, NC. Contact Kathy Richards, (503) 627-1555.
4-6: SCTE Wheat State Chapter seminar, BCT/E exams to be administered, Wichita, KS. Contact Jim Fronk, (316) 792-2574.
5: SCTE Ark-La-Tex Chapter seminar, new technologies, Shreveport, LA. Contact Randy Berry, (318) 238-1361.
5: SCTE Badger State Chapter seminar, amplifier technology, roundtable discussions and Cable Games also will be held, Holiday Inn, Fond du Lac, WI. Contact Brian Revak, (608) 372-2999.
5-6: Tektronix cable TV measurement seminar, Chicago. Contact Kathy Richards, (503) 627-1555.
5-7: Pacific Northwest Cable Show, Spokane, WA. Contact (612) 641-0268.
6: SCTE Gateway Chapter seminar. Contact Duane Johnson, (314) 272-2020.
6-7: Tektronix cable TV measurement seminar, Minneapolis. Contact Kathy Richards, (503) 627-1555.
10-13 Philips Mobile Training Center, Raleigh, NC. Contact (800) 448-5171.
11: SCTE Heart of America Chapter meeting at the Mid-America Show, BCT/E exams to be administered, Kansas City, MO. Contact David Clark, (913) 599-5900.
11: SCTE Southeast Texas Chapter seminar, Installer and BCT/E exams to be administered, Warner Cable office, Houston. Contact Rosa Rosas, (409) 582-4855.
11-12: General Instrument Cable Insights seminar for nontechnical cable and related industry personnel, the Carlton Hotel, Washington, DC. Contact Joanne Haire, (215) 956-6501.
11-13: Mid-America Cable Show, Kansas City Merchandise Mart and Convention Center, Overland Park, KS. Contact Mid-America Cable TV Association, (913) 841-9241.
12: SCTE Coastal Carolina Meeting Group seminar, Holiday Inn, Kingston, NC. Contact Larry Huffman, (919) 353-3500.
12: SCTE Delaware Valley Chapter seminar, fiber-optic technologies, Williamson Restaurant, Willow Grove, PA. Contact Bob Lauer, (215) 876-5000.
13: Society of Cable Television Engineers Satellite Tele-Seminar Program, *An Overview of the Society's BCT/E Program, Part 2*, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. EDT. Contact SCTE national headquarters, (610) 363-6888.
13: SCTE Heart of America Chapter seminar, Kansas City, MO. Contact Dave Clark, (913) 599-5900.
17-19: Society of Cable Television Engineers Technology for Technicians II hands-on technical training program for broadband industry technicians and system engineers, Columbia, SC. Contact SCTE national headquarters, (610) 363-6888.
17-20: Philips Mobile Training Center, Harrisburg, PA. Contact (800) 448-5171.
17-20: Siecor fiber-optic training course, Hickory, NC. Contact (800) 743-2671, ext. 5539 or 5560.
18-19: Tektronix cable TV measurement seminar, Boston. Contact Kathy Richards, (503) 627-1555.
19: SCTE Big Sky Chapter seminar, BCT/E and Installer exams to be administered, Locomotive Casino/Restaurant, Laurel, MT. Contact Marla DeShaw, (406) 632-4300.
19: SCTE Central Florida Chapter seminar, terminal devices, Lakeland, FL. Contact Pam Kernodle, (813) 371-3444.
19: SCTE Dakota Territories Chapter Installer seminar, Watertown, SD. Contact Michael Schmit, (605) 229-1775.
19-20: Tektronix cable TV measurement seminar, New York. Contact Kathy Richards, (503) 627-1555.
20: Society of Cable Television Engineers OSHA/Safety Seminar for system managers and safety coordinators on maintaining records and developing safety training programs, Columbia, SC. Contact SCTE national headquarters, (610) 363-6888.
20: SCTE Big Sky Chapter seminar, BCT/E and Installer exams to be administered, Elks Lodge, Helena, MT. Contact Marla DeShaw, (406) 632-4300.
20: SCTE Dakota Territories Chapter Installer seminar, Fargo, ND. Contact Michael Schmit, (605) 229-1775.
20: SCTE New Jersey Chapter seminar, network architecture, Wayne, NJ. Contact Linda Lotti, (908) 446-3612.
20-21: Tektronix cable TV measurement seminar, Washington, DC. Contact Kathy Richards, (503) 627-1555.
20-21: Cable Television Operators of Oklahoma annual meeting, Oak Tree Country Club, Oklahoma City. Contact (405) 843-8855.
22: SCTE Miss-Lou Chapter meeting, Slidell, LA. Contact Gary Vidrine, (504) 295-1197.
24-27: Philips Mobile Training Center, Boston. Contact (800) 448-5171.
26: SCTE Miss/Lou Chapter seminar, Ramada Inn, Slidell, LA. Contact Dave Matthews, (504) 923-0256, ext. 309.
Oct. 31-Nov. 3: Philips Mobile Training Center, Calais, ME. Contact (800) 448-5171.

November

6-7: SCTE Old Dominion Chapter seminar, BCT/E Category II, audio and video signals and systems review, headend and earth station review, Installer and BCT/E exams to be administered, Holiday Inn, Richmond, VA. Contact Maggie Fitzgerald, (703) 248-3400.
7-9: Society of Cable Television Engineers Technology for Technicians II Seminar hands-on technical training program for broadband industry technicians and system engineers, Nashville, TN. Contact SCTE national headquarters, (610) 363-6888.
7-10: Philips Mobile Training Center, Syracuse, NY. Contact (800) 448-5171.
7-10: Siecor fiber-optic training course, Hickory, NC. Contact (800) 743-2671, ext. 5539 or 5560.
8: SCTE Cascade Range Chapter meeting. Contact Cynthia Stokes, (503) 230-2099.

Planning ahead

Nov. 13-15: Private Cable Show, Atlanta. Contact (713) 342-9826.
Nov. 30-Dec. 2: Western Cable Show, Anaheim, CA. Contact (510) 428-2225.
Jan. 4-6, 1995: Society of Cable Television Engineers Emerging Technologies conference, Orlando, FL. Contact (610) 363-6888.
Feb. 26-Mar. 3, 1995: OFC '95, San Diego, CA. Contact (202) 223-0920.

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Cable TV: The ideal PCS applicant?

If you would like to speak to the author of this column, he can be reached at (202) 728-0001.

By Thomas K. Crowe, Esq.
Communications Attorney
Irwin, Campbell & Crowe, P.C.

Personal communications services (PCS) may present cable TV system operators with their best opportunity to date to enter the telecommunications marketplace and to take advantage of their existing infrastructure and capabilities to generate new revenues in the process. This opportunity is made possible by the recent actions of the Federal Communications Commission, which has adopted a spectrum allocation plan and rules for the new service as well as rules for the auction of that spectrum.

PCS defined

PCS can be defined as a family of mobile or portable digital radio communications services that may be provided to individuals or businesses, and be interconnected with competing networks to allow communications by individuals on a person-to-person (rather than the traditional station-to-station) basis. The largest allocation of spectrum by the FCC — a total of 120 MHz of spectrum in the 1,850 to 1,990 MHz range — was for broadband PCS, which is suitable for voice and data applications. In addition, the FCC allocated 3 MHz of spectrum in the 900 MHz range for narrowband PCS, which is expected to be used for advanced paging and two-way data applications. As well, 20 MHz of spectrum from 1,910 to 1,930 MHz is for unlicensed PCS devices.

Cable's role

Considering the capacity of the PCS spectrum and the broad definition of the service, CATV operators may be in

a unique competitive position to combine a PCS license with the capabilities of their existing network to offer telecommunications services. With PCS, CATV operators could be very competitive with cellular, paging and other service providers in meeting the rapidly growing mobile communications needs of the public and perhaps even offer local telephone service and access to long distance services in competition with the local telephone companies.

And even though competition in the local loop is precluded by statute or regulation in most states today, PCS and other wireless services may offer the means for removing the main obstacle to lifting such restrictions. That is, the issue of universal service. With the potentially broad capacity of their networks and the option of a wireless "last-mile" to subscribers, wireless providers such as PCS licensees could guarantee universal service to the public, thereby effectively removing the strongest argument for a local service monopoly.

Entrepreneurs' block

CATV operators interested in bidding for a PCS license would likely have several advantages over any competing bidders. For instance, CATV operators could use their existing coaxial or fiber-optic cable networks to connect PCS base stations and antennas to central locations for control and switching. CATV operators have skilled personnel for the installation and maintenance of PCS equipment and for customer service, as well as support systems for service orders, maintenance or repair and billing and collections. These core competencies may transfer well to the operation of a PCS system. Finally, CATV operators may have better access to the necessary capital than many competing bidders, especially if they are eligible to bid for certain PCS licenses set aside in what the FCC has defined as the entrepreneurs' block.

Broadband PCS licenses will be awarded by auction, with licenses available in 493 basic trading areas (BTAs), which typically consist of several counties, and 51 major trading areas (MTAs), which overlap and consist of two or more BTAs. The FCC will first auction two 30 MHz licenses on an MTA basis, followed by the auction of one 30 MHz and one 10 MHz licenses — the entrepreneurs' block licenses — on a BTA basis, and finally the auction of the remaining two 10 MHz BTA licenses.

The FCC limited eligibility to bid on the entrepreneurs' block licenses to applicants with less than $125 million in gross revenues and $500 million in total assets in order to broaden participation in PCS beyond the traditional large telecommunications companies, such as the regional Bell operating companies (RBOCs). This limitation may be a tremendous advantage for CATV operators that satisfy the eligibility criteria, especially considering their existing capabilities as compared to other potential entrepreneurs' block bidders.

In addition to limiting eligibility to bid on the entrepreneurs' block, for those licenses the FCC adopted preferences for certain entities designated by Congress. Namely, that's small businesses, women-owned and minority-owned businesses and rural telephone companies (commonly referred to as SWMRs). CATV operators that qualify as SWMRs are eligible for attractive preferences. The preferences include bidding credits for small, women-owned and/or minority-owned businesses; installment payment plans with favorable interest rates and terms for all entrepreneurs; relaxation of the rules for attributing ownership interests in, and therefore in aggregating the revenues and assets of, the applicant; tax certificates, which allow for the nonrecognition of capital gains by investors in women- and/or minority-owned applicants; and the ability for rural telephone companies to partition a PCS license to create a separate license for their telephone service area.

Time is of the essence for parties interested in pursuing a PCS license. The FCC has stated that it will begin auctioning broadband PCS licenses in November or December of this year, which may require the filing of an application, including a description of the ownership of the bidder, as early as now.

However, much planning is required prior to the filing of such an application. A business plan should be prepared, arrangements for financing must be made, and the ownership structure finalized, among other tasks. Even though well-positioned to compete, CATV operators would be well-advised to conduct such business planning steps well in advance of an auction to ensure the profitable use of any PCS license acquired. **CT**

The author was assisted in preparing this column by Jeffrey L. Timmons, an associate with Irwin, Campbell & Crowe.

Installer certification still a high priority

By Bill Riker
President, Society of Cable Television Engineers

I am pleased to report that SCTE has recently certified one of the highest numbers of CATV installers within a six-month period. With this in mind, I would like to tell you more about the Society's Installer Certification Program.

Since its inception in 1989, the goal of our Installer Certification Program has been to establish minimum skill requirements for installers and installer/technicians working in the cable TV industry.

Our program consists of training conducted by local chapters and meeting groups using the *SCTE Installer Manual* as the basis for classroom training as well as hands-on training. Actual certification testing to measure competency consists of one written examination and two practical examinations.

The written examination is comprised of 50 questions that measure the knowledge and understanding of the job. Our practical examinations measure the demonstrated skills needed to be a thorough, quality-oriented Installer. The areas covered under the practical examination are "proper drop cable preparation and connector installation" and "signal level meter reading."

Benefits of membership

Installers and installer/technicians applying for certification are charged a fee of $25 that entitles them to one full year's Installer membership in SCTE. This fee also provides them with the *Installer Manual* and the initial certification examinations. Renewal of annual dues at the Installer level of SCTE membership is $20.

Installer membership is an educational opportunity as well as a support system for our industry's installers. Membership at this level entitles individual installers to all of the discounts afforded SCTE members at our meetings, seminars and conferences. Discounts also are available on all SCTE products, publications, materials and videotapes sold by the Society.

In addition, through SCTE, installers have the opportunity to participate in local meetings with those that have been in the industry for years. This is the most beneficial course of action a new installer can take.

SCTE chapters and meeting groups are an enormous support system for the installer applying for certification. The individual chapters provide classroom training as well as direct, practical training. Once training is complete, testing may begin, but only if overseen by a qualified SCTE proctor. Installers will be able to take certification exams through their local SCTE group, that is in turn guided and directed by SCTE national headquarters.

Upon completing the exams, our Installer Certification department will grade the tests and process all information that has been forwarded. The results, and any certificates due, will be returned within 30 days. An installer awarded certification will then receive an endorsement on his next membership card indicating his certification by the Society. He also will receive a personalized name tag indicating to subscribers and fellow employees alike that he is a SCTE certified installer.

In order to reimburse groups for their training and testing efforts, each local chapter receives a $5 check for each candidate fully certified through their group. This funding serves to help chapters put forth the needed training with quality and professionalism in mind.

Our Installer Certification Rebate Program is just another way SCTE is supporting its members. Through the rebate program, the Society is able to show our appreciation for the time, expense and effort made by members of the local groups. Additionally, chapter and meeting groups may utilize the rebates to expand education and training tools for its members. SCTE has readily available a full library of videotapes focusing upon the industry. The Society also offers a wide variety of training manuals and handbooks that cover topics of interest for the installer, technician and supervisor alike.

Companies involved

We would like to recognize each of the companies whose employees have been certified in the Installer Program between Jan. 1-June 30, 1994:

Adderley Industries, Adelphia Cable Communications, Alexandersen & Sons, Alleghaney County Cablevision, Arvig Telephone Communications, Baker Installations, Bayside Telecom, C-Tec Cable Systems, C&D Installations, Cable Express, Cablecom, Cablevision, Capitol Cablevision, Charlottesville Quality Cable, Colony Cablevision, Columbia Cable of Oregon, Columbine Cablevision, Concord TV Cable, Continental Cablevision, Cox Cable, DHS Cablevision, Daniels Cablevision, Desert Cablevision, Donrey Cablevision, DuCom Inc., Harron Cable TV, Inland Valley Cablevision, Interlake Cablevision, Intermedia Partners, JBN Cable, Jones Cablevision, K&L Cable, K&L Quality Installation, King Videocable, Lakewood Cable, Marcus Cable, Merideth Cable, Midco Cable, Midcontinent Cable TV, Midwest Cablevision, Multimedia Cablevision, Palmer Cablevision, Palmetto Cablevision, Paragon Cable, Preferred Cable, Preferred Services Corp.. Prime Cable, Prime Time Cable of Houston, Queens Cable Contractors, RTK Corp., Rankin County Cable, River Raisin Cablevision, SRS Communications Corp., Sammons Communications, Simmons CATV, Southbay Cablevision, Spectrum Cable Services, Star Cablevision, TCI Cablevision, TVC, Tennessee Valley Cablevision, Time Warner Cable, Tuscan Cablevision, Tucson Cablevision, United Artists Cable, United Video Cablevision and Viacom Cablevision.

I would like to commend all of the newly certified installers, and the companies for which they work, on a job well done. We at SCTE look forward to continuing to provide the most advanced, proficient technological education methods, practices and procedures for the ever-changing industry. **CT**