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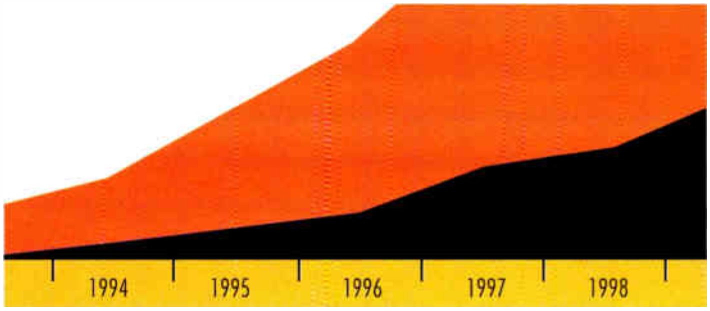
July 1995

DEPARTMENTS



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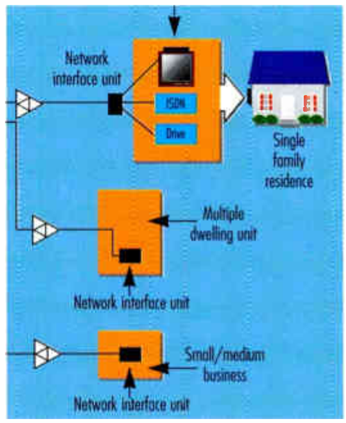

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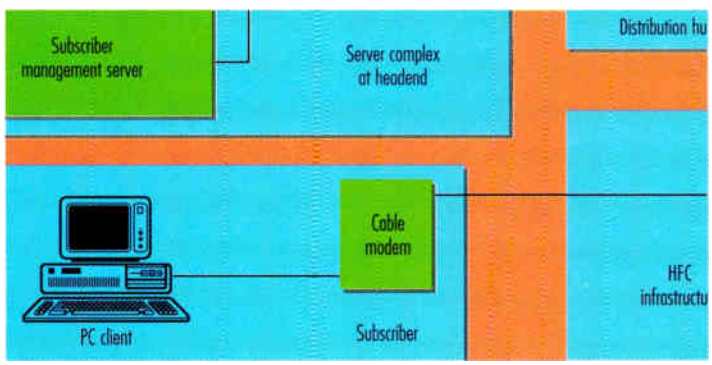

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FEATURES

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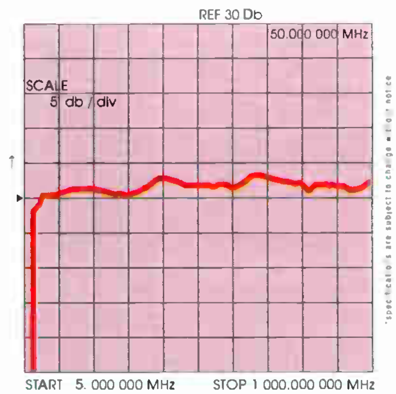

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77	+20 dBmV	+50 dBmV	-55	-50	-50

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Reader Service Number 111

EDITOR'S LETTER

Data-ready cable

I'm a firm believer that data communications will be a significant revenue source for the cable industry. In particular, PC-based data communications via high-speed coax modems will likely be a bigger boost to our pocketbooks than will video-on-demand (VOD) or possibly even telephony. In the home market, for example, I've heard estimates ranging from 28% to 37% of households now have a personal computer. (The variation in these figures comes from the fact that some studies have difficulty accurately accounting for replacement computers or multiple computers in many homes.) Online services are enjoying unprecedented growth and activity on the Internet shows no sign of doing anything but increasing.

The problem is that most of us who use our computers to connect to the outside world are faced with a bottleneck known as the telco twisted-pair. Even using 28.8 kbps modems — rockets compared to their 300 or 2,400 bps ancestors — are painfully slow when transferring large files. ISDN is an option, but just try to get your local telephone company to provide ISDN service at your home within your lifetime. One solution? Data communications over our broadband networks.

Several companies are proposing asymmetrical data transmission formats for cable. This means that the downstream data might be something like 10 Mbps, and the upstream a much lower rate of, say, 96 kbps. The lower upstream rate would be to accommodate the smaller bandwidth available in our upstream spectrum. But to be successful, we have two major obstacles to overcome.

The first is getting our systems to work reliably in a full two-way configuration. It can be done and requires a fiber-rich architecture with moderately small nodes; good construction and maintenance practices to ensure a high-quality and RF-tight outside plant; and high-quality drop installations to minimize ingress problems. There are various other technical and operational considerations, such as data modulation schemes, operating frequencies, data traffic management, node segmentation, subscriber education, etc., but the point is we can make two-way data communications work.

The second obstacle is more marketing-related. In other words, we'll have to get the word out to the computing public that our broadband networks will be a superior alternative to the existing twisted-pair. This will involve some sort of national media promotion, as well as access via our systems to the Internet and the major online services.

I think we also need to consider such things as joint ventures or marketing agreements with computer and software manufacturers. This would allow us to effectively bundle coax-compatible modems and companion software in PC packages, much like Microsoft does now with Windows. After all, it's pretty hard to buy a PC today that doesn't include Windows, a 9.6 or 14.4 kbps modem, and a bunch of other software already preinstalled on the hard disk. So why not also include a cable modem (or possibly a combination telco/coax modem) and software to use it?

By the way, operation needs to be easy enough that any subscriber in a "data-ready" cable system simply connects the drop cable to the modem's F-connector. When turned on, it should work without complex setup procedures. (Maybe we can develop a standard that uses a downstream pilot carrier on a certain frequency that broadcasts digital information to cable modems about specific configurations for that particular system.) The potential is here. Let's show our stuff!

Ronald J. Hranac
Senior Technical Editor

HL4000 SYSTEM READY

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Return on investment.

Reader Service Number 13

Jones to acquire Virginia systems

Jones Intercable Inc. entered into a letter of intent with Columbia Associates L.P. to acquire its cable TV systems serving eight Virginia cities and portions of Prince William County, VA. The systems serve approximately 50,000 subscribers. The purchase price is $123 million, subject to normal closing adjustments.

The letter of intent is subject to a number of conditions, including the negotiation of a definitive purchase agreement and the consent of governmental franchising authorities and other regulatory authorities having jurisdiction. If a definitive agreement is reached and all other conditions to closing are met, the transaction is expected to close in late fall 1995.

Jones currently serves, through systems owned and managed by it, approximately 125,000 subscribers in the Washington, DC/Baltimore area. The transaction with Columbia Associates and one other pending acquisition would increase the company's service to approximately 200,000 subscribers in that area.

In other news, Jones Intercable Investors L.P., a publicly traded master limited partnership for which Jones Intercable Inc. serves as general partner, announced financial results for the first quarter ended March 31, 1995, as well as a cash distribution of $.15 per Class A unit for the second quarter of 1995. The partnership's revenues increased 6% from $6.8 million in the first quarter of 1994 to $7.2 million in the first quarter of 1995. An increase in the number of basic subscribers was primarily responsible for the increase in revenues.

Bell Atlantic bags video net request

The Wall Street Journal reported that Bell Atlantic Corp. withdrew its pending applications before the Federal Communications Commission to build video networks in six major markets but affirmed its intention to build interactive networks throughout its region.

The company said recent technological advancements had rendered its original technical approach outmoded. It is expected to resubmit applications for the same markets within a few months showing a different technical approach.

AT&T, Pac Bell select Times Fiber

AT&T signed a six-year contract for Times Fiber Communications Inc., a subsidiary of Amphenol Corp., to provide a minimum of 80% of the distribution cable requirements for Pacific Bell's hybrid fiber/coax broadband network in California.

AT&T estimates that the system requirement for such cable is approximately $120 million. AT&T and Pacific Bell, a subsidiary of Pacific Telesis Group, selected Times Fiber's advanced low-loss series of coaxial cable.

Construction of Pacific Bell's broadband network began in 1994 and Times Fiber has been providing the coaxial cable distribution requirements to date. The network will be a full service system capable of offering voice, video and data services.

S-A key supplier in Pac Tel system

Pacific Telesis Group selected Scientific-Atlanta as its key supplier and integrator of a video delivery system that includes video headend equipment and set-top terminals for the company's advanced communications network.

Two Pacific Telesis subsidiaries, Pacific Bell and Pacific Telesis Video Services, anticipate purchasing equipment to deliver video signals from S-A that could total $150 million over the next three years. Although the agreement carries no firm purchase commitments, the company says both subsidiaries are working under aggressive construction and deployment schedules in order to deliver video services to four large areas of California beginning in 1996.

Under terms of the agreement, S-A's digital and analog headend equipment will be purchased by Pacific Bell; in-home set-top terminals and remote controls will be purchased by Pacific Telesis Video Services.

Vela Research to supply Graff PPV

Vela Research Inc. was selected as a key component vendor by Graff Pay-Per-View for its Cable Video Store (CVS) enhanced pay-per-view application. Vela Research will supply the entire enabling technology to provide a system-specific, turnkey, enhanced PPV operation to cable systems. Graff's initial deployment of the enhanced PPV service will be in the upcoming US West video dial tone trial in Omaha.

Vela's Perspective 2000 video server will distribute movies at various start times to an unlimited number of subscribers, who can order movies by phone or interactively through any addressable set-top box. Through the company's Media Manager software, CVS will be able to provide scheduling flexibility for rapidly changing movie line-ups and special promotions remotely from its Manhattan playback center or on premises.

Its MPEG-2 encoders will be used to digitally compress movies at selected bit rates to be stored on disks for later distribution. The units can encode at data rates from 1.5 to 15 Mbits/sec in real-time.

In other news, Digital Equipment chose Vela Research and Probita Inc. to provide enabling technologies for its Mediaplex ad server, a scalable, digital video solution for cable advertising insertion. Digital is using Vela's MPEG-2 encoder and Model 2000-0201 EISA decoder board, and Probita's Proclaim multicast distribution and network management software, which is optimized for distribution problems requiring enhanced network management, such as microwave, satellite, PSTN or other specialized transport systems.

Hyundai to buy TV/COM Int'l

Hyundai Electronics America signed a definitive agreement to purchase TV/COM International. Subject to obtaining required government approvals, TV/COM will be operated as a wholly owned subsidiary of Hyundai. In conjunction with Hyundai's Digital Video Systems Di-

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vision, TV/COM will provide standards-based (i.e., MPEG, DVB) end-to-end solutions for satellite, cable, interactive and video-on-demand services.

Stellar One, Mitsubishi to produce set-tops

Stellar One and Mitsubishi Electric Corp. entered into an alliance to produce set-top boxes for interactive digital video systems. The manufacturing agreement provides for shipments of digital set-tops to fulfill current Stellar One contracts, Mitsubishi licensing of Stellar One's set-top technology and engineering collaboration between the two firms on future set-top technology deployment.

The alliance will allow the companies to bid jointly on proposals to supply millions of digital interactive set-tops to telecommunications carriers exploring an expansion in interactive video services over their networks.

The agreement provides Stellar One customers with Mitsubishi's warranty and customer service. Mitsubishi Electronics America Inc., a subsidiary of Mitsubishi Electric Corp., announced it intends to invest in Stellar One.

Because Mitsubishi's manufacturing facilities have DRAM and ASIC capabilities, the alliance says it will be able to supply the ongoing digital set-top needs of regional Bell operating companies, cable operators and other carriers throughout America and the global marketplace.

MasTec to sell Lectro Products

MasTec Inc. executed a nonbinding letter of intent with Exide Electronics Group Inc. to sell its CATV power protection subsidiary, Lectro Products Inc. Under the terms being negotiated, Exide would acquire 100% of the capital stock of Lectro, with substantially all of the purchase price to be paid in cash at closing. If approved, the deal is expected to close no later than July 31, 1995.

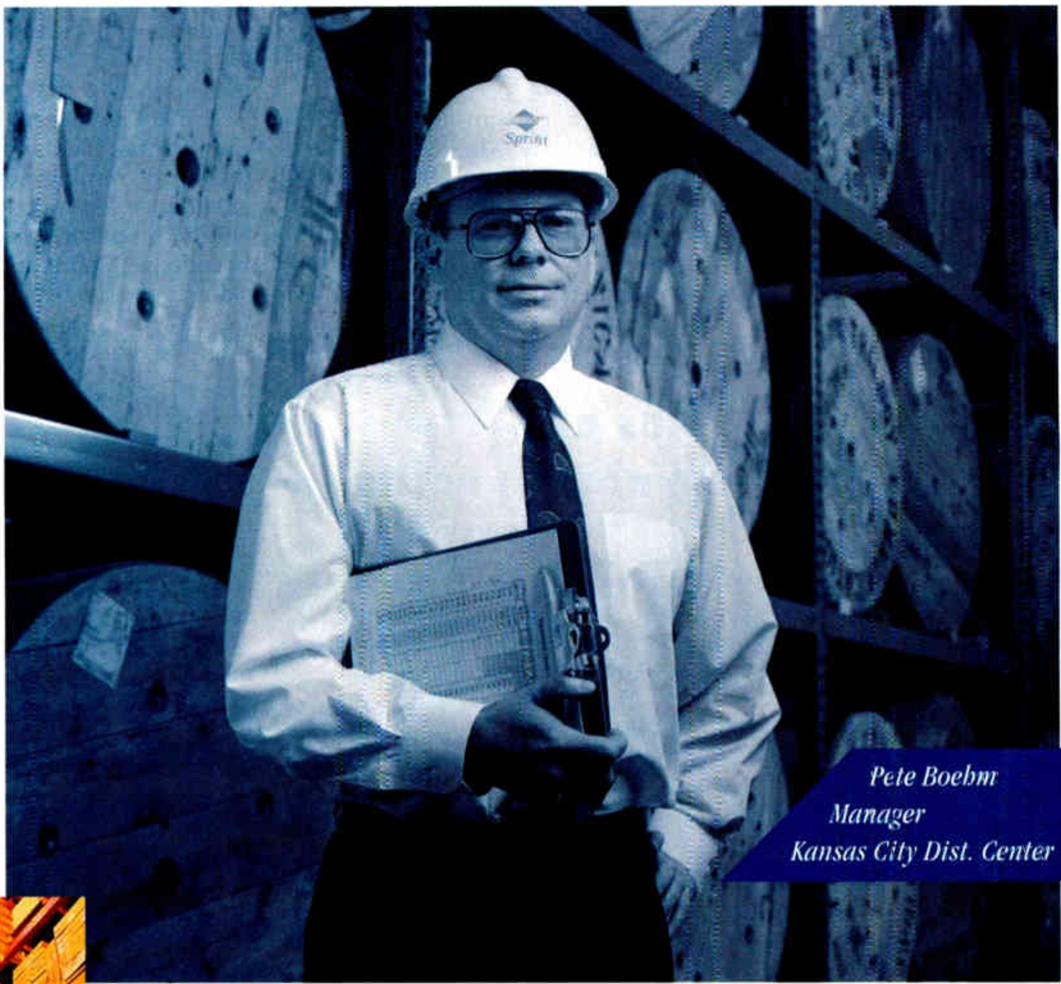
Notes

Cox selected **Nortel's** Cornerstone supertrunk solution for its broadband video network in the Phoenix area. Cornerstone allows the transport of TV signals and provides a platform for advanced services such as digital music, high-speed data services and telephone traffic across fiber-optic networks utilizing SONET rings.

AM Communications announced it received authorization to commence shipment of its first production commitment from **AT&T Network Systems** to produce 10,000 status monitoring transponders based on AM technology. This initial order represents approximately $2 million worth of new business form AM. AT&T plans to use the equipment to monitor the new interoperable amplifiers used in its HFC-2000 broadband access system.

Harmonic Lightwaves announced the initial public offering of 2.6 million shares of its common stock at an initial public offering of $13.50 per share. Of these shares, 2 million were offered by the company an 600,000 were offered by certain selling stockholders.

Pete Boehm Ships More Than Products With Every Package



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Reader Service Number 77

8054D

By Andrew H. Chapman, Executive Vice President, Integrated Network Corp.

Engineering challenges in a changing cable market

To defend and maintain "cable cash flow," CATV operators are considering substantial investments in new network infrastructure. Emerging cable technology will deliver interactive broadband services such as video-on-demand (VOD) and Internet access, as well as traditional narrowband services, such as telephony. CATV engineers will be critical in making the right networking decisions to keep cable competitive and profitable.

Provisioning of interactive services requires substantial re-engineering. The projected cost of new investment will probably reach into tens of billions of dollars over the next 10-20 years, but critical decisions are being made now. The CATV industry has relatively little experience with switched digital networks but it is facing complex and costly decisions on architecture, technology and deployment at a time when many of these issues are in flux.

Further, industry leaders believe a large market is waiting to be exploited but no one can predict in what form, at what time and place and for what price consumers will choose to purchase new services. Network operators are embarking on development of gigantic proportions without assurances that customers will respond. Yet, if no actions are taken, consumers will never get an opportunity to learn for themselves which services they want. It is no wonder the industry is in an anxious and cautious frame of mind.

To move forward, both operators and engineers must account for CATV economics and business conditions. An overly aggressive approach might force the industry into misguided and/or premature investments, services and technology. An overly conservative approach might stifle the market and give competitors too much advantage. The future of the industry literally balances between confidence and prudence.

Five keys to success

We believe CATV engineers must follow five principles to succeed. The first is to use what they have. Cable has in its existing hybrid fiber/coax (HFC) infrastructure the building blocks of a broadband interactive services network. The issue is how to deliver multiple network traffic in the most cost-effective manner.

Second, CATV engineers should design systems to offer consumers the broadest possible suite of service choices. Given that systems like Time Warner's Full Service Network are probably beyond the reach of all but the largest and best-financed CATV operators, engineers should structure local networks to permit delivery of all manner of services on a step-by-step basis.

Third, CATV engineers should invest in infrastructure in lockstep with actual demand (i.e., revenue). Network designs should use systems that can scale up as large as necessary to keep pace with growth.

Fourth, CATV engineers should view local-loop bandwidth as a scarce and valuable asset. Operators who manage bandwidth most efficiently will have the lowest marginal cost of delivering services. Ultimately, the low-cost producers will win.

Finally, CATV engineers should stay flexible. The only sure prediction about the future is change. The service mix demanded by consumers will fluctuate by time and place. Technology standards will evolve. Network designs must adapt to the latest ideas and offerings.

Meeting the demands

An access network architecture meeting these five guidelines was pro-

Reader Service Number 200

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posed recently in a CableLabs RFI/IDP — formally, "Request for Information & Industry Developmental Proposals (RFI/IDP) for an Integrated Multiple Services Communications Network (MCN)," issuance date, Oct. 7, 1994. In Section 12 of the RFI/IDP, Tele-Communications Inc. provided a specific network design illustrating one approach to a multiple services access network. Other sponsors of CableLabs RFI/IDP included Comcast Corp., Continental Cablevision Inc., Cox Cable Communications Inc. and Viacom International Inc.

The proposed CableLabs network uses an access gateway at the headend that integrates multiple backbone network traffic into a common cell transport format carried through the loop plant to a residential gateway. At the residence, service traffic is delivered to consumer appliances by means of service application modules or plug-in boards.

The CableLabs RFI/IDP is not a theoretical proposal. For example, Integrated Network Corp. has implemented an integrated multimedia services access network called Allendale that conforms to the RFI/IDP. Based upon INC's scalable multimedia network architecture (SMNA), Allendale provides integrated access to otherwise incompatible backbone networks such as ATM, X.25, PSTN, frame relay, MPEG, etc.

An optimum CATV network should integrate communications services into a common logical stream through statistical multiplexing in order to conserve local-loop bandwidth. The network should be primarily concerned with session management such as virtual circuit grooming and routing, service protocol adaptation, integrated services transport, flow control and addressing. CATV networks should employ granular, cell-level multiplexing rather than less agile, session-level or service-level multiplexing. Cell-level multiplexing permits integrated transport of narrowband services, such as telephony and interactive video gaming, whose sensitivity to latency makes fixed cell length transport inappropriate.

A CATV network also should be adaptable and modular. CATV physical network topology needs to accommodate broadcast-oriented tree-and-branch or a circuit-oriented star models and any physical media (copper wire, coaxial cable or fiber-optic cable). Engineers must be able to build single-service networks in small configurations of bandwidth and customer lines, yet "vertically" scale-up as large as necessary. Building blocks should be fast, inexpensive and common. System control design should be similarly modular to allow for performance and to ease development and maintenance. Scalability should extend "horizontally" to the addition of new services. Network operators need the flexibility to begin with a single service local network, grow the service and add services using the same infrastructure. This reduces start-up costs while establishing a coherent upgrade path.

The cable industry has the potential embedded in its existing network to develop cost-effective interactive multimedia services. If developed in an unplanned manner, that latent power could be squandered and the competitive advantage lost. However, the sort of activity represented by the CableLabs RFI/IDP is a sign that this will not be the case and the industry will again exhibit entrepreneurial, innovative skills. **CT**


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HEWLETT PACKARD
Reader Service Number 10

By **Gaylord A. Hart,** Director of CATV Product Development, XEL Communications Inc.

T1 telephony services for business applications over HFC

Many geographic pockets of businesses are too small to be provided T1 service economically directly via high-speed digital multiplexers operating over fiber. On the other hand, providing these services via twisted-pair may be difficult due to distance limitations, a lack of available pairs or the high cost of conditioning available pairs.

In these cases, the hybrid fiber/coax (HFC) network traditionally used by CATV systems provides an easily implemented, cost-effective means of providing these services, allowing system operators to reap additional revenue with little additional overhead.

This article discusses the applications and services that can be provided with a focus on the T1 RF modem technology for transporting these services over the HFC network. Technical performance issues and implementation requirements are discussed, including such topics as T1 formats, signal security, RF spectrum utilization, error performance monitoring, operational support system interface, provisioning and link testing.

Figure 1: Typical 750 MHz HFC spectrum allocation

As deregulation of the telecommunications industry continues, competition will increase to provide alternate sources for existing services and to offer new services. This competition will ultimately result in new technologies being developed and older technologies being made obsolete. New opportunities for revenue generation will be created while traditional revenue bases may be eroded by competition. It will be a period of great change and during this time it will be important to recognize the emerging opportunities and the technologies that will drive these opportunities.

Competition for telecommunications services already exists, mostly in the form of long distance services, long distance competitive access and alternate access services for large volume business users. To date, much of this competition has been focused on high-volume, high-end business services where the large traffic volume and the revenues thereby generated can justify the rather high up-front installation costs of providing those services directly via separate, dedicated fibers and transmission equipment.

Two trends will push this competition for service toward the medium size and smaller business user. First of all, new transmission network topologies and lower cost transmission equipment will force downward the break-even point for providing competitive access services, thus allowing smaller businesses to take advantage of the lower operating costs typically offered by alternate access providers and at the same time allowing more alternate access providers to enter the business. Secondly, small businesses will require greater connectivity capacity as new services, primarily digital, become available. In most cases, one to four T1s (one T1 = 1.544 Mb/s) will very adequately serve the requirements of one of these smaller businesses. Each T1 may in turn be used to support a combination of voice, data or even video.

There are basically three transport technologies by which these smaller businesses can be delivered T1 service: fiber optics, twisted-pair or HFC. Each of these approaches offers unique advantages and disadvantages, depending on the number of T1s to be provided and the size of the geographic area over which they must be provided.

In choosing which of these technologies is most appropriate for the individual application, a major factor will be any embedded technology base. From an economic perspective, service costs can usually be kept to a minimum by using the existing network infrastructure. It is unlikely a CATV operator would choose to use twisted-pair for delivering T1 services and just as unlikely that a telephone company would install an HFC link for a business user. As networks are rebuilt, however, the choice between technologies is once again open, and each may considered on its own merits.

Fiber

Delivery of T1 service over digital fiber-optic links is readily accomplished today with off-the-shelf

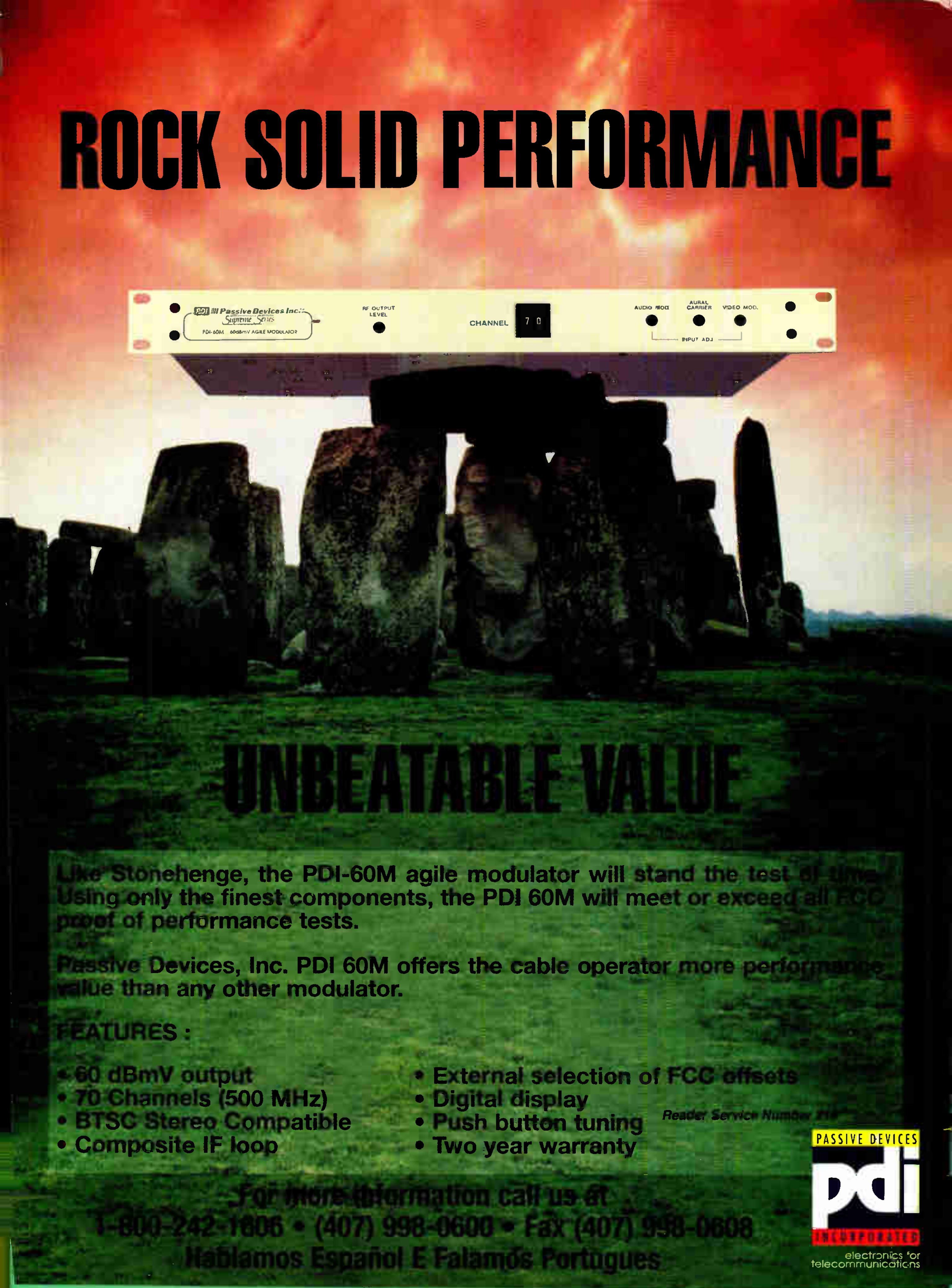

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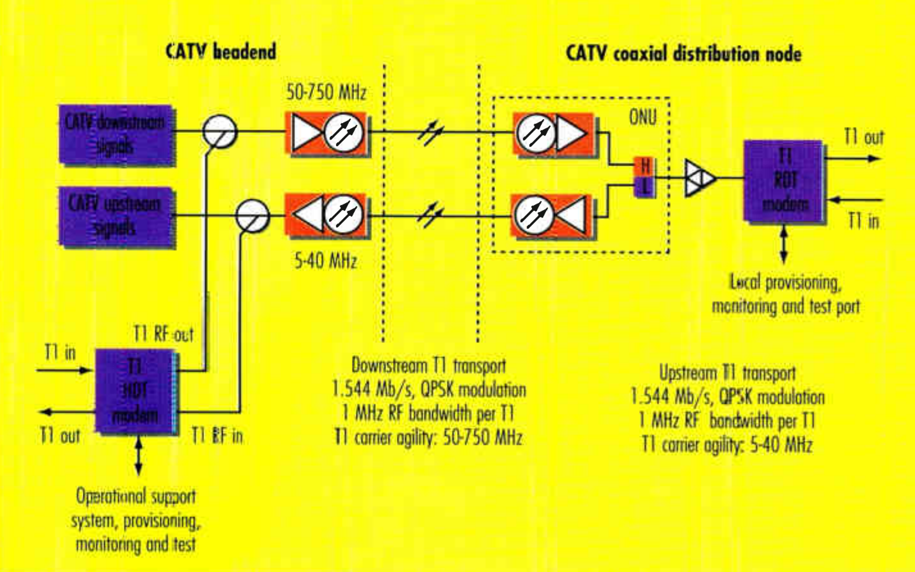
Figure 2: T1 RF transport on a broadband HFC network



then conditioning these pairs for transmission (typically by removing any bridged taps).

However, due to the attenuation characteristics of twisted-pair, repeaters must be used at regular intervals (typically 3,000 to 5,000 feet) to reconstruct the digital signal for further transmission. This now requires engineering the line for repeater spacing and location and then actually installing the repeaters. This can add weeks to the initial service delivery date.

Assuming unused pairs are available and suitable (and they may not be), the cost of conditioning these lines and providing repeaters at regular intervals is expensive. Of course, the farther the remote termination is from the central office, the higher these costs are. If suitable pairs are not available, or if the repeatered line is too expensive, the installation costs of a fiber transport system may be lower.

T1 circuits also may now be delivered over twisted-pair (again, using two pairs) without line conditioning or repeaters when HDSL (high bit rate digital subscriber line) technology is used. HDSL requires the use of unloaded lines but does allow the two pairs to be in the same binder group. Bridged taps also may be left in place (providing in general that no bridged tap exceeds 2,000 feet and that the total length of all bridged taps is less than 2,500 feet). Far more lines will qualify for HDSL use than will qualify for repeatered T1 use. However, HDSL does have one primary limitation — distance. An HDSL circuit is typically only meant to work to 12,000 feet using 24 gauge wire (26 ga. wire shortens this to 9,000 feet), and this distance must include the cumulative lengths of any bridged taps. HDSL presents a very cost-effective alternative to repeatered T1 lines, but the cost of the HDSL transceivers is still somewhat expensive. These costs are expected to drop as production volumes increase and as more circuitry is integrated in silicon. For the purpose of T1 delivery, HDSL will likely extend the useful plant life of the embedded copper base.

Hybrid fiber/coax

HFC networks represent a third network transport technology that can deliver T1 service to business users. Most industry experts now recognize that the broadband HFC network is the most economical distribution architecture for delivering voice, video and data services to a large number of end users over a single network. To date, very few T1s have actually been deployed to end users over this type of network, with the bulk of these circuits being used in broadband local area networks rather than in actual CATV systems. However, CATV systems may provide the most economical transport for delivering T1 service to small- and medium-sized businesses.

First of all, a CATV network is inherently a shared pipeline. The costs of building and maintaining the network are shared among many users since the signals they use are all multiplexed over the same fiber and coax.

Secondly, since the transport system itself is inherently transparent, adding new services on the network is relatively simple and usually only a matter of spectrum allocation. Rarely is it necessary to modify the network itself. Usually only the end points where the signals are put on and taken off the system is it necessary. The incremental cost of providing T1 service is largely in the two RF modems required to get the T1 on and off the network.

Third, adding additional users to the network is usually very quickly and inexpensively accomplished, typically requiring only a relatively short coaxial drop cable to be run from the nearest feeder to the new user.

Fourth, CATV system coverage of most urban and metropolitan areas is already virtually universal. Most small- to medium-sized businesses are already passed by cable, making them good candidates for advanced services of all types.

The one exception to almost universal CATV coverage is in large industrial areas or business parks. Since most people tend not to need entertainment services at work, CATV operators have traditionally not wired these areas. Recently, with a stronger view toward the emerging new services and markets, operators have begun rethinking their strategy and many have begun planning (if not already building) their systems with the view of serving these customers. In this case, however, it may make more sense to use the entire broadband RF spectrum for data and voice services and eliminate the entertainment services altogether. As an alternative, and as pointed out before, these areas also are very suitably served over dedicated digital fibers.

It now appears that the greatest competition to provide T1 service to small- and medium-sized businesses will come from the CATV industry. CATV operators have an embedded HFC base and infrastructure in place that will readily allow T1 service to be delivered economically to anyone on the network. Incremental revenue from these services will be

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highly sought after by operators because the cost of operating the network has, in essence, already been covered by other users on the network. In fact, the revenue from T1 service may prove to be attractive enough to displace low viewership TV channels in order to free up spectrum for more T1s.

Because T1 transport over digital fiber and twisted-pair is so well-understood and widely implemented today, and because it appears that the next-generation technologies and actual deployment for T1 transport will concentrate on HFC systems, this article will concentrate on issues surrounding transport of T1 service over HFC architectures and on the services that may be provided over these T1s.

"In providing T1 services, care must be taken to select a T1 RF modem that is flexible."

HFC system considerations

Transporting a T1 over an HFC network presents unique technical challenges that must be addressed if the service delivery is to be error-free, reliable and cost-effective. Fiber-optic and twisted-pair T1 transport systems have one thing in common: Once the two endpoints are connected to the medium between them, a connection exists for communications. In an HFC network, frequency division multiplexing is used to transport several signals simultaneously throughout the system. A connection between two devices on the network can only be made when both devices are attached to the network and when both know which frequency to use for the connection. Spectrum management and utilization are important factors in operating any service over an HFC network and this is particularly true for bidirectional services.

CATV spectrum allocation

Figure 1 on page 20 shows a typical frequency allocation plan for a 750 MHz CATV system. Below 550 MHz, analog TV channels occupy most of the spectrum between 50-550 MHz. Compressed digital NTSC signals and other advanced digital services occupy the spectrum above 550 MHz. The return path occupies 5-40 MHz. The spectrum from 40-50 MHz is a guard band used for diplex filter roll-off between the upstream and downstream paths.

In this example, 35 MHz of bandwidth has been allocated for the reverse path, but many systems have been built with return paths using 5-30 MHz. In either case, full utilization of the return spectrum may not be possible, or at least not without forward error correction (FEC) or other means of maintaining a low bit error rate (BER). System ingress originating in the subscriber's home wiring is not uncommon and this ingress may come from several sources including amateur radio and CB transmitters, which are often active in urban neighborhoods in the 5-30 MHz band.

As new interactive services are deployed and the demand for data transport grows, it is likely that the 5-40 MHz return path used today will not be adequate to support these new services. Additional return spectrum can be created by using a mid-split return (e.g., 5-112 MHz return, 150-750 MHz forward), but this is unlikely in the near future due to the analog spectrum currently in use for TV services and the vast number of consumer products already supporting this spectrum.

One possibility, as compressed digital NTSC signals become more widely deployed, is to convert the downstream analog TV signals to compressed digital signals, thus freeing up considerable spectrum for upstream and/or downstream applications. Another possibility is that additional return spectrum will be carved out of the higher end of the spectrum, say from 850-1,000 MHz.

If additional return spectrum is provided at the top of the CATV spectrum, the 5-40 MHz spectrum could be utilized as a fully passive bidirectional transmission path operating without any intervening amplifiers. Cable attenuation at these frequencies is very low, and if the node sizes are small enough, reliable bidirectional transmission should be possible. In this case, transmission will not be interrupted even if power is lost or an amplifier fails. For services such as telephony and network management, which need to be highly reliable, this spectrum could be extremely valuable.

Before fiber was widely used in CATV systems, it was common to have cascades of 32 or more trunk amplifiers with thousands of subscribers being served off this cascade. Under these circumstances, any services other than those that could be broadcast to all users on the network were virtually impossible to deliver. Due to the summation of noise in the reverse path, return data transmission was either impossible or expensive to implement, often requiring reverse path cutoff switches at each bridger amplifier to turn off the other legs of the return system when a particular leg was being used for transmission.

Any service that required unique bandwidth on a per-user basis (e.g., telephony) was out of the question. With thousands of users sharing the same bandwidth on a single cascade, not enough spectrum existed to give each user even a small piece of bandwidth to call his own.

Reliability also was an issue since the network was spread out over a large geographic area and the failure group size was extremely large. A single failure in the cascade took out all the subscribers downstream of the failure.

The extensive use of broadband AM fiber-optic transport in the CATV industry has eliminated these problems by fiber division multiplexing small geographic pockets onto separate fibers. Node sizes now are usually no larger than 2,000 subscribers with 500 being a typical number for nodes being installed today.

The trend is toward even smaller node sizes, possibly even entirely passive beyond the optical node itself. Under these circumstances, reliability has gone up, return noise summation is minimized and, most importantly, bandwidth is now available to provide unique services to each subscriber.

The HFC architecture's flexibility

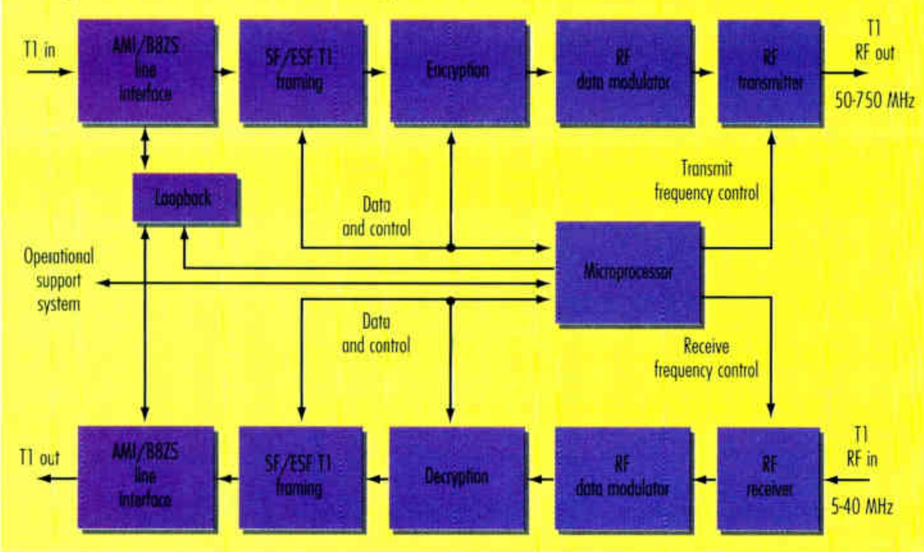

Figure 3: T1 modem headend digital terminal

inherently supports low-cost network implementation with future growth being paid for only as it is needed. Should a node run out of capacity due to growth in customer traffic, that node need only be subdivided into two smaller nodes, a relatively simple and inexpensive task to accomplish providing the fiber is already present for the second node.

Since the target application here is to provide T1 service to small- to medium-sized businesses located within or next to residential areas served by CATV, it is likely that any given node would not have to supply very many T1s and that existing spectrum could be used for this purpose. Even in a CATV system with 550 MHz of downstream bandwidth or less, it should be relatively easy to find portions of spectrum in which to dovetail the T1 signal.

T1 spectrum allocation

In North America, the first order of digital multiplexing is the T1 (1.544 Mb/s), which was derived by combining 24 digitized voice channels (24 DS0s, each 64 kb/s, for a total of 1.536 Mb/s) with overhead bits used for framing the overall signal (8 kb/s). The actual transported content of the T1 is in the 1.536 Mb/s; the framing bits may be thought of as the package used to transport the other bits. Today, T1 is used in many different ways and for many different purposes. It may be used to carry voice, video or data, or a combination of these. It may be channelized (typically into 64 kb/s channels), or unchannelized (the full T1, 1.536 Mb/s), and if channelized, more than one channel can be combined to form larger subchannels (n x 64 kb/s). For the purposes of actually transporting the T1 over an HFC network, it is not important what is being transported on the T1 or whether it is channelized or not. The objective here is to transmit the full 1.544 Mb/s signal bidirectionally as transparently as possible between the headend and a remote user. It is up to the users at either end of the T1 to determine how the T1 is actually used.

Aside from the T1, additional channel overhead is required in the bit stream for control purposes within the T1 transport system itself (e.g., for remote provisioning and monitoring of the subscriber terminal unit). This overhead may come at the expense of capacity taken from the T1, or by using the T1s embedded facility data link (extended super frame format only), or by providing additional channel overhead by transmitting at a higher data rate (and thereby occupying a larger transmitted bandwidth). Each of these methods has unique advantages and disadvantages but the most important criteria in selecting which of these approaches is most suitable must be the transparency of the transported T1 itself. For the purpose of simplifying discussion, this article assumes T1 transmission rates will be used.

Many modulation methods exist for transporting the T1 as an RF signal on the network: FSK, BPSK, QPSK, QAM and others. Any choice represents a trade-off between bit rate vs. bandwidth used and circuit complexity. The modulation scheme chosen directly effects the overall system traffic capacity, system cost and system reliability. QPSK presents a good balance here (providing a transmission efficiency of 2 bits per hertz with relatively inexpensive circuitry and good noise performance), and many proposed CATV telephony systems employ QPSK. For the purposes of discussion, QPSK data transmission is assumed in both the downstream and upstream transmission paths.

Given the same data rate and modulation method, the transmission bandwidth required for the upstream and downstream paths will be the same. Depending on the modem design, there may be compelling reasons to use different data rates or modulation methods for the upstream and downstream paths, in which case the transmission bandwidths would be different. Using QPSK, the 1.544 Mb/s T1 will occupy a minimum (Nyquist limited) bandwidth of 0.772 MHz. Providing approximately a 30% guard band for real world filtering and adjacent channel protection, this provides us a transmitted bandwidth for the T1 of 1 MHz, or a center-to-center channel spacing between T1s of 1 MHz. This will allow us to fit six T1s into the same space as an NTSC TV channel.

However, there is no inherent reason why T1 signals should be contiguously transmitted. In fact, it is far more likely that they will not be. Given the relatively narrow bandwidth of this signal, system spectrum may be more efficiently used by tucking the T1 into normally unused areas of spectrum. In the downstream direction, good candidates for T1 placement are the regions below Ch. 2 (50-54 MHz), between Chs. 4 and 5 (72-76 MHz), within the FM radio band (88-108 MHz), within the A-1/A-2 aeronautical bands (108-120 MHz), or above the highest TV channel on the system. Given the choices, it should not be too difficult to find downstream spectrum for at least a small number of T1s. To utilize the available spectrum to the fullest advantage, it is important that the T1 modems be


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plex the modulation method is, the smaller the transmission bandwidth will be and the greater the circuit complexity and susceptibility to noise will be. The next and final stage is the RF transmitter. This stage is responsible for converting the modulated signal to the appropriate transmission frequency and output level for combining with other signals to be sent downstream.

Looking at the receive path, we see what is in essence, and block for block, the exact opposite functions as performed in the transmitter. One difference, however, is in the upstream and downstream frequencies. The downstream RF T1 signal may be placed anywhere within 50-750 MHz, while the upstream signal may be placed anywhere within 5-40 MHz. The upstream transmission path also will likely have an additional data link associated with it so that the RDT can send messages to the HDT, as well. This channel would typically be used to report status, request loopback testing and perform other tasks.

Two items not specifically associated with either transmission path are the operations support system (OSS) interface and the loopback. The OSS interface serves several functions. It may be connected to a larger network management system, which would in turn perform such functions as monitoring error performance and alarms, provisioning the HDT and RDT, controlling encryption keys, and carrying out other tasks as well. On the other hand, this interface also could be connected to a stand-alone controller for similar purposes or to a diagnostic controller for executing systems tests and locating faults. The loopback is used for link testing and fault isolation. This loopback should be capable of looping in either direction — back to the central office or back to the RDT.

Most of the system functions are implemented in software in the microprocessor. This software must support full detection and reporting of system status, data errors and link failure. Additionally, this software must accommodate remote provisioning of the RDT and complete auto-recovery when system comes up after any link failure. Test and fault isolation functions also must be supported as well as the communication interfaces between the OSS port and the RDT.

Remote digital terminal

A simplified block diagram of the RDT is shown in Figure 4 (page 30). For almost all practical purposes, the block diagram for the RDT is the same as for the HDT. Notable exceptions are that the transmitter and receiver frequency ranges are now reversed and that the HFC network is now connected to the modem on a single coaxial cable. The upstream and downstream signals are then separated and routed to their appropriate blocks by a diplex filter.

Other differences exist as well, but these are primarily in function and in the software. An OSS interface is not required since this has been essentially handled at the headend, and any OSS communication with the RDT will take place over the T1 data link itself. A communications port is provided, however, for status monitoring, local provisioning (if desired) and testing the link. This port is primarily intended for use by the network operator.

Applications overview

The variety of T1 applications that can be supported by T1 transport on an HFC network is probably as varied as the end users themselves. Virtually any application requiring data transport over a metro area (or a portion thereof) is a potential candidate for T1 service over an HFC network. And since voice, video and other services can be digitally supported and transmitted, these too are candidates for T1 networking.

Perhaps the first application that comes to mind is traditional telephony, although several applications fit into this category. T1s can be used to provide connection from remote sites to the PSTN, whether the local telephone company or cable operator is performing this role. The entire T1 may be used strictly as a data interface, or the remote site may in turn be connected to a digital loop carrier system (DLC) or to a T1 channel bank. Here the T1 may in turn be demultiplexed and disseminated as several other services: ISDN, voice, data, ATM transport, videoconferencing, telefax, telecommuting, etc. The T1 also may be used to provide businesses with direct access to long distance carriers or to other services.

For businesses with more than one site in a metro area, a T1 may be used to directly link these sites without need for transport on the PSTN. In this application, both voice and data can readily be supported. There also are numerous LAN bridgers and routers that are designed to operate over T1 circuits and provide full computer networking interconnectivity between LANs located at different sites.

These are but a few examples of the uses of T1 service. Each year new applications and services are provided over T1 and each year an increasing number of T1s is installed. Ample opportunity exists for CATV operators to provide these services and T1s economically over an HFC network directly to end users.

Summary and conclusions

In providing T1 services, care must be taken to select a T1 RF modem that is flexible enough to support various spectrum plans, taking advantage of small gaps that either already exist or can be created in the HFC network spectrum. The modem also must be inexpensive to install and operate, which typically means the unit requires little installation time and a minimum of provisioning and setup. The modem also must support rapid detection and isolation of faults.

Existing HFC networks are capable of providing reliable and competitive bidirectional T1 transport directly to small- to medium-sized businesses. Such customers cannot always competitively be offered T1 service using other technologies. The incremental cost to the CATV operator for providing T1 transport to these users over the existing HFC network is almost entirely in the cost of the T1 RF modems alone and these modems will be relatively inexpensive to purchase and install. By providing T1 services directly to businesses, the CATV operator maximizes the return on the investment he already has in his network while at the same time realizing a significant new source for profits. **CT**

Table 1: Service penetration and requirements

Service	Penetration	Requirements
Telephony	100% single line 8% second line	TR-303 No concentration
Video telephony	10%	1.544 Mb/s 6 CCS
Entertainment (Interactive digital)	77 channels analog 25% penetration 25% peak	4 Mb/s MPEG (per channel)
DS1 business services	1% penetration	Dedicated

subscription rates already exceed over 6 million homes for online services.

The Internet is giving people the opportunity to experience the power of accessing a very large server network through their personal computers at home. Unlike other arenas where a particular regulatory environment is needed or a particular technology is required, the services infrastructure supporting the Internet is already (essentially) in place. One hundred new WWW sites are being created every month and the Web is expected to absorb access to all previously separately accessed online services by the end of 1995.

According to information from Kessler Marketing Intelligence (Figure 1 on page 34), 30 million homes will have a two-way HFC network in place by the end of this year with that number growing to more than 65 million by 1998. The network infrastructure is rapidly moving into place. Network access is widely available (thanks to the personal computer) and services are increasing daily as the WWW continues to grow. With all of this already in place, what role does an HFC architecture play in making it happen? The answer involves the high bandwidth that will be necessary to support the new wave of services to the home.

Telephony

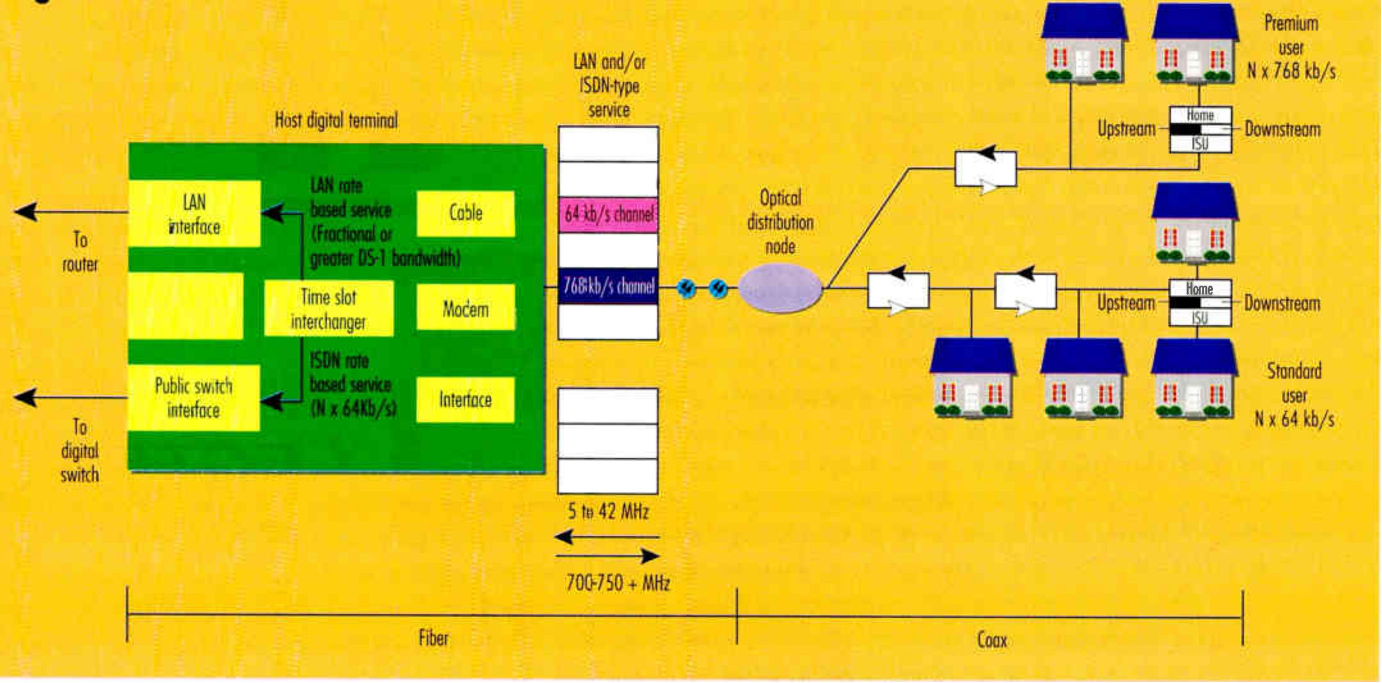
Telephone services to the home have remained fairly constant over the past five to 10 years, despite the telephone companies' push for additional services to the home. However, as previously discussed, a new wave of services will soon be required at the home, including things like videoconferencing and data access. To support these services, the network's bandwidth will have to increase dramatically, which is where the HFC architecture comes in.

HFC architecture

A typical HFC architecture consists of a few key components enabling it to provide high bandwidth capacity. (See Figure 2.) The first is the host digital terminal (HDT), which provides a switch or a router interface to support these new services. A standard user may require a 64 kb/s service similar in nature to ISDN, while a premium user — more of a work-at-home, Ethernet connection type of user — will require more bandwidth to support work-at-home applications as well as videoconferencing. Subscribers would generally use such a service only for a short period of time, causing it to be somewhat bursty in nature. For this reason, the HDT utilizes a time slot interchange for bandwidth management.

In Figure 2, information going out to the subscriber over an HFC network passes through the optical distribution node and then on to an integrated services unit (ISU), the network interface device residing at the subscriber location. For standard users, a serial interface similar to RS-432 would be used, allowing them access to 64 kb/s channels — a considerable improvement from the 14.4 kb/s modems available today. Premium users would require a 10Base-T Ethernet connection, which utilizes a clear channel based on multiples of T1 bandwidth. Again, such a service would be somewhat bursty in na-

Figure 2: HFC data access



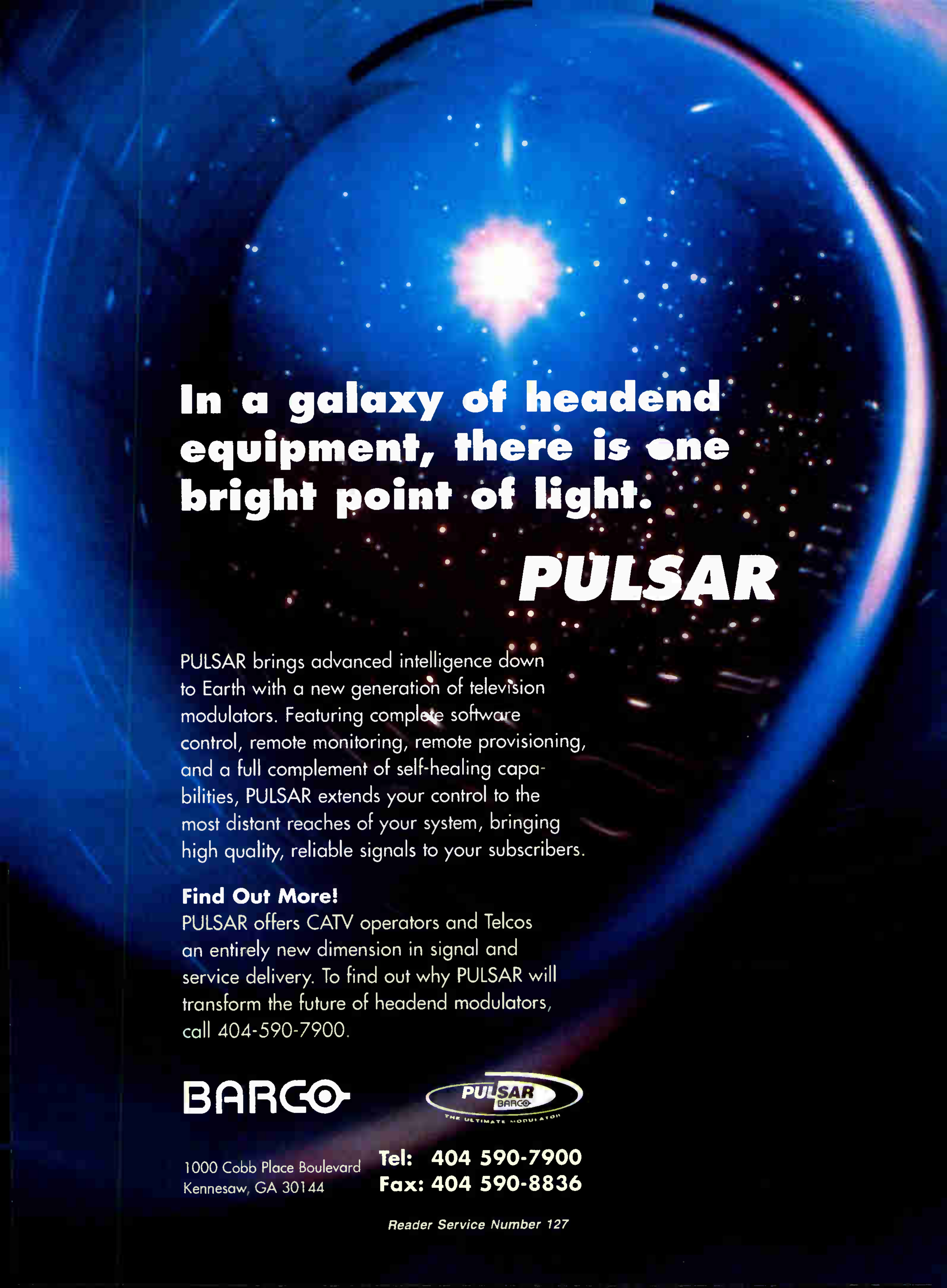

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Table 2: Bandwidth and other requirements

Service		Bandwidth required	Assumption
Telephony		500 x 1.08 = 540 DS0s	
Video telephony		500 x .10 x .17 x 1.544 Mb/s = 204 DS0s	6 CCS
Entertainment			
Analog		77 RF channels	
Digital		(50 x .25 x .25)/8 = 3.9 RF channels	Eight 4 Mb/s MPEG channels per 6 MHz
DS1 business services		500 x .01 x 1.544 Mb/s = 120 DS0s	Dedicated
Totals			
	Digital	16 (3.9 x 4)	Assumes four-way optical split
	Analog	77 RF channels	
		93	
	DS0s	864 DS0s (864/224 = 3.9 RF channels)	
		97 channels downstream	
		13 channels excess capability	

ture, but both types of services could be managed simultaneously by the HDT time slot interchange.

The HFC network itself is already being put in place. The key now is the modulation technology used within the home network interface device and the HDT. A flexible and robust HFC technology will be necessary to handle the kinds of high bandwidth services consumers are demanding. The only remaining question now is exactly how robust it must be. To determine future robustness, it is important to consider service requirements for the next several years. The following service model illustrates the home services requirements anticipated in the year 2000.

As shown in Table 1, telephony penetration will be 100%, with 8% of subscribers having a second line. Presumably, a TR-303 switch interface will be used. In this model, concentration is not assumed. Video telephony will generally use 1.5 Mb/s worth of bandwidth and will have a 10% penetration at a usage rate of 6 centum call seconds (CCS).

From an entertainment perspective, it is anticipated there will be a standard offering of 77 analog channels. Digital channels will incorporate both VOD and interactive video with interactive video having a 25% penetration and a 25% peak usage. The average bandwidth required for each interactive channel will be 4 Mb/s. In addition to telephony and video entertainment services, high capacity business services also will be provided to the home. A 1% penetration is assumed for T1-based business services to the home.

Table 2 breaks down the bandwidth, channel allocation and other requirements that will be necessary in order to support the services highlighted in Table 1 (page 36), beginning with the telephony services. It is expected that a 500-subscriber node will be commonly used for telephony being supported over a 750 MHz video transport system. Based on the previous assumptions, the average subscriber will have 1.08 DS0s (64 kb/s) to the home, for a total requirement of 540 DS0s per node. Video telephony, based on the take rates indicated in Table 1, will require approximately 200 DS0s. Entertainment services will require 77 channels to support analog services and four channels to support digital services. However, since each 750 MHz transmitter supports four nodes, a total of 16 channels in the downstream direction is required. T1 business services will require 120 DS0s to be dedicated to support the home business requirements.

In considering all these numbers, it is important to keep in mind that we are dealing with a 750 MHz spectrum, from which there are 110 channels available to be used in the downstream path. Analog services will require 77 channels, while 16 channels will be needed for digital services, and there is still the bandwidth needed for telephony, data and videoconferencing services, which will require a total of 864 DS0s. The selection of which RF modulation technology will be used is critical because a limited amount of spectrum remains to support these services.

Most current vendors of HFC technology support approximately 60-120 DS0s in a 6 MHz bandwidth, although ADC Telecommunications' Homeworx platform can support 224 DS0s in a 6 MHz bandwidth using orthogonal frequency division multiplexing technology (OFDM). The 864 DS0s needed to support telephony, data and video conferencing services will require only four RF channels when an HFC architecture supporting 224 DS0s is employed. An HFC architecture supporting only 60 DS0s will require four times as many channels and will ultimately exceed the available bandwidth in the 750 MHz spectrum. A robust HFC technology supporting 224 DS0s will meet the total requirement of 97 downstream channels while still maintaining 13 channels of excess capacity for unforeseen services. In addition, the precious upstream spectrum is preserved, using only 24 MHz of the 5 to 42 MHz spectrum available. This leaves added spectrum to be utilized for additional services such as energy management and other technology-oriented services.

This is an exciting time for service providers as well as consumers. The explosion of the WWW and the Internet is creating a flurry of excitement among consumers over new services being offered today as well as the promise of those coming soon. Service providers — from telcos to cable TV operators — are looking down the road at a myriad of brand new revenue-generating services. The network is going to happen. It is already happening. The infrastructure is in place and widely accessible through home personal computers and service offerings are increasing daily. All that is needed now is for service providers to deploy a robust HFC architecture that will support the great amounts of bandwidth all these new services to the home will require and the information superhighway will be driven home. **CT**

By Bob Hutchinson, Cable Systems Architect, Hewlett-Packard Home Products Division

The cable modem system: Your solution to success

The ever-changing interactive technology industry is burgeoning. Every day companies are creating technologies that make our lives at home and at work more efficient, while rendering existing technologies obsolete. In this information age, consumers are hungry to access, create and distribute information faster and better than ever before. Broadband network operators are now looking to cable modem technology to do just that for their subscribers.

As the race for new technology continues, broadband network operators such as cable companies must ask themselves how emerging technologies can benefit their business and subscribers. Typically, the focus has been to provide the best in cable programming to consumers at a price point acceptable to consumers and profitable for the operators. The cable modem allows broadband network operators to leverage existing infrastructures to provide additional, value-added services to the home and office and generate revenue.

There are several cable modem providers in the market that offer a variety of options to the cable operator, ranging from stand-alone unit sales of the hardware to a ready-to-install, end-to-end cable modem solution. It is important, therefore, to understand what composes a successful cable modem solution.

Cable modem: Fast forward

The online services market is growing at an amazing rate each year. While the telephone dial-up modem has enabled consumers to do everything from work at home to communicate with PC users all over the world, the performance has been slow, the graphics limited and the phone bills high.

Because of limited bandwidth, regular phone service has made transmission of pictures and graphics time-consuming and costly. The cable modem system will give PCs access to enhanced interactive services at a much faster rate. In fact, the rate of transmission via the cable modem is thousands of times faster than the traditional modem, making the online environment more multidimensional, cost-effective and entertaining as well as more user-friendly. For instance, a graphic that may take more than 10 minutes to download via a telephony-based modem operating at 14.4 kb/s would take only 10 seconds by cable modem, operating as fast as 30 Mb/s.

In addition to access to the standard online services, the cable operator may provide value-added features to its subscriber base via the cable modem, which increases demand and leverage cable's locally based presence. Content servers at the headend allow localized information services to be offered in which the subscriber accesses local restaurant listings, yellow pages, city maps, library data bases and government information. The cable operator also can provide its subscribers access to a wide area network (WAN) such as the Internet and enable private business-to-business local area network (LAN) interconnections.

Designed for ease-of-use, the cable modem solution enables a point-and-click interface, making it simple for consumers to navigate online, receive electronic mail and faxes, explore the Internet, access electronic bulletin boards and participate in special interest forums.

According to research from Hewlett-Packard, PC users desire a functional industrial design that can be placed horizontally for "stackability" — either under or above other computer peripheral equipment — or vertically (on its side) to minimize its footprint (the amount of desk space it uses). Overall, the cable modem solution provides information to consumers faster and cheaper and enables an easy-to-use forum for private communication from the home or business.

End-to-end solution

There are several elements crucial to the success of the end-to-end cable modem solution. Powerful servers and other computers, user-friendly software, and a partner with experience in advanced data networks comprise the complete solution. With the right partner, cable operators tap into the power of broadband interactive data services and leverage present infrastructures to generate additional revenue. In addition, they can offer subscribers value-added service at the right price.

Ideally, the cable operator selects a provider that can build a customized, ready-to-install, end-to-end cable modem solution that is reliable, cost-effective, scaleable and easily managed. In the first step of this process, the two companies develop a customized business plan to create a feasible, revenue-generating business. The cable operator and the cable modem system provider can design a solution by identifying existing interactive services and creating new ones that will interest the subscriber base. Based on the operator needs and level of investment, the provider will outline the hardware and software systems required from the headend to the home. Once the solution is designed, the ideal provider may (if requested) install the entire system, manage the data network, maintain it with field support as well as train the cable operators' staff in these duties.

In designing and managing the network, the provider and the cable operator must be aware of privacy and security issues relating to both the individual user and the network.


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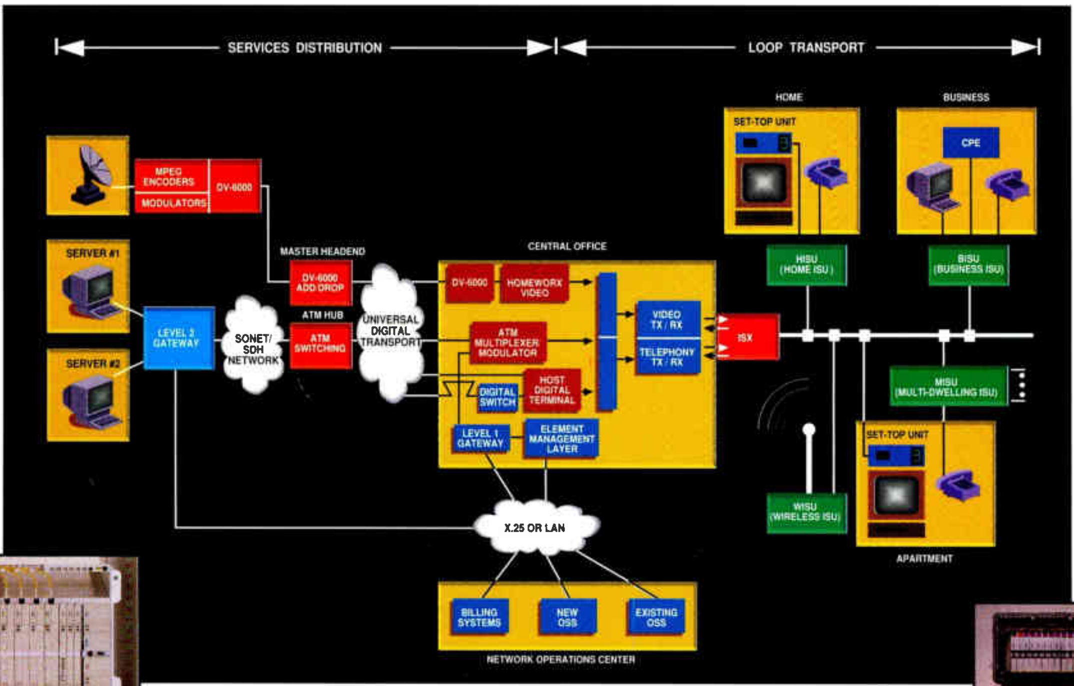
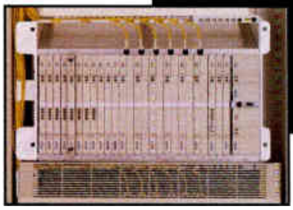
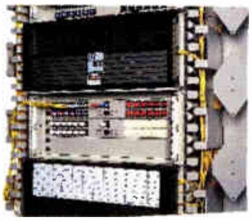




ADC is the leader in the development, design and deployment of residential broadband networks. Whether you're upgrading an existing telephony or video network or building it from scratch, ADC's Homeworx HFC access platform is the most cost effective, end-to-end transport solution available today. With flexible sizing and service components, the Homeworx platform permits a "pay-as-you-go" method of responding to changing technology and market demands.



Maximum deployment flexibility is ensured with the fiber-fed Homeworx ISX integrated services access node. Surrounding the ISX package is the video services node cabinet, an aluminum housing for the RF amplifier, power supply, transmitters, receivers and status monitoring modules.

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To manage your network, ADC offers a complete suite of broadband service assurance hardware and software. These systems integrate seamlessly into any service environment. And the software-based, centralized administration and management system also improves performance, allowing preemptive responses to problems before they impact users.

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Committed to innovative practical solutions, ADC is the home of broadband. For more information on end-to-end solutions for residential broadband services, call us at **1 800 366-3891**.

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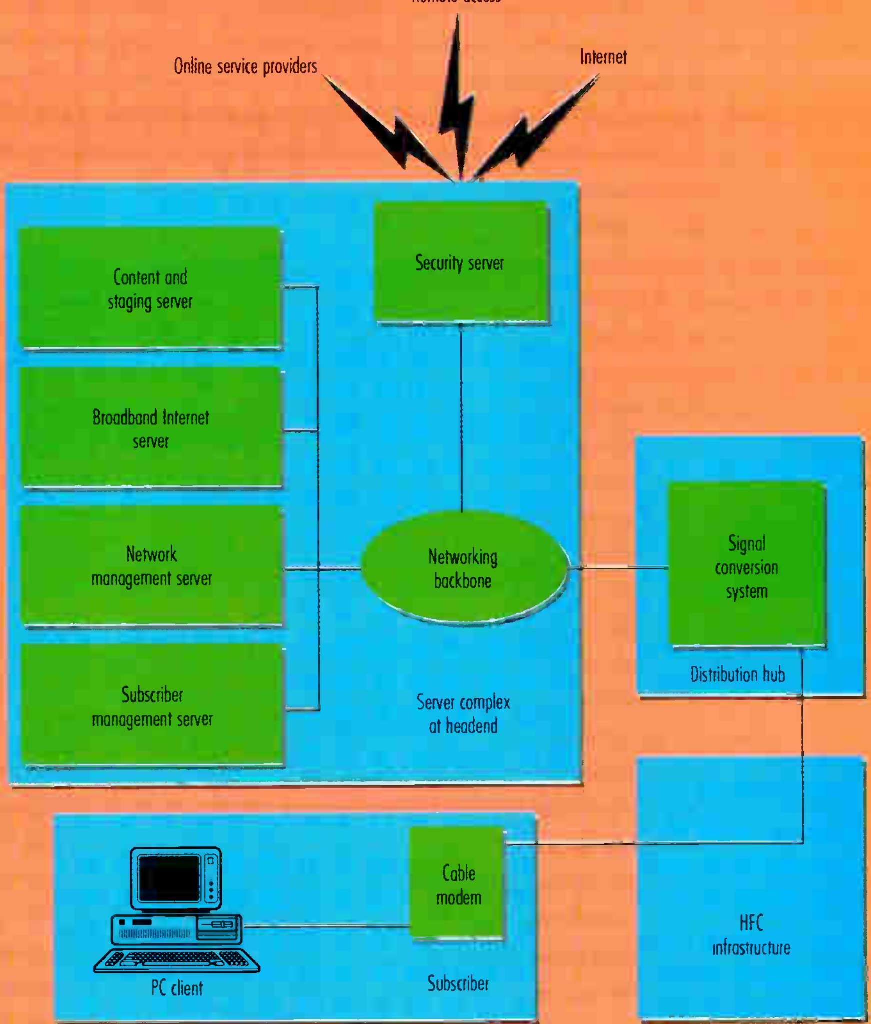
An interactive data solution

The interactive data solution shown in the accompanying figure creates a sophisticated, communitywide interactive network over an HFC plant. The cable modem connects the subscriber's personal computer to the networked servers at the headend that provide the subscriber with seamless access to a wide variety of interactive data services.

The signal conversion system converts the RF data to standard link protocol (like Ethernet or ATM) and then routes the data to its destination. Local content is prepared, housed and accessed on the content and staging server. The broadband Internet server provides the same services that are available on the Internet, but is for browsing local community information. The network management server manages the network and on-site systems. The subscriber management server interfaces the MSO's billing system with all the servers in the server complex. The security server provides user authentication and access to external online services and the Internet.

Broadband interactive data system



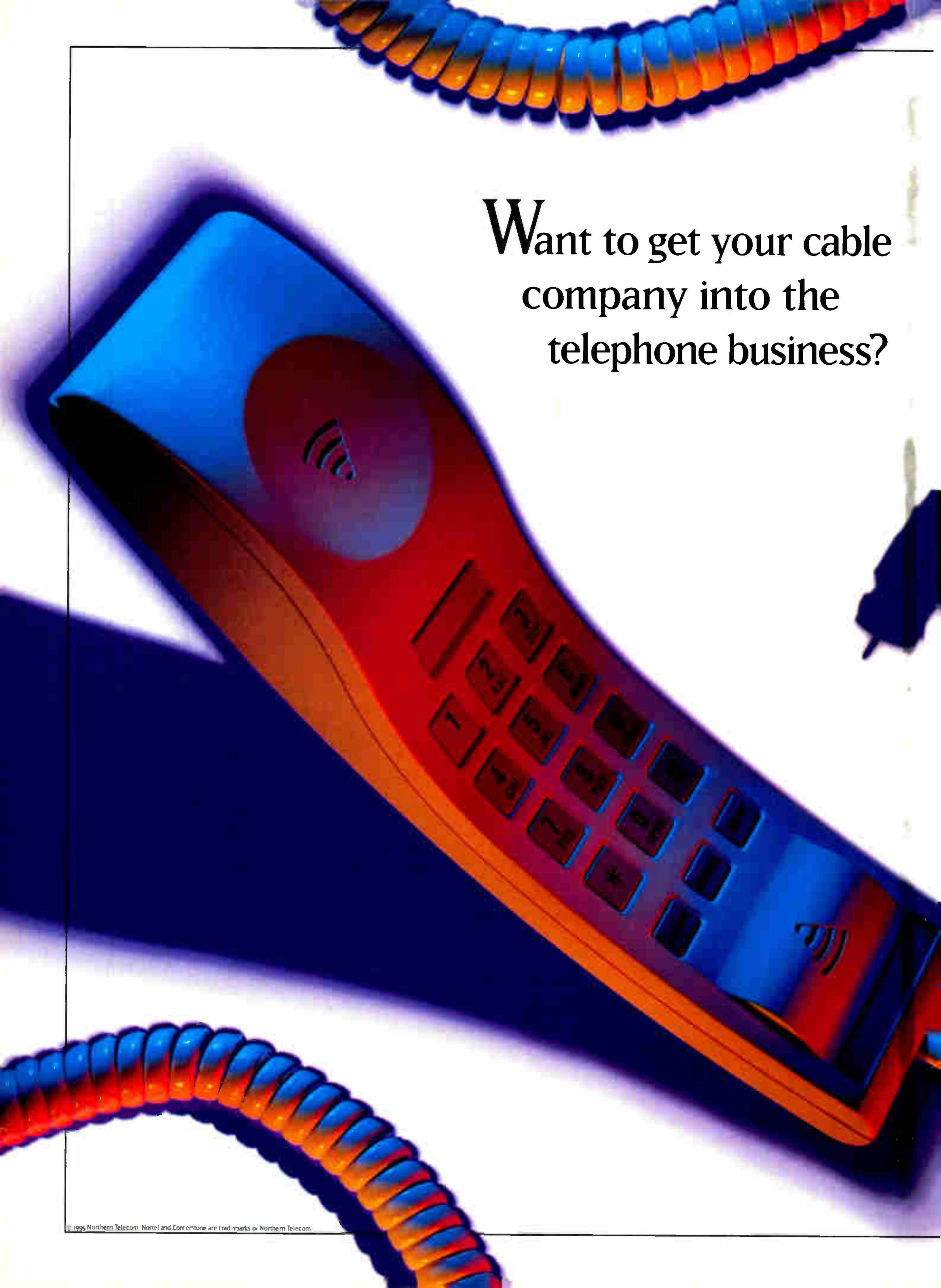
As consumers share information via public networks, the hybrid fiber/coax (HFC) network security becomes more important. Cable operators must assure the privacy of its service and therefore work with a supplier experienced in designing data network security. The provider must offer encryption that makes infiltrating security computationally so expensive and time-consuming to decode that the cost outweighs the value of the information extracted.

The right business partner

A secured end-to-end cable modem system is an excellent source for an additional revenue stream. The following outlines key considerations in selecting a partner that will customize a solution maximizing all benefits:

- A provider with a proven track record in building, designing and delivering secure, reliable, high-speed data networks for large corporations, including knowledge of providing measurement, computation and communications solutions.
- A partner with the expertise to manage a complete solution including the business model, design solution, delivery, installation, field support, network management and system security.
- A partner that offers a scaleable solution that can grow with the subscriber base.
- A provider that offers hardware and software that are upgradable so as technology advances so can the services the cable operator provides.
- A partner that understands both the cable operator's and its consumers' needs and can provide educated guidance from an established research base.
- A partner that is committed to this industry for the long-term and will be available to address the cable operator's ongoing needs.

With the right cable modem solution and partner, broadband network operators can manipulate modern technology to significantly increase their bottom line. In using existing infrastructures to create new revenue streams, the cost transferred to subscribers is reasonable, while the benefit of accessing interactive services via cable is high. The key to success, however, is taking advantage of experienced providers that understand the business, can provide the best customized business plans and the highest quality hardware and software. **CT**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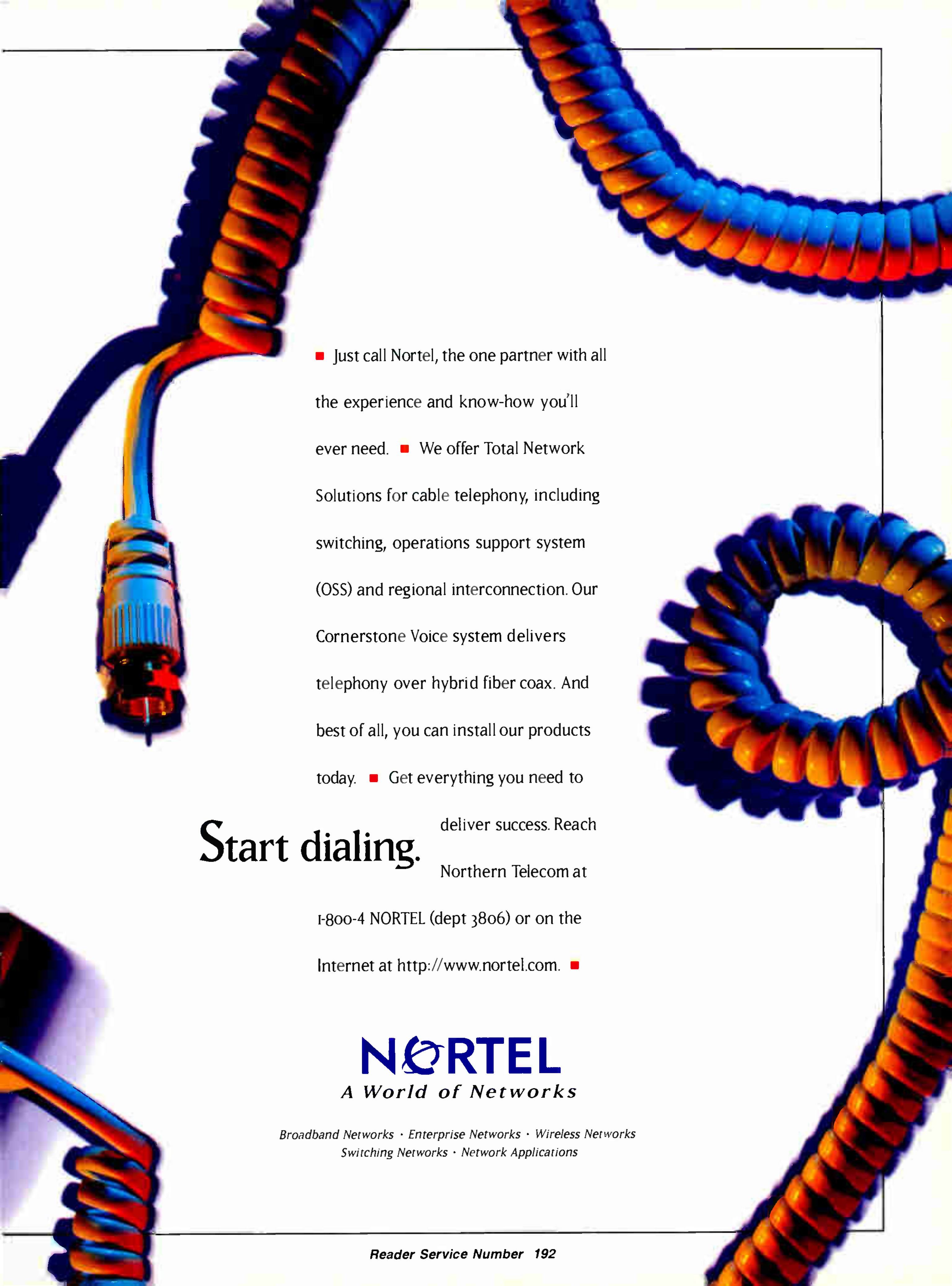
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By George Lawton, West Coast Correspondent

Videoconferencing for cable operators

At first glance, videoconferencing seems like a natural fit for cable operators. After all, their primary business is delivering video to subscribers. However, there are limitations in the two-way capabilities of most cable plants.

Since many operators are in the process of going through rebuilds, it makes sense for them to think about how to offer new services. The delivery of customized point-to-point video streams could be a big business for any operator that can offer a cost-effective service.

The primary economic argument for videoconferencing is that it saves travel time for business people. But that is just the tip of the iceberg for its applications. Video telephony is finding use today in remote surveillance, video vending machines, medicine, education and even sex.

Today, there are primarily two delivery mechanisms for wide area network (WAN) video. The first is over the standard switched telephone network. Room-sized videoconferencing systems for linking up entire rooms transmit video at speeds ranging from 384 kbit/s up to 45 Mbit/s.

The other delivery mechanism is through the Internet. It is a bit more sporadic in its delivery of video but people report achieving throughputs of 1.5 Mbit/s across WAN links and good results with only a fraction of that bandwidth. In addition, the Internet is more suited for multicasting videoconferences to a large audience.

"Video telephony is finding use today in remote surveillance, video vending machines, medicine, education and even sex."

Both of these delivery mechanisms could provide cable operators the opportunity to offer video telephony services. Since many operators are planning on rolling out telephony, a videoconferencing system could ride on top of it. Operators could even offer bandwidth on-demand for making those high-resolution calls.

The same is true for Internet access. A number of operators have announced plans to offer high-speed Internet access. Intel's latest modem is capable of delivering 27 Mbit/s shared downstream to customers, and 96 kbit/s of dedicated upstream bandwidth. That is more than enough for video telephony.

Designing for profits

Although cable operators could roll out services using either of these delivery mechanisms, they stand to lose out on additional revenues unless the service is architected and priced accordingly. For example, many cable operators are considering rolling out flat rate Internet services. That would enable customers to log on for an unlimited length of time for a flat $40 (or whatever) monthly fee. Such a scheme would enable customers to create high-speed video links over the Internet without spending an extra dime.

The same is somewhat true for telephony-based videoconferencing systems as well. Customers could use an integrated services digital network (ISDN)-based videoconferencing system over their cable-provided telephone service, just as they do today. However, with this kind of scheme, cable operators will not make any incremental revenue off the video.

Cable operators can add value to video by tailoring their networks to carry high bandwidth video streams to and from their customers' premises. For example, many switched telephony-based videoconferencing systems support variable speeds ranging from 64 kbit/s on up. In most schemes, the technology for delivering telephony over hybrid/fiber coax (HFC) dynamically allocates bandwidth for a given call. Consequently, cable operators could give businesses and consumers the

bandwidth they need when they need it, for a fraction of the cost they must now pay for fixed bandwidth from the telephone company.

Down the road, cable operators may even roll out a dedicated videoconferencing service. They might install a video switch in the headend that could enable customers to call each other or connect to the switched telephone network or the Internet. However, this is unlikely unless a large number of consumers or businesses can be convinced to pay significantly more for the service.

H.320 switched network

Desktop videoconferencing systems are the fastest growing part of the videoconferencing market according to Will Strauss, a consultant with Forward Concepts in Tucson, AZ. There are now over a dozen different products and many of them use proprietary protocols for communicating. Consequently, unless you and your partner have the same system, they may not work together.

That is starting to change as vendors realize the importance of interoperability. For example, a year ago, Intel rolled out Proshare, a desktop videoconferencing product that operates over ISDN. However, sales have been slow in part because of the lack of ISDN as well as Proshare's incompatibility with other videoconferencing systems.

Intel recently announced support for H.320, a set of standards for videoconferencing. This will enable Intel systems to communicate with any one else that supports the standard.

The International Telecommunications Union also is considering a variation of the H.320 standard for plain old telephone service (POTS) dubbed H.320 P. It will run on a standard V.34 modem at 28.8 kbit/s. Strauss said that the ITU has agreed on the audio but not yet the video portion of this standard. He noted, "It makes good sense to have some lower level entry into the market."

All is not dead. PictureTel recently announced a new POTS-based system of its own. Some have reported achieving 30 frames per second of video in a quarter of a PC screen. At the heart of the new system is a compression algorithm developed by the company called SG4 that can achieve compression ratios of 100:1 on the fly. Some have speculated that PictureTel may even try taking this to Geneva to get it standardized for POTS videoconferencing.

Videoconferencing standards

The most important standard for the videoconferencing industry is H.320. It is an umbrella standard designed to create videoconferencing interoperability. It was developed by International Telecommunications Union Study Group 15 (formerly known as the CCITT). Although proprietary systems can give better performance and quality, H.320 makes different systems work together.

The standards recommended by H.320 specify how two systems will communicate with each other by defining the protocols and procedures that will enable one vendor's videoconferencing unit to display video and play audio generated by another vendor's system.

H.320-compliant systems allow users to communicate with business partners all over the globe, without requiring partners to use identical hardware or software.

Such interoperability is crucial especially in a market too small to support multiple proprietary standards. As long as the participating systems are H.320-compliant, it should not matter what kind of hardware or software either party is using (although conference room systems may have to transmit at a lower sound and video quality to communicate with personal computer-based systems).

Proprietary systems, which only allow users to communicate with other systems from the same vendor, do not deliver that kind of universal communication. The H.320 standard was architected to support videoconferencing over ISDN, calling for the constant bit rate, isochronous transmission and dedicated bandwidth ISDN provides. Conferences also can be held over two switched 56 kbit/sec or fractional T1 lines.

The H.320 standard outlines all phases of the procedure for establishing a videoconferencing call. Those phases include call setup and outband signaling, call setup of additional channels, mode initialization on an initial channel, establishment of common parameters, visual telephone communication, termination phase and call release. Further, H.320 carves out specific roles for existing standards — H.261, H.221, H.230 and H.242 — in the videoconferencing process.

The core of the H.320 standard is the H.261 video compression recommendation, which presents the general rules of communications for encoding and decoding digital information. H.261 defines two resolutions: quarter common intermediate format (QCIF), a format used mainly in desktop and video phone applications, and common intermediate format (CIF), a format that is optional under H.261 and is used for room systems.

CIF requires coder/decoders to transmit video at a rate of 30 frame/s, with 288 lines of luma pixels per frame, 352 luma pixels per line, 144 chroma lines per frame and 176 chroma pixels per line. This produces a lower picture quality than broadcast TV. With QCIF, the pixel and line numbers are both halved, resulting in an even lower resolution picture.

H.221 handles communications framing by specifying what information is in a bit stream so each codec can keep track of video frames. It describes the order in which the bits are woven together and lined up (multiplexed) before they are transmitted. It also describes how to label the bits of transmitted information as either audio, visual or control data.

H.230 specifies how commands between codecs are exchanged during a videoconferencing session. The two primary parts of H.230 are the definition of both control and indication signals for various functions, as well as a table that specifies when certain signals — such as audio looping or fast video updates — are mandatory or optional. The signaling standards also call for certain types of diagnostic and indication messages to be sent to the user.

H.242 deals with call setup and disconnect. Like the modem handshake, it determines the method by which the two communicating codecs tell each other what capabilities they have so that both sides will independently set themselves in the same modes. H.242 in-

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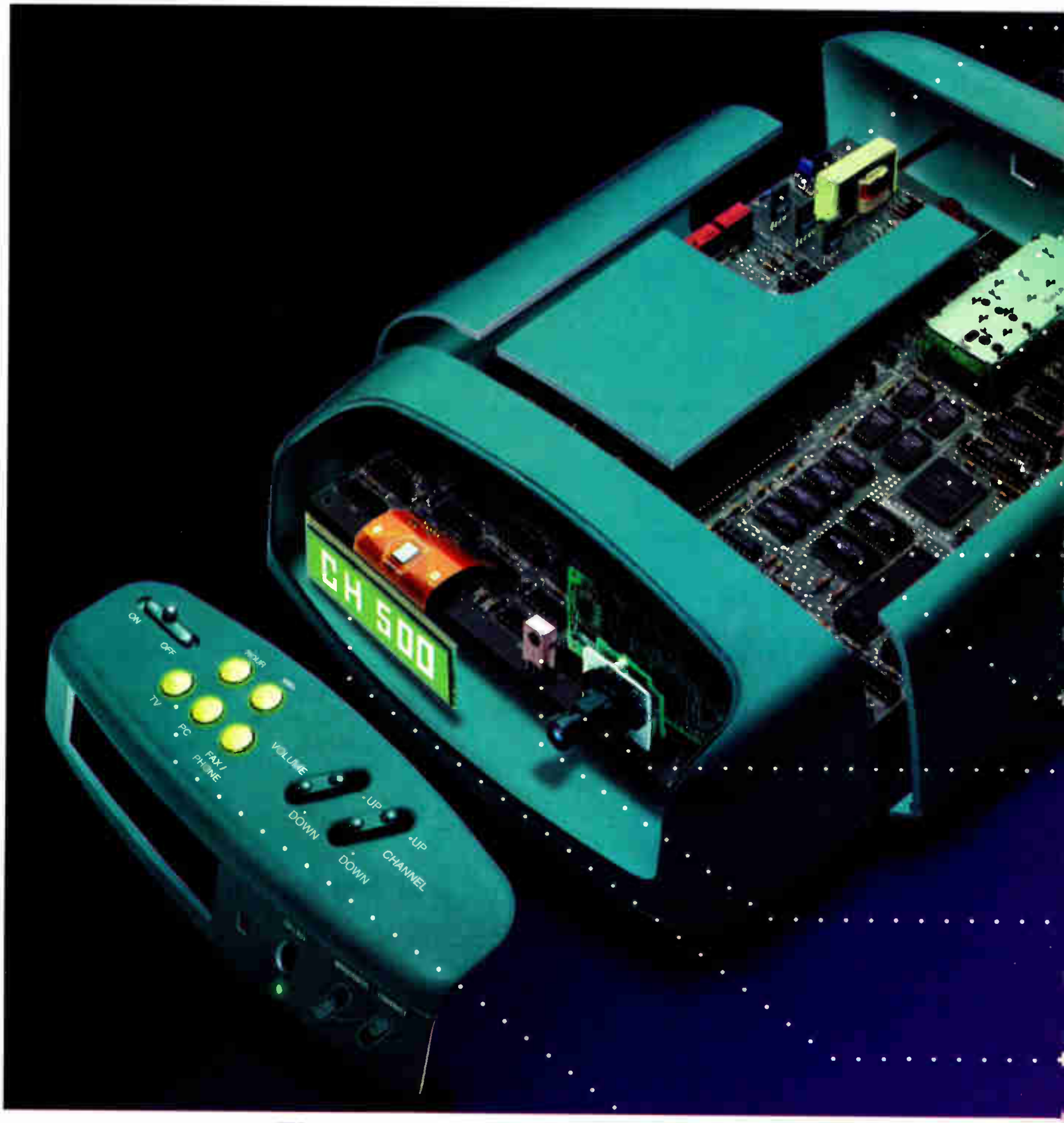
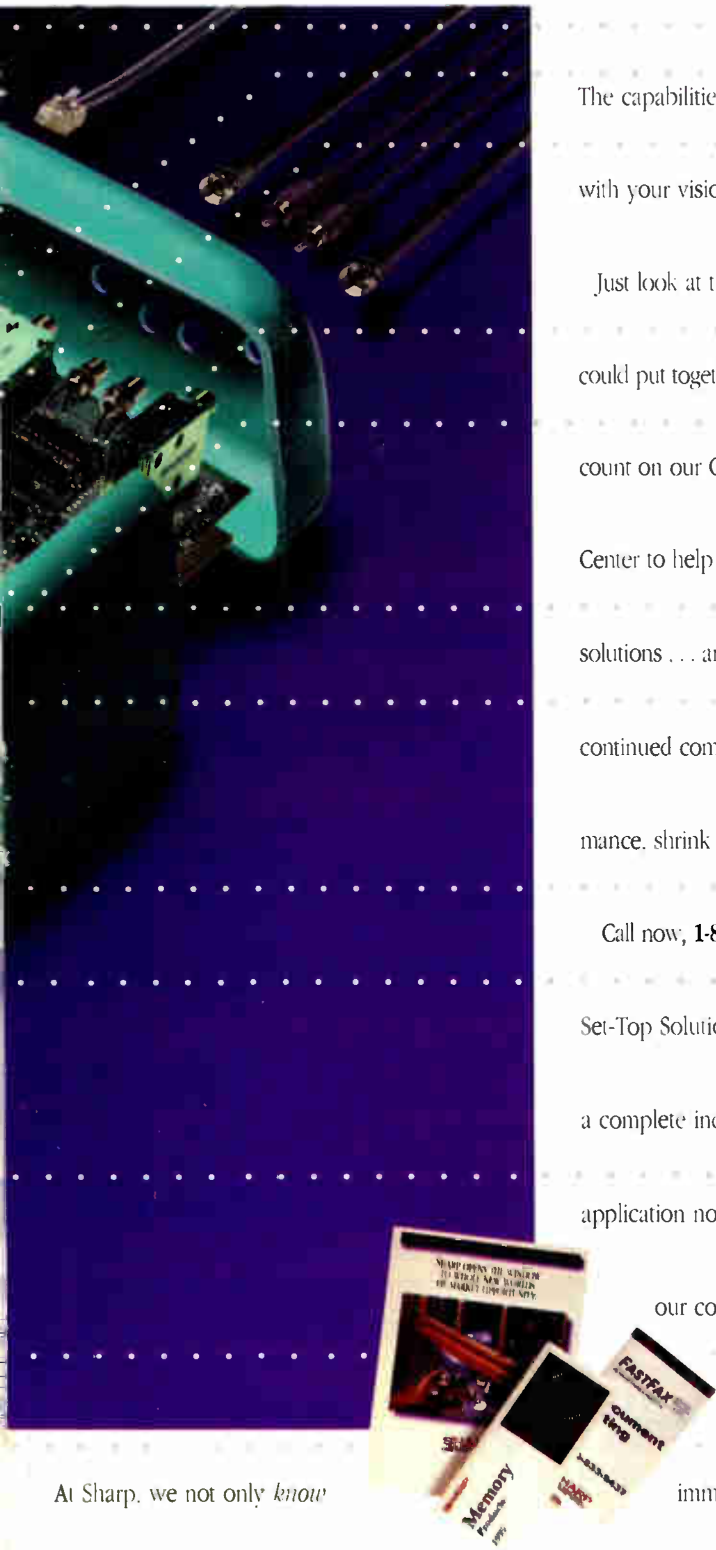


Everyone likes to talk about interactive TV; but only a relatively few really appreciate everything that still has to go into it—from the standards to the infrastructure to the integration required to meet mass market price points.

t o   S h a r p

got the guts.



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By Stacey White, Assistant Product Manager, International DigiCable Markets, General Instrument

Graphical user interfaces: Navigating the infobahn

The following is adapted from the "1995 National Cable Television Association Technical Papers."

The graphical user interfaces (GUIs) being designed for consumer broadband TV devices will play a crucial role in determining the success — or failure — of current and future services. These initial user interfaces will train viewers to navigate the wealth of programming and services available through new technology. An effective GUI will encourage viewers to use the services currently being offered and to be receptive toward future services. If the user interface makes it difficult to use initial services, the viewer may not be receptive toward new services.

Couch potato mode

As people spend more time managing work and home responsibilities, they have less to spend in front of the TV set. When viewers do turn it on, they expect to be entertained. They are in the relaxation — aka "couch potato" — mode. Television is meant to be easy, mindless. Despite hundreds of choices, GUIs should make locating something to watch effortless. The last thing the viewer expects to see is a DOS prompt on the TV screen.

Choices, choices

Think about the choices: Hundreds of channels of program offerings. The power to watch what you want at your convenience. Digital stereo audio and wide screen TV sets for home entertainment theaters. Secondary audio programming for multilingual households. Downloaded video games, CD-quality commercial-free music programming and home shopping all available at the press of a remote control button.

The good news is that convergence of computer and broadband TV technologies provides viewers greater variety in TV programming and services. Viewers have more control over what they watch and how it is delivered.

The not-so-good news is that the video tuning device that enables these choices is more sophisticated. Channel surfing is still possible but it no longer allows the viewer to maximize his or her viewing pleasure potential. The viewer must interact more frequently with the device, not only to find something to watch or select a service, but to modify the manner in which this program or service is delivered.

If the household is Spanish-speaking, the device would display all GUI text in Spanish and to tune all Spanish-language audio where available. If the viewer is the only Spanish-speaking member of a household, he would like to enable Spanish-language features during his viewing sessions only.

Technology being developed enables these capabilities. There is little doubt that the viewer would want a few of them. The question is: Will the viewer use them? The graphical user interface is the key. The on-screen graphics will either empower viewers to take full advantage of everything the technology makes available or frustrate them so they will not appreciate the power of the technology.

The challenge

Graphical user interfaces on TV sets, VCRs, satellite receivers and cable terminals will be challenged to entice viewers to relax in front of the TV set. Viewers will be inclined to spend more of their ever-decreasing spare time in front of the TV set if the technology, and the GUI that drives it, makes the experience fun and rewarding. Viewers will want to spend more disposable income on TV programming and services — both now and in the future — if they feel the programming, the services and the power of the technology enhance their family's home entertainment experience. GUIs will play a crucial role in determining a viewer's feeling of satisfaction and value.

Graphical user interface systems being designed for consumer broadband video products will be a training ground for viewers. The assumption is that ever-increasing home computer sales or office or school computer use will prepare viewers for new interactive services or next-generation consumer broadband video equipment. This assumption may not be completely accurate.

The level of confusion tolerated when operating a computer at home to reconcile one's finances, at school to finish one's term paper or at work to create a slide presentation, may not be tolerated when trying to operate the electronic program guide to determine what is on television. This low tolerance level could be especially evident when one has limited choice in the video equipment or services offered by the broadband network service provider.

Care must be taken to design GUI systems that train viewers to interact differently with their TV sets. A successfully designed GUI will entice the viewer to use features and services that are complex without appearing to be. The learning curve should be shorter than that of learning how to operate most computer software. And over time, the viewer should not only feel confident navigating current service offerings but also comfortable enough to subscribe to new ones when offered.

Potential revenue-generating capabilities from new technology will depend on how comfortable viewers feel operating these initial systems. If the electronic program guide is frustrating to work, viewers will not use it. They will not pay for the service and they could be disinclined to experiment further with other interactive services. If purchasing and watching a near-video-on-demand (NVOD) movie is complicated, viewers will not purchase many NVOD events. Furthermore, they will be less likely to experiment with video-on-demand (VOD) services when they become available.

User's perspective design

Designing a user interface from the user's point-of-view is easier said than done but it is crucial in developing products that people can use intuitively. User-centered design means anticipating the user's expectations and questions and then using design to address them. Instead of relying on explicit user manual directions to explain the product's capabilities, the designer relies on the design of the product's user interface itself as a guide through procedures.

This design approach tends to be complicated because the designer becomes too familiar with the product's features and capabilities. It is easy for the designer to momentarily forget that the user does not have the same product knowledge. The designer must constantly ask himself the following: "If I had never used this product, what would be my expectations of how it works? What are the design clues suggesting I do? Based on the patterns I have used so far, what would the user expect to do?"

A well-designed user interface does more than work with the current expectations of the customer. A successful user interface coaxes the user into trying unknown features. For example, most users would assume that an electronic program guide would tell what programs are on now and in the future and that the GUI would help navigate through the guide. Users may not be aware that the program guide would allow them to sort and display programs by themes. The graphical user interface should suggest that this possibility exists and effortlessly guide the user through the steps.

Enticing and guiding users through the unknown in a stress-free fashion are the most important objectives of any GUI. These are the paramount objectives of the graphical user interfaces being designed for consumer broadband TV devices. How well these products can do this today could determine how willing viewers will be to use services tomorrow.

Testing, testing

The development of intuitive GUI systems requires the early and continuous involvement of users throughout the development cycle. While focus groups, surveys and mall intercepts can be informative, the only real way to determine if a concept works is to test it on a typical user.

Once the designer has an idea, a prototype is developed and given to someone who represents the type of person who would use this product. This person should not be familiar with the product or the interface. The subject, alone in a room with the prototype and the person conducting the test, is asked to complete certain tasks, but is not assisted in any way by the tester. The tester watches how the subject interacts with the prototype. Ideally the subject would be videotaped and the tapes made available for study throughout the design process. Upon test completion, the tester would interview the subject to determine why he approached tasks in that particular manner. The feedback from such testing tells the designer what elements work and do not work and why. Videotape reviews allow the designer to learn helpful behavioral clues. This information is then incorporated into the design.

This type of testing can be used to analyze the effectiveness of a concept implementation or screen composition or to choose between several implementation ideas. Unlike surveys and other types of market research, user testing sample size need not be large because the objective is to observe how the subject interacts with the design in order to improve it. One need not test 100 subjects if the first 10 behave similarly. This is especially true if the sessions are

videotaped because the tapes provide firsthand information. Once the design is complete, user testing should be conducted to determine if it is indeed easy to use. Feedback from testing can be incorporated into the design prior to release, or in the next release of products.

Helpful help

Even the most intuitive GUI system needs to provide help instructions. Not everyone approaches unknown tasks the same way. Some people take chances when they reach a point of uncertainty, pressing buttons and dealing with the results. Others feel intimidated and will not proceed without seeking help first. Well-designed GUI systems accommodate both groups of users.

Help can be categorized into two groups: general help and specialized help. General help describes basic navigational and operational procedures. Specialized help is function-specific. While the basic navigational information may sufficiently execute a specific function, this may not (for some reason) be apparent to the user. The risk-averse users must be able to access specialized help on a specific function and read that its execution is no different from other known functions. The GUI designer is free to implement these types of help — the only requirement being that they are easily accessible.

Mistakes should not be fatal

For those who are willing to take risks, mistakes cannot be traumatizing. Pressing the wrong key should not confuse the user. Incorrect buttons are pushed and wrong choices are made, both intentionally and by mistake. Choice confirmation and the ability to return to a previous screen or exit the graphical user interface system entirely are ways to restore user control when a mistake occurs.

Remote controls

Less is more vs. more is better when it comes to remotes. There are many schools of thought on the number of buttons that should be on the remote control. Actually, the most important thing is the ease with which a user can locate the buttons.

The feel of the remote control in one's hand also is important. Is the remote control big and awkward? Are the buttons big enough given their importance to the user interface? Are the most frequently used buttons easily accessible? Are the labels easy to see in dim light?

There are many, many styles and price ranges from which to choose. While price is a major factor in choosing a remote control, cost savings gained from choosing an inexpensive but difficult-to-use unit can be wiped out by the loss in service revenue because the remote control inhibits the user's access to services.

Conclusion

Broadband TV technology will provide viewers with more programming and service choices. Unfortunately, technological advances in other areas of life are leaving viewers less time and disposable income to spend on these new and exciting services. This increases the importance of the graphical user interfaces currently being developed for consumer devices.

GUI systems designed from the user's point of view instead of the designer's point of view will be more successful in empowering users in navigating the many choices made available to them. The more comfortable viewers feel navigating the infobahn today, the more likely they will be willing to access it tomorrow. **CT**

By Jeff Berenson, Senior CTI Consultant, Dialogic Corp.

Customer service operations in an interactive TV environment

New methods for communicating mean new ways of doing business. As interactive TV (ITV) solutions are designed, piloted and deployed, solution providers must pay attention to several technological and human factors issues. These issues cover areas in technologies such as set-top box design, communications delivery systems, how a user will interact with the multimedia communications device and how the customer service function will be performed. This article addresses an aspect of ITV solutions that is often overlooked: The technical design considerations that must be taken into account in order to provide the commercial and residential user with state-of-the-art customer service operations.

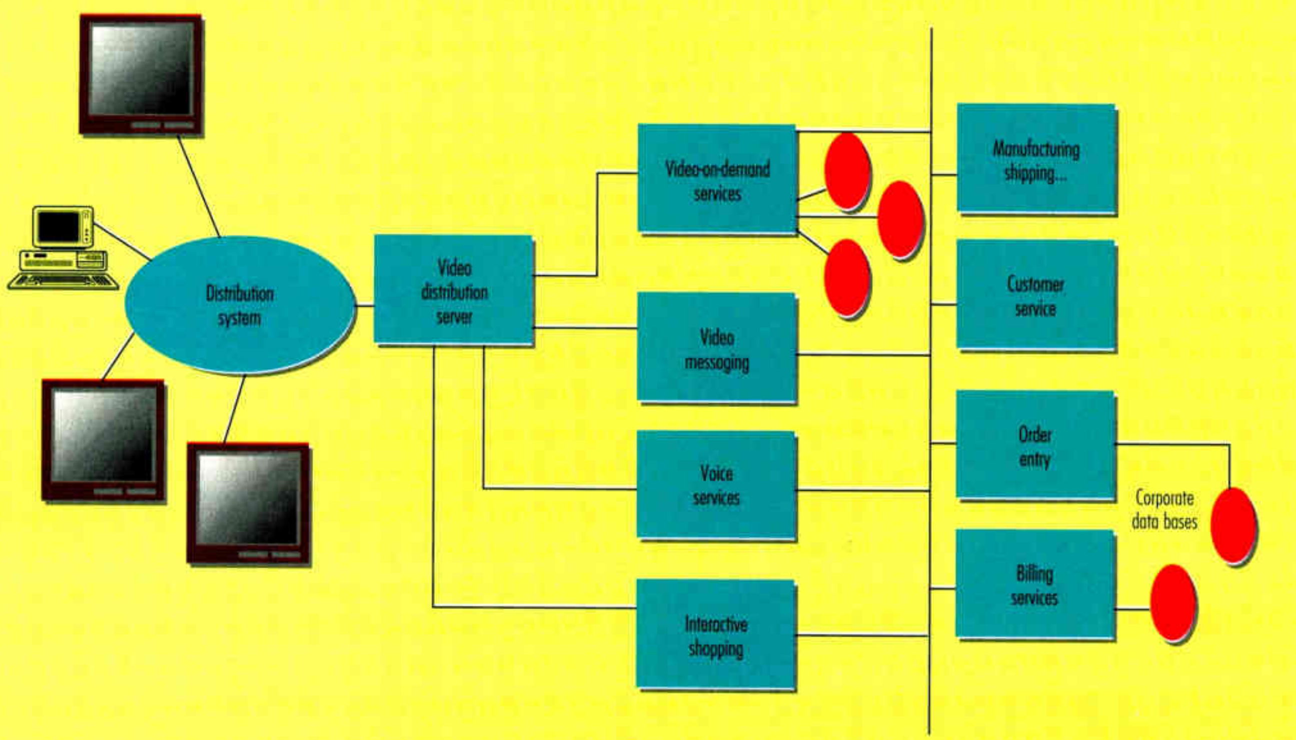
Multiple computing environments

ITV systems are poised to deploy an array of exciting applications for the commercial and residential user. Applications such as distance learning, multi-user video conferencing, interactive home shopping, video messaging, movies-on-demand, team games and others, promise to make the 21st century one of the most exhilarating for the user of such services. It also will be the most challenging for the systems designers particularly with respect to the customer service systems that must support this environment.

System designers will need to take both technology and human factors issues into account. Issues like the amount of bandwidth required for the user interface device given a particular application will need to be evaluated. At the same time, attention to how a user will interact with the system will have to be addressed. If the user interface supports a TV remote control, the number of buttons pushed will be of major concern. Alternatively, if the user interface supports voice commands, the verbs necessary to run a particular application will have to be determined. All these technology questions can be answered, but what about the human factor component of any system? What about the customer service function?

As the industry continues on its rapid pace toward delivering "killer" applications, little thought has been given (until now) to the administration and customer service aspects of an operation. Administrative applica-

Figure 1: ITV must interface with several backend computing environments



tions such as service change orders and billing/payment information will combine with services such as "replenishing the Internet access meter" as a key component of any deployment. Customer service offerings and accessibility of the ITV provider may well be the determining factors in the rapid acceptance of the technology for both the commercial and consumer user. Consider the following example.

A typical consumer application scenario will consist of a user pressing some buttons on a remote that instructs the set-top box to (have the backend video server) go to the local department store's home page, navigate to the men's tie selection and present video clips of the different offerings that are on sale. From the remote control, the user selects the item wanted, enters an authorization number, confirms an overnight shipping address and ends the transaction. Several days go by and nothing arrives. Who does the user call for service? The ITV provider? The store? The overnight shipping carrier? The credit card provider? How does the user begin to track the retail transaction?

As new applications are envisioned for an ITV environment, there must be a customer service component to those applications. Figure 1 shows how an ITV application must interface with several backend computing environments. These environments provide services such as billing, order entry, video-operator, enterprise messaging and manufacturing/shipping information.

Some solutions could be simple. For example, with a national retailer, all information regarding ordering is passed directly into the supplier's computing environment. The retailer would then be 100% responsible for order processing, billing, shipping and all other functions including customer service. Confirmation back to the end-user could display/print customer service contact instructions.

On another level, a solution could involve many more backend computer systems interactions. Consider a deployed ITV system that will have to support local retailers (just as they do today for advertising insertions). In this case (see Figure 2 on page 58) the local ITV service provider would be the ordering, billing and provider of the customer service function.

This would be done on a fee-based structure. Many different types of structures could be implemented. For example, a fee could be charged by the ITV provider based on the dollar amount per item sold. In another case, a flat or graduated fee based on the number of expected sales could be implemented to handle the ordering and billing component of an application. Separate fees to the product/service supplier could be assessed based on the number of customer service transactions involved.

Tracking the transaction

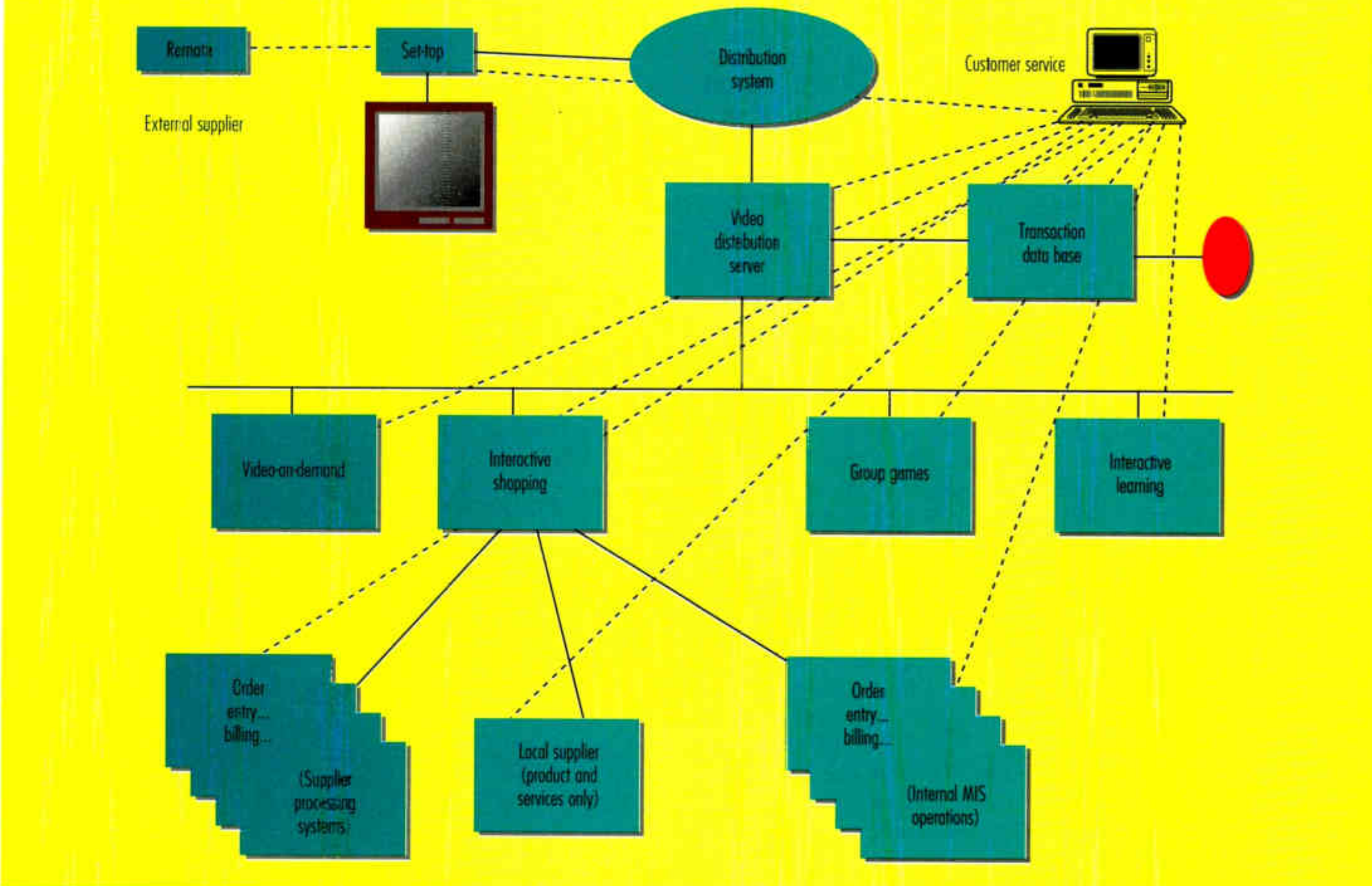
In an application where the ITV service provider is the first line of interaction with the user either from an ordering/billing or customer service viewpoint, its representatives must be knowledgeable about the product and service offerings of the specific application. From a customer service perspective, an agent must be able to track each transaction regardless of the different backend systems utilized in a particular application.

As each new application is developed and deployed (either on a local, regional or national basis), transaction tracking will take on a higher precedence. With today's state-of-the-art integrated voice response systems, each keystroke and/or subtransaction is logged into a "call status" or "transaction status" data base. When each step of the transaction is processed, update entries are made within the data base. If a user of the service requires human intervention, applications at the desktop provide the customer service agent with exact details about the caller and his/her interactive voice response (IVR) session before the call is answered.

This type of transactional logging will become even more essential with the deployment of ITV systems. System and application providers alike will have to provide the necessary "hooks" into a tracking data base subsystem for detailed recording and analysis of ongoing events. As part of the "event logging" schema, each "set" of events will need to be assigned a unique tracking number or serial number. The serial number could then be used by customer service agents, system reporting facilities or trouble ticket operations as a key into the data base for gathering information.

Looking at authoring tools now appearing in the market (such as

Figure 2: ITV system supported by local retailers



SyBase's Intermedia system, Digital's Video Server product, Oracle's Media Server tool kit, and Hewlett-Packard's Media Stream Server technology, we can see a developing industry. These tools give the "content" providers a defined access method to a powerful media and thus, to the end user. Equally important to bringing new applications online cost-effectively is the ability to integrate easily with backend data processing systems. These tools provide the hooks but it is up to the application designers to use these interfaces for administrative and customer service functions in conjunction with the mainline application.

In using a tool, ITV service provider base operating environments will need to track each transaction and how it relates to a user's request. This can be done using existing MIS data base technologies. The data processing systems that run the video servers will need the ability to send application-specific information to other systems for processing. Configuration of such environments will need to be flexible, reliable and adaptable. Without these capabilities, it will be cost-prohibitive to bring new applications online.

The customer service factor

As new ITV applications become more varied and more complex, the backend data processing environment will have to "belly up to the bar" when it comes to customer service capabilities. If the user of the service is a commercial enterprise, the customer service operation will take on an even more extensive meaning. This becomes especially true when businesses start relying on "the system" for their day-to-day operations.

"The cable plant will no longer be the bottleneck in providing true ITV capabilities."

If we assume that a structure (wire plant, video servers, application backend systems) exists in an ITV deployment, flexibility in adding or enhancing existing applications becomes essential. The customer service component is a key part of the application. This means that if the end-to-end environment (from both a technology and customer service perspective) is not extensible and flexible, it will become cost-prohibitive to add new applications.

Finally, after 20+ years of rewiring and technology enhancements, the cable plant will no longer be the bottleneck in providing true ITV capabilities. The computing cycles are finally cost-effective and the application authoring tools are coming online. What will really make the industry progress to the next level will be the ability for service providers to use their customer service operation as a distinguishing factor in this new environment. **CT**

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By Rick Cavanaugh, HFC-2000 Broadband Access System Offer Manager for MSO Markets, AT&T Network Systems, Gordon Bechtel, Member, Technical Staff, AT&T Bell Laboratories, and Curtis Siller, Distinguished Member, Technical Staff, AT&T Bell Laboratories

Telephony, interactivity and the upstream spectrum

Most multiple system operators are currently in the process of modernizing their systems with hybrid fiber/coax (HFC) networks to begin offering a suite of new services — like telephony, video-on-demand (VOD) and Internet access — in order to capitalize on the promise of increased subscriber bases and revenues. To reap the benefit of these new services, however, the MSO must first find a way to manage a precious and scarce resource, the upstream spectrum.

The problem is the upstream and downstream HFC spectrum are unequal. In the past, this was acceptable because analog TV signals are very unidirectional (or asymmetrical). However, new services are more symmetrical. Some are characterized as even having as much — or more — information upstream as downstream.

Because the amount of upstream spectrum available for these new services is limited, managing it has become a priority for most MSOs today. In addition, the upstream spectrum is challenged with a great deal of ingress noise (relatively low frequency ambient noise picked up by the coaxial plant) further reducing usable bandwidth and complicating matters more.

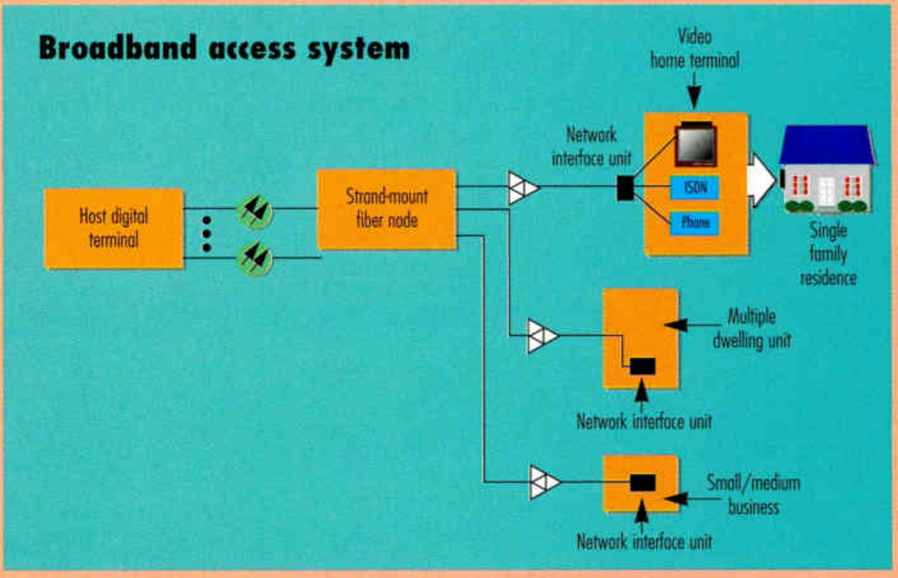
New services, demands

Modern HFC plants provide enough spectrum downstream to deliver new services such as VOD, telephony and data. However, the MSO should understand what demands these services will place on the upstream spectrum

Networking solution at the point of convergence

The broadband access system shown in the accompanying figure is an integrated HFC network with a star-bus topology that uses a single coaxial service cable to carry both broadband multimedia services and narrowband telephony services to subscribers. This network has three primary components:

- *The host digital terminal* (HDT) is located in the headend and provides a TR303 interface to the digital switch. The HDT includes RF distribution shelves that modulate digital telephony and data signals onto RF carriers. Finally, optical distribution shelves combine all telephony, analog broadcast and digital video signals, and distribute them via fiber to multiple fiber nodes forming the fiber star topology of this network.
- *Fiber nodes* are installed in neighborhood serving areas and receive the optical signals transmitted from the HDT. The fiber nodes convert the downstream optical signals to electrical signals for transmission over multiple coax trunks. The fiber node also accommodates the upstream signal required for full implementation of symmetric services.



- *Network interface units (NIUs)* consist of a flexible family of terminals that split out the telephony and video signals and transmit them within the home, apartment building or business utilizing conventional premises wiring. Twisted-pairs handle narrowband services like plain old telephone service (POTS) and ISDN. Coaxial cable connects the NIUs with broadband equipment such as TV sets or home terminals. The NIUs also collect and transmit upstream signals to the HDT.

In addition to fiber facilities already in place, the system may use existing twisted-pair in the home for narrowband services, existing coaxial cable, amplifiers, headend optics, fiber nodes and power supplies for service to the subscriber.

as it prepares to integrate them into the network.

The upstream traffic for VOD, for example, is characterized by small bursts of data as the subscriber interacts with the system via a remote control. Because only short button pushes to fast forward or pause need to be transmitted upstream, very little bandwidth is required. Yet these button pushes need to be transmitted with very little delay so that the subscriber sees the desired reaction within an acceptable period of time. Therefore, the upstream channel must have a mechanism for delivering bursty, delay-sensitive traffic in an efficient manner.

Transmission of data services for applications like work-at-home, Internet access or e-mail is packet-based and bursty, as well. In contrast to VOD, these bursts are not as delay-sensitive. These services often contain large amounts of information and require a bursty, high-rate transmission mechanism. Telephony services, on the other hand, require transmission at a constant bit rate. When a telephone goes off-hook, the network needs to allocate a dedicated 64 kb/s channel in both directions.

Regardless of which service a MSO is providing to its subscribers, latency will become a critical issue. For example, with VOD applications it is very important that the button pushed by the subscriber — to pause, rewind or initiate playback — is quickly sent to the server so that the response is much like a VCR in the home. Latency is an important consideration for telephony, as well, since too much latency will result in echoes during a conversation. The latency factor is probably least critical with data services since small delays in transferring files are acceptable provided that the total transfer is completed quickly.

Coaxial integration of services

Today, different services occupy their own spectral channels and coexist as spectral "neighbors." Although coaxial integration is the first and most natural step for incorporating them, there are issues involved with placing too many services in the same coaxial spectrum. For example, there is a proliferation of modems in use today with various spectral roll-offs and spurious emission that may require guard bands of various sizes so as not to impact their neighbors.

If all the different modems from different vendors are to operate in the same spectrum, certain guidelines need to be defined in the short term when services are still spectral neighbors. Unless rules (and eventually standards) are established, the lack of interoperability of all this various equipment will restrict MSOs from utilizing the spectrum to its full potential.

In terms of managing spectrum, the MSO allocates separate blocks within the upstream spectrum (5-30 MHz or 5-40 MHz) to each individual service. Unfortunately, that available spectrum is a finite resource. If an MSO experiences success in one service area, it may quickly reach a point where it has no upstream spectrum available for new services. Customers want a new service but can't get it. How does the MSO avoid missing out on customers — and revenue?

There are two HFC plant measures the MSO can pursue today that will increase the upstream spectrum. First, using the scenario where a fiber node serving 600 homes passed has reached capacity, the MSO can push fiber further into the serving area to the 300-homes-passed point. With separate fiber nodes, the two 5-30 or 5-40 MHz upstream signals are routed over two separate upstream paths to the headend. By doubling the number of fibers nodes, the MSO also doubles the amount of spectrum available while keeping constant the number of homes passed.

A second alternative for a fiber node that has reached capacity is the use of block converters. Assuming a fiber node serves two coaxial cable legs with each serving 300 homes passed, the MSO can take both coaxial legs and block convert them to different frequency blocks over an upstream broadband laser. By doing so, two separate pools of upstream bandwidth are now available to the MSO.

Block converting doubles the upstream capacity of the system and works with existing equipment, making it a cost-effective alternative for the MSO. However, if the MSO is successful in offering new services to its subscribers, there will be a point when even these measures are not enough. Integration of all services onto one modem is the only way a MSO can truly optimize its scarce resource and remain competitive in the long run.

Spectral integration

The day is quickly approaching when the upstream needs of telephone, data and entertainment services will be integrated into the same upstream spectrum. For those possessing this ability, it could mean a distinct marketplace advantage.

For example, one broadband access system available (see sidebar), provides functionality in flexible ways so that the MSO can begin combining telephony with television in a smooth and cost-effective manner. The modularity of the system allows the MSO to upgrade its network based on its own needs and growth projections without committing up front to a full array of possible services. The system successfully integrates any data (e.g., ISDN) or other service that terminates on a SLC channel unit, along with telephony.

Also envisioned for the future is a flexible access protocol (FAP) to accommodate the provision of different traffic types over a HFC network. When FAP is incorporated into the system not only will it be able to provide connection-oriented services (e.g., a phone call), it also will support connectionless services like cable LANs.

There are a variety of services that can be supported within the same spectrum. The complete integration characteristics of FAP will enable MSOs to utilize the maximum potential of their available spectrum. By making the most efficient use of this bandwidth, an MSO can then maximize its revenue for a given piece of spectrum. On the other hand, if an MSO doesn't embrace a multiple services protocol like FAP, it most likely will be faced with upgrading its cable plant before it would have had to otherwise.

FAP divides time into two parts in the upstream direction — one dedicated to constant bit rate services like telephony and one dedicated to variable bit rate services like VOD and data traffic. The boundary between the two regions is flexible and can be adjusted dynamically over time. When an MSO experiences an increase in phone calls, for example, the portion allocated to telephony can borrow from the portion allocated to handling bursty data traffic with the sum of the two remaining constant. If data transmissions are on the increase, this same scenario happens in reverse — effectively integrating constant and bursty traffic patterns. Within the two types of bursty upstream traffic (video and data), multiple access time slots are provisioned to handle traffic. Small bursts can jump on at any time. Meanwhile, a mechanism is in place to reserve time slots for rapid transfers of large files.

The benefit of FAP to the MSO is that once all these services are rolled into one piece of the spectrum, they can be managed much more efficiently. In today's environment of segregated services, if one service (like data) gets busy while another (like telephony) is slow, the MSO will have underutilized spectrum. Unfortunately, reprovisioning that space to the busy service is difficult. The end result is that the MSO loses an opportunity for increased revenues. With FAP, the MSO has the flexibility to change allocations to match the current traffic trends on the plant — and ultimately, generate more revenues. Furthermore, services can be provided more cost-effectively since only a single modem at the premises (compared to multiple modems) is required for a suite of services.

There is no question that traditional single-service providers will eventually compete against each other for telephone and interactive multimedia services. Since existing telephone and cable TV networks offer special advantages that the other lacks, MSOs who successfully bring these diverse technologies together with state-of-the-art integrated systems are likely to profit most. The upstream spectrum may be scarce, but it still offers a wealth of opportunity to those who use it effectively. **CT**

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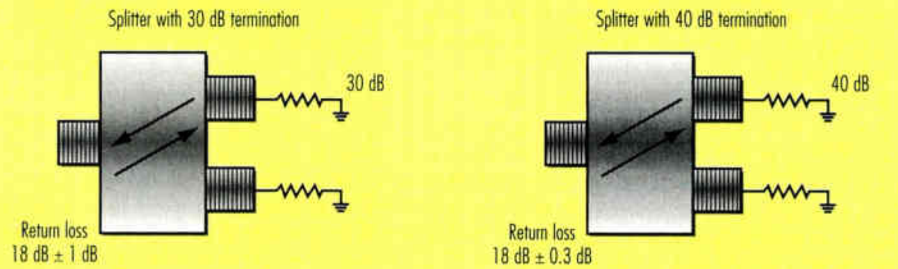
By Michael Holland, President, Holland Electronics Corp.

Determining test system accuracy in measuring 1 GHz passives

The new generation of 1 GHz passives has renewed and magnified the cable industry's longstanding problem of setting more accurate test standards for passive products. As the frequency of operation has gone up to 1 GHz, the accuracy of the same equipment and adapters used previously to 600 MHz has gone down. The combination of these lower equipment accuracies, with some passive parameters being lowered to barely acceptable levels, has created the need to examine our testing methods and improve their performance.

The primary requirement of the new 1 GHz taps, splitters and directional couplers has been to provide a lower and flatter insertion loss over the entire frequency range. Optimizing this parameter makes a lot of sense in that cable loss and tilt become a critical factor in higher frequency systems. With the present passive technology, these lower losses can only be accomplished at the expense of other specifications being loosened. For example, the typical 25-30 dB port-to-port isolation spec for a high-quality 600 MHz splitter has been reduced to 18-25 dB for 1 GHz products. Acceptable return loss (RL) specs also were dropped from a typical range of 22-28 dB to 16-22 dB for similar reasons.

Figure 1: Splitter terminations



These spec trade-offs for lower insertion losses are wise, but have unfortunately resulted in the removal of the buffer between typical specs and the absolute minimum levels the industry has required for present and future technologies. These future minimum requirements for return loss and isolation have not been fully addressed in the past because there was always a large enough buffer between actual performance and what was perceived as the bare minimum. As we now get near the bottom on some specs, pressure has been renewed on the test engineer to accurately measure parameters such as insertion losses to within 0.2 dB at 1 GHz and return losses to within 1-2 dB on an 18 dB product. To make matters even worse, the connectors and terminations formerly used to test products at 600 MHz also exhibit more mismatching at the higher frequencies when we are in fact demanding even greater accuracy due to the loss of the former buffer in our specs.

Typical measurement uncertainty

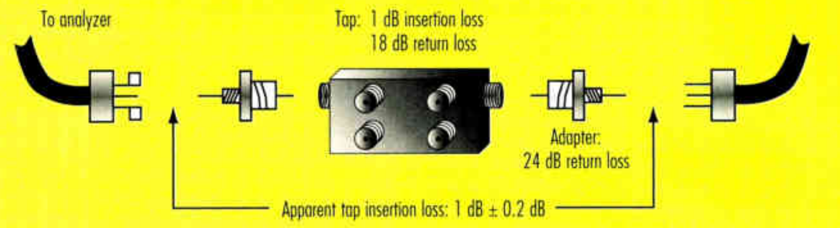
	Insertion loss	Return loss
Standard sweep generator (similar to Wavetek 1801)	0.5	10
Scalar analyzer (transmission/reflection using a broadband detector)	0.5	6
Scalar analyzer with one-port test (with tracking tuner/detector, similar to HP 8711)	0.3	3-6
Vector network analyzer, one-port test (similar to HP 8752)	0.25	3
Vector network analyzer, two-port test (similar to HP 8753)	0.08	1

This article will briefly mention the general accuracy levels of currently used test equipment and explain the errors caused by poor matching and phase differences of the termination, adapters, detector and bridge. The test system's overall accuracy is equally dependent upon the precision of these connectors, adapters and terminations as the analyzer itself. Even the best analyzer can have its accuracy degraded by low return loss accessories.

If the cable industry's minimum return loss is 16 dB and the passive to be measured is specified at and reads 18 dB, then it is clear that only a 2 dB maximum RL error on the test system can be tolerated. It will be shown later that only the highest level of analyzer and the best adapters can assure this accuracy.

If we cannot get this accuracy at the new 1 GHz range with present test systems, we must either lower our requirements to allow for greater equipment variance or upgrade our equipment and adapters to perform within specifications. Since we do not wish to lower system performance by degrading product specs further, the only choices are to either understand the accuracy level of our own test system or upgrade the equipment.

Figure 2: Apparent tap insertion loss



Test equipment and accuracies

There are basically five types of test setups used in the CATV industry to measure passive device insertion loss and return loss. It is important to understand the capabilities of each. The fact that they specify operation above 1 GHz is not a guarantee that they will be able to perform to the new stringent requirements.

The tolerances in the accompanying table show the typical measurement uncertainty in each type of analyzer calculated on a typical tap with a 1 dB insertion loss and an 18 dB return loss. Even though this article will not go into the calculations used to determine the error values, it is important to mention the theory behind those calculations.

Factors affecting analyzer accuracy include:

1) Standard sweep systems (typical price: $5,000-$10,000). Errors arise mainly from:

- Noncompensated cables — the cable lengths, connectors and impedance play a major part in the sweep's accuracy.
- Low RL detector (20 dB typical). A return loss of 20 dB facing an 18 dB RL device may produce insertion loss errors of 0.3 dB.
- Noncorrection for load, detector and bridge phase difference.
- Uses a separate bridge for RL measurements. RL and phase error of the bridge can be a factor.

2) Scalar analyzers ($10,000). Errors in insertion loss arise from low detector return loss (as in the sweep system). Return loss improvement is made from the scalar analyzer's ability to compensate for cable's impedance, length and connectors. Usually the scalar analyzers also have higher accuracy over the traditional analog sweep systems due to their digital processing and compensating circuits. The scalar analyzer uses a separate bridge. Phase and RL have some effect. The passive's termination phase and RL can be a factor.

3) Scalar analyzers with tuned detectors ($10,000). This type of analyzer is similar to the scalar previously mentioned but further improves performance by improving the noise floor of the detector using tuned swept input circuits. This tuned input makes synchronous detection possible and provides vector correction of the built-in bridge.

4) Vector analyzer with transmission / reflection with one-port test capability ($20,000). This type of analyzer improves over the scalar type in measuring vector S parameters. It corrects for errors by detecting the phase of the devices under test. It does not correct for phase and load match of the load termination.

5) Vector analyzer with transmission / reflection with two-port test capability ($35,000+). This analyzer has the added feature of not requiring a load or bridge to measure return loss. The analyzer looks into both ports of a passive simultaneously and corrects for its own detector and loading errors from reflections.

The test equipment you buy will usually come with special test connectors and calibration kit with precision loads and adapters. In the case of taps, a high return loss pin-to-N or pin-to-F connector is needed to interface with the analyzer cables. This adapter is not compensated for by the analyzer's calibration kit and can be the limiting factor that will determine your overall accuracy.

Effects on accuracy

First, let's look at the effects of connectors, adapters and terminations on test accuracy It should be noted again that all the analyzers mentioned perform well at lower frequencies where the RL of the terminations and adapters are high. Unfortunately, as operating frequencies have risen, the return loss of the connectors and terminations have dropped, making the test system's inability to compensate a factor in the overall test system effectiveness.

As the RL of the adapter comes closer to that of the passive under test, the error effects become greater. This is especially true if the insertion loss is very low. If a typical sweep system/RL bridge was used to measure a 1 GHz two-way splitter, the standard adapters, 45 dB directivity RL bridge and standard terminators could produce a visible ripple or error variance of up to 9 dB for an 18 dB RL passive.

When measuring taps, the use of the pin-to-N adapter over the pin-to-F can provide higher return loss accuracies of approximately 1.5 dB. This higher accuracy using the N connector system is not usually available in that most test systems are set up with precision F cables and calibrations for splitter testing.

Now let's look at the effects of termination on passive input RL measurements

A standard terminator may have a RL at 1 GHz of less than 30 dB where a precision test terminator might reach 40-50 dB. In that the load match is reflected to the input of the passive, a low RL load can cause large errors in the input RL measurement. The following will show the possible errors using a 30

By Doug Daut, Technical Trainer, Viacom Cable

Pole climbing training safety

You have just hired a brand new extremely motivated installer. He's a fairly young guy, recently married with a child on the way. He has no experience but that's OK. Employees with his level of enthusiasm and desire are few and far between. Your boss just met him and thinks he's great so the rest is cake, right?

Monday he will go through orientation, Tuesday he will be issued all of his equipment (tools, climbing gear, etc.) and Wednesday you will personally take him out to get his feet wet climbing poles. You have done it this way a hundred times before and it works great! As the saying goes, "If the system ain't broke, don't try to fix it."

Barry Smith

On Wednesday, you and your Wonderboy get in the truck and go find the closest bare pole to the office. After demonstrating your climbing prowess, achieved over 10 years of experience, it's his turn. The first day you take it easy — 10 feet max. Wonderboy looks pretty good. A little shaky on his technique, but what can you expect on the first day.

So, feeling positive about the progress made, you both head back to the office. Once there, some time is spent reviewing the video climbing tape and discussing all areas of concern.

Wonderboy admits that he was really nervous but in true grit fashion he states, "I just have to concentrate on good climbing techniques and not think about the height. Tomorrow, I want to go all the way."

The next day Wonderboy pushes you to let him go past the 10-foot mark. You just smile and say, "Sorry, not today. I want to make sure your technique is impeccable. Tomorrow."

On your way to work the next morning, you think about how quickly this new guy is going to get up to full speed. You'll have the install backlog in shape in no time. During your morning cup of coffee you catch a glimpse of the new kid inspecting his climbing gear and talking a little nervously with the old pros.

George, a senior tech, begins telling one of his war stories, "Hell, when I first learned to climb all they did was throw you a pair of gaffs and point. I was lucky. I only fell once from about 10 feet. Got a nice big creosote splinter in my arm — right here. See the scar. Some of my friends back then weren't so lucky you know. Why ..."

You cut him off, saying, "OK, let's travel out of the 19th century and back into the 20th century where you, George, have been in a bucket truck for so long you wouldn't know a pair of gaffs from ice picks."

Everyone chuckles, including the new guy and both of you head out the door.

Once at the chosen pole, you go through all the standard safety procedures and practices. You can see he is anxious to tackle his objective. It reminds you of the emotional adrenaline rush that comes with that first trip to the top of the pole. After some preliminary practice, Wonderboy heads for the strand. The first 10 feet are perfect. At 15 feet he loses his concentration and rhythm just a bit.

You offer him encouragement by hollering, "You look great! Concentrate on that 30° angle and you'll be there before you know it!" Two steps later you notice one foot begins to shake. With his next step he hits a small crack — not enough to make him slip if he keeps the proper angle. But he doesn't! In a panic he pulls himself against the pole and down he comes. It happens so quickly. As he slams against the ground you see a splintered bone protrude from his leg. With your heart attempting to exit your chest, you run over to him and notice his back is severely contorted. You provide what first-aid you can until paramedics arrive.

Devastated, sick, remorseful, angry, upset. How do you live with these feelings? You see, Jimmy (Wonderboy's real name) is now paralyzed from the waist down. At the hospital, his pregnant wife just looks at you with tears in her eyes. She doesn't say anything. She doesn't need to. Why did this happen? What did you do wrong? That is what you, she and everyone else will be asking for a long time to come.

Could this happen?

Perhaps this story has never occurred in the exact way I just described. But believe me, in one form or another, it has happened — or is waiting to happen — at every cable system operating today. As a technical trainer, one of my responsibilities is to train, certify and recertify over 200 employees per year to safely climb utility poles. Having been too close on too many occasions to the Wonderboy scenario, I decided to develop something that would help alleviate the danger of training technical employees to climb.

What you'll need

Following is a step-by-step description of an inexpensive method and device that should substantially reduce the possibility of injury during new-hire climbing training. In addition, if you live in a litigious state such as I do, it may save your company a wheelbarrel full of money.

The first area of concern in the previous story is the use of system poles for training purposes. The telephone and electric companies frown heavily upon this practice. It takes very little space and money to set up your own climbing area. A 12- x 30-foot area (or roughly three side-by-side parking spaces) should allow ample room for two poles, strand and downguys. Class 3 or 4, 30- to 35-foot Douglas fir untreated poles can be purchased for less than $200 each. Shipping costs will vary depending on location. If you do not have a truck equipped to set poles and anchors, there are plenty of contractors who do. (A strong relationship with the utility companies can come in handy in this situation.) Once poles are in place, add a few cubic yards of sand and you're in business. Regardless of your particular resources, costs should not exceed $1,500 and in some cases can be far less.

Once you have established a safe climbing area, it is time to install a safety harness. This harness will protect the new climber from serious injury in the event of a slip or fall. It also is an excellent confidence builder.

I want to emphasize that this device is not used during the final pole climbing certification process. Obviously, the employee will not have the luxury of a fall arrest system in the field. Its primary use is to overcome the initial fear encountered by the new climber during his/her first trips up the pole. It also does wonders for the trainer's nerves.

In order to accurately utilize and install the safety harness, you will first need to become familiar with rock climbing apparatuses and procedures. (Any good outdoor retail chain can accommodate your needs.) You will then need to purchase the following equipment:

- 100 feet of static rope (80 cents/foot)
- Four steel locking biners ($20 each)
- One belay harness ($40)
- One belay device ($14.75)
- One rear attachment body harness ($205)
- 30 feet of tubular webbed slings (45 cents/foot)

The approximate total for this equipment is $433.25 + tax.

Definitions

Let's quickly define some of the pole climbing terms you'll probably run into.

- *Tubular webbed slings:* Part of support mechanism between groundperson and anchor. (It is necessary only when climber is substantially heavier than the ground person.)
- *Static rope:* Support rope for pole climber.
- *Steel locking biners:* Support clips for rope attachments to pole, groundperson and climber.
- *Belay harness:* Groundperson's body harness.
- *Body harness:* Pole climber's body harness with rope attachment in back.

Once you have purchased and familiarized yourself with the proper use of this equipment, it's time to install it. (Note: I had absolutely no rock climbing experience upon beginning this project. It took approximately three hours to become familiar with the proper use of all equipment involved.)

1) Start by framing the pole 4 to 5 feet above the strand. Make sure to use an all-thread bolt with thimble eyes on both sides of the pole. (This will allow for climbing all sides of the pole without the rope wrapping around the pole.) It is recommended the framing bolt be perpendicular to the strand.

2) Next, clip a steel locking biner onto one of the thimble eyes and feed the static rope through it. Both ends of the rope should have a minimum of six feet of coil on the ground. You will need this in order to tie the appropriate knots.

3) Now attach one end of the rope to the steel locking biner on the climber's rear attachment body harness. (A figure-eight climber's knot is recommended.) Attach other end of rope to the groundperson's belay harness — via the belay device and steel biner.

The groundperson is known as the belayer. It is essential that this person be properly trained. Again, any outdoor retail store should be able to direct you to the proper training facility. Quite often it will provide this service.

So how does it work? Well, when I initially installed this safety feature, I asked a rock climbing trainer to help me demonstrate its use. He is six inches shorter and 40 pounds lighter than I. With him as the groundperson (belayer), I ascended the pole to a height of 20 feet and, without warning, stepped backwards into the clear blue sky. He brought me to a complete stop after descending only 2 or 3 feet, then safely lowered me to the ground. Obviously, this demonstration convinced the "powers that be" of how valuable this device really is. However, the best proof comes from talking to the many employees who quickly overcame their fear of climbing and, in some cases, avoided injury thanks to this fall arrest system.

Finally, as I did, just ask yourself what you would do and how you would feel if you were Jimmy's supervisor. Is saving $2,000 or $3,000 worth the risk you may currently be taking? Every time this industry trains an employee to climb poles, we are rolling the dice. It is our responsibility to ensure we have done everything reasonably possible to keep the odds entirely in our favor. **CT**

The author can be reached for questions or comments at (415) 459-5333, ext. 1807.

ple with this misuse, the phrase of "bend your knees when lifting" was created. The complete proper movement is to bend the knees, shift the buttocks backwards and put the chest up. By shifting your buttocks backwards and putting your chest up, you are putting your back into its optimum posture. Keep your natural curve and you will greatly reduce the damage that can occur to your spine.

Body postures

How do you carry your extension ladder? The muscles of the back are designed to hold a person in a upright position. With the same concentration of a weight lifter preparing for a lift, get in the proper position. Bend your knees, shift your buttocks backwards and put your chest up. This aligns your back in its natural position. Now, to provide additional muscular support, create interior pressure and tighten your stomach muscles. This tightening creates an increase in pressure inside of your body against your spine providing support from the inside out. It also causes the abdominal muscles to become weight bearing muscles, which then increases your strength. Also, keep your buttocks in line or slightly behind your shoulders, this will help prevent any arching of the back. (See Figure 1 on page 70.)

When you come down the ladder, each step can have an impact on your back. Think of the natural curves of your back as you descend. The easiest way to quickly get into the correct position is to let your buttocks lead the way down the ladder. (See Figure 2 on page 70.) A fullback on a football team positions himself on the line with his buttocks up and his back in a natural position. With his back in its natural curves, he is in the most powerful position to absorb the force from the opposing team. Your back deserves the same preparation. The repetitive action of coming down the ladder with your body weight can stress your back if it is not in its natural position.

Figure 3: Installing an outlet

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When you install an outlet in the customer's home, how do you squat? There is a tendency to place both knees right next to one another and bend and twist the back. Try a knee-foot stagger with one foot on the ground and one knee on the ground. With the knee-foot stagger, it will encourage you to bend from the hips, force your buttocks out and maintain the natural curve in your back. Remember how wrestlers are positioned during a meet. One foot is in front of the other and the natural back curves are maintained. Be sure to shift your weight to your front foot when reaching forward and shift back when relaxing. (See Figure 3.)

Each task or movement you make during the day can be of benefit to strengthen and protect your back. The key is to minimize the twisting, bending and overextending of back muscles. At the end of your job, when you reach up to bring the extension down, grab the rope and as the extension comes down, force your buttocks back. Allow your entire body, leading with your buttocks, to bring down the extension. By thinking of leading with your buttocks, it will serve to remind you to keep the natural curves of your back.

Physically, you may not feel any changes by incorporating these new movements in your daily work. Initially, it will feel awkward. If you have any questions, see a back care doctor. Remember, one of the key destroyers of backs are the daily repetitive actions.

Conclusion

A fit back is strong and resilient, capable of absorbing a multitude of shocks every day and of supporting loads far greater then your body weight. The cable TV world is a fast-paced mobile industry introducing new and exciting technologies. Will you be there in the year 2000 or flat on your back because "it just gave out?" **CT**

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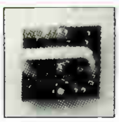

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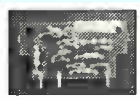

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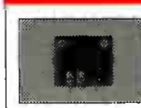

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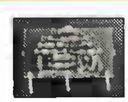

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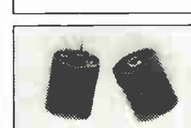

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Ham radio operators in the cable TV industry — Part 2

The following is the second part (N-Z) of a list (in alphabetical order) of amateur radio operators employed in the cable TV industry. It was compiled by Steve Johnson, N0AYE. Please send any additions or corrections to his attention at Time Warner Cable, 160 Inverness Dr., W., P.O. Box 6659, Englewood, CO 80155-6659; fax (303) 799-5651; e-mail: steve.johnson@twcable.com

Name	Call	Company	City	Packet Address
Nadeau, Dave	KA1GPE	SRS Communication	W. Hartford, CT	
Nakashima, Ray	WH6CEO	Time Warner Cable	Honolulu, HI	
Narramore, Frank	W5BGW	Y-S Cable TV	Yellville, AR	
Nelson, Barry	KA9YIS	Time Warner Cable	DeKalb, IL	
Nelson, Jim	N5IZT	Pwr Cntrl Tech	San Antonio, TX	
Nemser, Ben	WA4DZS	Nemal Electronics	N. Miami, FL	
Newell, Steve	KA8USS		Owosso, MI	
Newlin, Jeff	N4UPS	Continental	Richmond, VA	
Newton, John	KA2ZZL			
Norman, Tom	WA7HFY	UWTV	Laramie, WY	
Nusco, Fred F.	WA2DWO	Time Warner Cable	San Diego, CA	
Nydegger, Charlie	WA9HCU	Cardinal	Crawfordsville, IN	
Nykjor, Ole	OZ2OE	Triax	Horsens, Denmark	
Obert, Paul	K8PO	Microwave Radio	Lowell, MA	
Orwen, John	KB0XE	Metrovision	Lincoln, NE	
Osterland, Derick	AH6KC	Time Warner Cable	Honolulu, HI	
Ottinger, Michael A.	NX9Q	TCI	Lebanon, IN	
Oyama, Blaine	NH6FM	Jones	Hilo, HI	
Pandzik, Mike	WB0PTZ	National Cable TV Coop	Lenexa, KS	
Panetta, Carlo	AG2C	Eagle Comtronics	Clay, NY	
Pangrac, Dave	WA0RNP	Time Warner Cable	Englewood, CO	
Paperman, Dave	WQ5Y	TX Childrens Hospital	Houston, TX	
Parmiter, Donald	N8LJF	TCI	Zanesville, OH	
Pastor, Tom	N8HUS	Continental	Painesville, OH	
Patrick, Al	WA4URT	S-A	Atlanta, GA	
Pearce, Grant	K8BKT	Reliable	Grand Rapids, MI	
Perry, Buck	K4ITT	Moffet, Larson	Falls Church, VA	
Peterson, Michael	KA0YAD	TCI	New Hope, MN	
Peterson, Par	AB6LF	Western Comm.	San Francisco, CA	
Pezzenti, Al	N8NED	Northeast Cable	Youngstown, OH	
Pezzenti, Albert	N8NED	NE Cable TV	Youngstown, OH	
Phelps, Alan	KA4DXM	Jones	St. Leonard, MD	
Piccolo, Tony	WD9GCJ	Texscan	El Paso, TX	
Pience, Roger	KA4ATI	NCTA	Washington, DC	
Pike, Dan	N5TLM	Prime	Austin, TX	
Pincombe, Scott	N2NNR	Phillips	Manlius, NY	
Pitcock, Ronnie	KB0MBE	Antec	Englewood, CO	
Potter, Greg	NM2L	New Channels	Syracuse, NY	
Prince, Bradley	N3GMT	Adelphia Cable	Plymouth Meeting, PA	
Pringle Jr., J. Leon	W5NA	Pine Belt	Hattiesburg, MS	
Proctor, Ken	N2DQD	Mobile Diagnstic	Bricktown, NJ	
Pruitt, Michael	KC4FMJ	Cablevision Ind.	Danville, VA	
Radicke, Chris	N7TWW	Westec	Scottsdale, AZ	
Radicke, Ingo	WA7KUM	Post-Newsweek	Miami/Globe, AZ	
Radicke, Lora	N7TWY	ComSonics	Chandler, AZ	
Radzik, Jack	N2RK	LRC	Horseheads, NY	
Raimondi, Steve	W2QUU		Englewood, CO	
Raue, Martin	WB5LJO	Texscan	El Paso, TX	
Reed Jr., Oscar	W3FFQ	Reed Assoc.	Silver Springs, MD	
Reed-Nickerson, Linc	W2HIE	Tektronix	Blue Bell, PA	
Reihs, Warren A.	WB6QKA	Intermedia Tech	Thousand Oaks, CA	
Reno, Larry	N0NPM	Mile Hi	Denver, CO	
Ressler, Bryan	N8BFC	Cable Link	Columbus, OH	
Reynard, Rand	N0DYQ	Antec	Englewood, CO	
Rice, Charles	KD4SS	Glasgow EPB	Glasgow, KY	
Rice, Milton	KC4YOT	Time Warner Cable	Gastonia, NC	
Richards, Dallas	WA0CFZ	TCI of Kansas	Junction City, KS	
Richardson, Earl	W1NIC	Moosehead	Greenville, ME	
Riggs, John	KA5UTF	Sammons	Dallas, TX	
Rios, Edgar	XE2SHL	Jerrold	Nogales, Mexico	
Rippe, Mark	KA1REO	Dimension	W. Warwick, RI	
Rivera, Phil	KM4OP	Gold Coast	Miami Beach, FL	
Roach, Scott	KB8SSI	Pioneer New Media	Columbus, OH	
Robertson, Bill	N6VLR	Continental	Lakewood, CA	
Rocci, Joseph	WA3CMQ	AM Communication	Quakertown, PA	
Rodgers, Gregg	KJ9X	Trilithic	Indianapolis, IN	
Roman, Geoff	WA2DTL	Jerrold	Hatboro, PA	
Rosenberg, Eric	WA6YBT	C-SPAN	Washington, DC	
Roush, Sam	KA8OOT	Rifkin	Point Pleasant, WV	
Runkle, Fred	K4KAZ	S-A	Atlanta, GA	
Rupert, J. Scott	N3DDZ	TCI	Apollo, PA	
Sabraw, Martin F.	N8IWQ	Starion	Ada, MI	
Salas, Gustavo	LU3DNM	Video Cable Comm	Buenos Aires, Argentina	
Salyards, Todd	W5VUX	Siecor	Raleigh, NC	
Sambol, Don	K7CS	Time Warner Cable	Englewood, CO	
Sanchez, Nestor	N4UJZ	Storer	Miami, CA	
Sandgathe, Michael	WB9VTX	Cable Labs	Boulder, CO	
Sanford, Mark	KF8KY	Time Warner Cable	Canton, OH	@KA8Z.#NEOH.OH.USA.NA
Schad, Doug	N5LBH	Sammons	Fort Worth, TX	
Scharf, Mike	KD4QLN	Scripps Howard	Gray, TN	
Scherer, Mike	N8OCA	Continental	Lansing, MI	
Schmidt, Bill	KF4CQ	Superior Tele.	Atlanta, GA	
Schmidt, Jim	WB9EPW	Time Warner Cable	Appleton, WI	
Schmidt, Wally	KD6EZE	Loma Linda U. Med.	Loma Linda, CA	@KC6LHA.#SOCA.CA.USA.NA
Schmig, Gene	KQ4AV	Time Warner Cable	Greensboro, NC	@WB4WOR
Schwarz, Guillermo	KP4DDB	Century Comm.	San Juan, PR	@KP4TW.#SJ.PR.USA.NA
Scott, Noel	KA0TWQ	Time Warner Cable	Kansas City, MO	
Seal, Thale	WB7CWB	TCI	Billings, MT	
Seale, Richard	VE2FEL	Infinity	LaSalle, Quebec	
Sell, Bob	WB4OEZ	Time Warner Cable	Melbourne, FL	
Sellers, Mike	KI6ED	Comcast	Fullerton, CA	
Selwa, Paul	NB9K	Trilithic	Indianapolis, IN	
Serafin, Neil	KE0XL	Peregrine Comm.	Golden, CO	
Sexton, Burl	KO4V	S-A	Atlanta, GA	
Seymour, Andy	N0JPD	Telecable	Springfield, MO	
Shaw, Bob	KB8BIY	Pioneer Comm.	Columbus, OH	
Shearer, Jeff	WA3UAT	Times Mirror	W. Warwick, RI	@KA1RCI.RI
Sherman, Craig	KC4QZD	Altam Electronics	Ft. Lauderdale, FL	@WB4TEM.#BCRFL.FL.USA
Shine, Daniel	K1NJX	M/AComm-MAC	Chelmsford, MA	
Sicard, Don	K1OSG	CommSpec	Haverhill, MA	
Siebring, Gary	KA0DWE	Siebring	George, IA	
Sigler, Glenn E.	N8IJY	Pioneer New Media	Columbus, OH	
Simmons, Marc	KD4JAZ	Spectradyne	Orlando, FL	
Simoneau, Wayne	WA1WSM	Aero-Trac	West Warwick, RI	
Skinner, Russ	WA8EQX	US West	Boulder, CO	
Smith, Bill	W5USM	CADCO	Garland, TX	
Smith, Melton	W4GOL	Lincoln CATV	Lincoln, AL	
Smith, Tom	W4YJU	Alpha Resources	Plant City, FL	
Snopko, Paul	K9VUD	Zenith	Chicago, IL	
Snyder, Mike	KB0MJW	Jones	Englewood, CO	
Sokola, Ray	K9RS	Wavetek	Indianapolis, IN	
Souci, Roland	N6WQ	Standard Comm	Los Angeles, CA	
Spence, Jeff	KA0QEJ	US Cable	Merrillville, IN	
Spencer, Ron	N4VOS	Spencer Const.	Stanton, KY	
Spilka, Jesse	N2HYR	Brooklyn Queens	Flushing, NY	
Squires, Steve	WB9LKT	TCI	Galesburg, IL	
Stader, Jim	KF0FL	MO Telephone CATV	Bolivar, MO	
Stahlman, Greg	KJ6KO	King Video	Placerville, CA	
Staiger, Jay G.	KA2HYA	Phillips	Manlius, NY	
Standridge, Jim	KB2PH	Jerrold	Lakeland, FL	
Stanek, Matt	N0OBE	Time Warner Cable	Denver, CO	
Stannard, Chris	KB4GAA	Storer	Miami, CA	
Star, Danny	N8KRZ	Dimension	Heath, OH	@KB8GVW.#CENT.OH.USA.NA
Stelle, Raleigh	NY0Y	Phillips	Manlius, NY	
Stephens, Bill	N9HEP	ALM	McHenry, IL	
Stewart, Columbus	KF8AN	TCI	Grand Rapids, MI	
Stewart, Neville	KB5YKN	Time Warner Cable	Austin, TX	
Stigberg, Chuck	NT4U	E. Tech Comm	Richmond, VA	
Stofer, Ray	K7JNK	Columbia Cable	Gardnerville, NV	
Strahan, Dave	N7LSD	TCI	Seattle, WA	
Strebel, Rich	KA3ANO	Adelphia Cable	Macedonia, OH	
Styblo, Milo	OK2VA	Cable Plus	Ostrava, Czechoslovakia	
Surkiss, Arie	4X6UO	Intermil Ltd.	Azor, Israel	
Sutton, Dave	WA9J	TCI	Galesburg, IL	@N9GQR.#WCIL.IL.USA.NA
Sutton, Steve	KC4ZTH	Time Warner Cable	Gastonia, NC	
Swanson, Pete	KA2IAY	Cable Exchange	Liverpool, NY	
Tash, Gill	WB6WNN	PTK	Gdansk, Poland	
Tauiliili, Sumatala	WH6CDN	Time Warner Cable	Honolulu, HI	
Taxdahl, Tax	W7KCZ	Telecomm Associates	Ferndale, WA	
Taylor, Jim	K9JT	The Video Term	Milwaukee, WI	
Taylor, Tim	N7PQZ	TCI	Rawlins, WY	@WD4MYL.WY.USA.NA
Templeton, Tim	KB0LDV	Time Warner Cable	Kansas City, MO	
Thomas, John	VE3BVX	Lindsay	Lindsay, Ontarrio	
Thomas, Ray	N0NNX	Cablevision Systems	Richmond, MO	
Thompson, Mike	KA0WJQ	Time Warner Cable	Kansas City, MO	
Timberlake, Herb	W5TQI	Sammons	Fort Worth, TX	
Tinggaard, Neil	WA0HJI	TCI	Englewood, CO	
Tobin, Greg	WA2SFT	Paragon	Torrance, CA	
Todd, Stephen	WB6ELD	Multivision	Lemoore, CA	
Tonge, Tim	KA0MWA	Time Warner Cable	Englewood, CO	
Troutman, Edwin L.	WA3TFX	Adelphia Cable	Winchester, VA	
Tschirner, Alan	KA0TQH	Time Warner Cable	Kansas City, MO	
Turner, John	WB5IRM	TCI	Muskogee, OK	
Tyler, Mike	N5OLP	Weather Scan	Olney, TX	
Tyrrell, George	K0CPT	H-P	Englewood, CO	
Ulrich, Dale	N4BZZ	Multivision	Rohnert Park, IL	
Unverzagt Jr., John R.	N8MCQ	Pioneer Communications	Columbus, OH	
Van de Mosselaer, Wim	ON1BMV	Electro Service	Mechelen, Belgium	
VanBuren, R.H.	W5ILH	Cablecom	Kirksville, MO	
VanDamme, Michael	N6MOF	Heritage	San Jose, CA	
VanDyke, Dave	KF2DT	Cable TV of Jersey City	Jersey City, NJ	
Vaughan, Jim	K4TXJ	Storer	Louisville, KY	
Vaughan, Ray	KD4BBM	Interaxx TV	Miami, FL	@W7LUS.#HWDFL.FL.USA.NA
Veelik, Ron	WA6LTH	King Video	Tujunga, CA	@WA6LTH.#SOCAL.CA.USA
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Voiles, Art	N5BZL	Texscan	Fort Dodge, IA	
Voorman, Jim	WA2GSX			
Vyverberg, Chuck	WB7NNF	Cox	Spokane, WA	@WB7NNF.WA.USA.NA
Wagenblast, Rich	WA2BWP	Falcon Cable	Big Bear Lake, CA	
Wager, Rich	N2UPX	C-Tec Cable	Carmel, NY	
Wagner, John S.	N3IYN	Service Electric	Pottsville, PA	
Walker, Dane	WB6JNP	Hughes Aircraft	Torrance, CA	@KJ6VV.#LACCA.#SOCA.CA.US
Wallpole, Bill	VE3WNW	Maclean Hunter	Owen Sound, Ontario	
Walters, Dave	KD4FZN	Paragon	Jamestown, NY	
Wanderer, Bob	AA0CY		Denver, CO	
Warburton, Peter	G8UGK	ARCOM	Syracuse, NY	
Warren, Larry	N4ZE	Antec	Bensenville, IL	
Wasleske, Bruce	WB9YVT	Jones	Mosinee, WI	
Watt, Philip	KB7IQO	TCI	Anaconda, MT	
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Weeks, Randy	KB9BFZ	DH Satellite	Prairie duChien, WI	
Whelan, Daniel	WB2WHD	NY Cable Comm.	Albany, NY	
White, Thomas	KB9ACX	Heritage	South Bend, IN	
Whitman, Shawn	KB8USG	Cable Link	Columbus, OH	
Wicks, Wayne	WA2KEC		Littleton, CO	
Wightman, Gary	WA8MCD	Cablevision MI	Kalamazoo, MI	
Wilke, Allen	KE0EN	Time Warner Cable	Kansas City, MO	
Williams, Billy	KB5ZFD	TCA Cable	Clovis, NM	
Williams, Paul	WB4GVY	John Weeks	Beauford, GA	
Williams, Robert T.	K5BFT	Century Comm.	Johnstown, PA	
Williams, Steve	KA1WAM	Continental	Beverly, MA	
Williams, Thomas	KD9KR	Continental	Centerville, OH	
Williamson, Mike	KA5DVR	TCI	Englewood, CO	
Wilson, Stephen	KB2RHY	TCI of NY	Niagara Falls, NY	
Wiltshire, Dan	KB8BKF	Pioneer Communications	Columbus, OH	
Winn, Al	KA9CAS	Time Warner Cable	Terre Haute, IN	
Witherspoon, Brian K.	KB4RAB	Alert Cable TV	Clayton, NC	
Witt, Scot	N9AZI	Col. of Dupage	Glen Ellyn, IL	
Wolcott, Mike	WB4OEX	S-A	Atlanta, GA	WB4OEX@WB4HUO
Wolford, James	WB8FAX	Texscan	El Paso, TX	
Wonn, Jim	W3GCZ	Trilogy	Jackson, MS	
Woods, Emmitte	KA7NEH	Cooke Cablevision	Cle Elum, WA	
Wouw, Tony	VE7CCI	ComLink	N. Vancouver, British Columbia	
Wyatt, Tim	KA0TYE	Time Warner Cable	Kansas City, MO	
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Yorks, Sal	WD4NZX	Phillips	Manlius, NY	
Young, Mark	N2MTT	Phillips	Manlius, NY	
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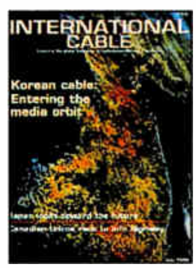

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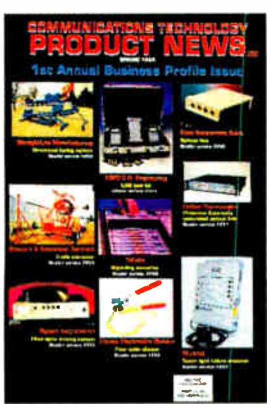

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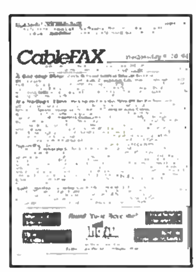

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the audio on the same channel with an addressable system.
Reader service #303

Cable modem

LANcity Corp. unveiled its Personal cable TV modem (LCP), designed so home office personal computer users can access corporate offices, on-line services and the Internet at the fastest speeds, longest distances and lowest cost possible.

The company says the LCP is the first true onramp to the information superhighway, providing users of any home computer and any cable TV system in any country with two-way, 10 Mbps connectivity citywide across 200 miles. According to the company, the unit operates 1,000 times faster than traditional telephone modems at 200 times lower cost per bit: faster than any desktop modem ever developed.

For example, a typical 80 Mbit graphics file requiring 2-1/4 hours to transfer via phone modem would take approximately eight seconds to transmit using the LCP. The unit sends data farther than it has ever traveled over cable TV: 200 miles round trip from any PC via any cable TV company, and worldwide over the Internet.

To maintain the integrity of long-distance data communications, the unit incorporates computer industry standard SNMP network management, providing cable TV operators a high degree of network control and visibility. Additional security measures prevent unauthorized access and control of the network.

The modem is simply installed between a personal computer and a cable TV line, operating transparently. After the software automatically determines the modem's operational frequencies and parameters, it is ready for use. The unit can only bring itself on-line if, and only if, authorized by the cable TV operator.

The company says the modem is ideal for home-based consultants, small businesses and telecommuters desiring citywide connectivity to other PCs, to on-line services and to the Internet.
Reader service #307

Agile modulator

Pico Macom Inc. announced the PFAM-550 double heterodyne conversion audio/ video agile modulator. The company says the unit's superior sideband filtering provides adjacent channel compatibility and FCC Docket 21006 frequency accuracy.

The unit provides 57 ± 3 dB output from VHF Channel 2 through cable Channel 78, including HRC and IRC offset frequencies, and is available in all PAL formats. The channelization configuration can be changed by resetting the DIP switches, which are accessible through the front panel. High-quality external modulation and RF level controls assure years of reliable operation, according to the company. The unit is shipped with all internal adjustments preset and FCC Docket 21006 offsets are standard at no extra cost.
Reader service #301

Video storage

Expanding its technological product offerings for cable operators, Pioneer New Media Technologies unveiled its Digital LD System that allows for high-capacity, compact storage of video on a durable digital disc recording medium. By providing automated rapid access capabilities, the company says the system will dramatically simplify video storage and retrieval and improve overall efficiency.

The system employs a write-once read-many (WORM) disc that is ideal for the safe storage of large video libraries. The disc is an essential part of a family of new digital products, including a real-time MPEG-2 encoder, a digital LD DiscWriter, a digital LD VideoDisc drive, a four-head digital LD player, an MPEG-2 decoder, a digital disc autochanger (252 discs) and a disc cart machine (504 discs).

The system compresses video material through a real-time MPEG-2 encoder and the digital LD Disc-Writer "writes" the information onto a double-sided, 30 cm (19 Gbyte) WORM disc, which uses a cost-effective organic dye recording technology. Discs can then be transferred and stored in the digital disc autochanger or the disc cart machine for automated viewer access. A four-head digital LD player also is available for applications, such as near-video-on-demand, that may require more than one simultaneous video output channel from a single disc.

The 252-disc digital disc autochanger and the disc cart system also can be used as a repository for other digital data formats, such as DigiCipher or JPEG. The disc cart system is built from separate disc and drive module components, accommodating up to 252 discs in each disc module and up to six drives in each drive module. Each disc and drive module comes with a built-in robotics system and a built-in transfer port to facilitate the transfer of discs between adjoining modules. The digital disc autochanger is a self-contained, dual-drive system targeted for archival applications.

Each 19 Gbyte digital LD disc can record up to two hours of D2 quality material, or over four hours of material at lower data rates. Depending upon application requirements, the system is capable of recording in both constant angular velocity or constant linear velocity modes. The real-time MPEG-2 encoder features a user-selectable compression rate that varies between 3 and 15 Mbps and transfers video data to the disc writer via a SCSI-2 output port.

Cable operators may choose to purchase the entire digital LD solution, including the MPEG-2 encoder and disc writer, or simply decide to use the autochanger or disc cart system with the facility's existing digital compression system.
Reader service #304

Return path lasers

Ortel introduced what it says is the industry's first return path solution that allows operators to provide video and PCN services as well as voice and telephony transmission over HFC networks.

The Model 1602A return path lasers use DFB lasers, internal optical isolators and thermo-electric coolers. The Model 2606 return path photodiodes are designed with broadband current transformers in miniature DIP packages.
Reader service #300

Power supply

Alpha Technologies introduced its Power MUX 60 VDC multiplexing power supply that facilitates the remote powering of 48 VDC telephony equipment from cable TV networks.

The unit rectifies and conditions 60 VAC power from a cable trunk to provide high-quality 48 VDC, 4 amp output. The Power MUX is equipped with redundant AC input to further ensure the integrity of the DC being supplied to the telephony equipment.

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

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

Designed to meet UL, CSA and VDE safety standards, the PM4804 Power MUX is said to be extremely rugged, reliable and versatile.
Reader service #299

Digital terminals

General Instrument announced an early version of a digital entertainment terminal to run advanced interactive services. Initial versions of the terminals are based on the Microware OS-9/DAVID operating system and the PowerPC microprocessor.

The unit is based on a modular architecture that segments the network front-end from the applications processing and presentation. As the network evolves, operators can change their network front-end and protect their investment in the digital terminal.

The unit is a natural extension of the company's analog CFT 2200 and digital DigiCable platforms. Customers will be able to choose from a variety of end-to-end product offerings that span the realm from standard analog to interactive digital services. This wide variety will allow operators to customize offerings.

DAVID is a standard operating system environment for interactive TV decoders that can be used in telephone, cable TV and wireless networks. Created and licensed by Microware, it is based on the company's OS-9 real-time operating system, using a variety of microprocessors.
Reader service #297

Addressable tap

New features of the Electroline Equipment compact addressable tap (CAT) allow cable operators to save 15-25% on the capital cost of MDU addressability, according to the company.

An extra connector port allows connection of up to three additional switchbanks without the need for extra addressable control or powering circuitry. As a result, a single CAT provides automatic and remote control of up to 64 drops. Previously, a controller was required for every four to 16 ports.

The unit also allows cable operators the choice of powering from the network, or from the premises, simplifying installation and operation. It helps cable operators, telephone companies and other video providers secure their MDU service and automate service changes, thereby improving service and cutting costs.

The tap automates on/off control of four to 64 drops, as well as a two-tier passband for each drop. That allows immediate service activation, leading to a happier new customer and additional cash flow, since revenue is earned as soon as the drop is activated. CAT also controls bad debt by automating disconnects (service is disconnected immediately), and slashes operating costs by eliminating truck rolls.
Reader service #296

PPV system

TVN Entertainment Corp. introduced its new TheatreVision Plus, which it says is the first comprehensive multichannel pay-per-view (PPV) delivery/ordering/transaction processing system for cable TV operators. The system combines the company's satellite-transmitted PPV movie feeds and conditional access control, with computer information technology and transactional services provided by Electronic Data Systems.

Features of the system include instant electronic ordering via phone (ANI/ARU); customer response and order processing; and billing, credit card and remittance processing. Also, the system offers studio license fee administration and system-specific marketing and financial data and reports. TheatreVision Plus was designed to serve as an analog-to-digital bridge.

According to the company, it enables cable operators of all sizes to start with the current analog signal multichannel PPV feeds, which can be programmed for up to eight channels of near-video-on-demand format PPV movies. They can then evolve to digitally compressed PPV without having to rush into early, expensive commitments to digital technology and equipment before all the choices are clear and digital standards emerge.
Reader service #295

Cable modem

Motorola's Multimedia Group announced the CyberSURFR modem, designed to provide high-speed data communications over interactive hybrid fiber/coax networks. An extension of the company's CableComm product line, the unit delivers data at 20 to 100 times the speed of today's conventional modems, according to the company. It will be available by the end of 1995.

The modem is targeted to both hybrid network providers and end users. It is specifically designed for data communications for on-line services, Internet access, telecommuting and other emerging services for home and business PC users. The unit offers throughput speeds of up to 10 Mbps per user in the downstream direction over existing cable TV networks. Return upstream path throughput is 768 kbps.
Reader service #302

MPEG-2 digital encoder

IBM unveiled the MPEG-2 I-frame encoder, which it says is the world's first commercially available semiconductor chip that can compress or encode the large amounts of data required to transmit and store digital video pictures, frame by frame. I-frame refers to the "intra-frames" used in high-speed compression and decompression. The company says its single-chip video encoder will significantly bring down the cost of MPEG-2 video compression.
Reader service #294

Digital ad insertion

Sony Electronics introduced its VideoStore disk-based digital ad in-

Time for a little fun. Our historical guru (aka Rex Porter) has provided us with these trivia questions on the cable industry. For the cable veterans, it should test their memory. For the neophytes in our fold, this should provide a challenge and offer some interesting background on our dynamic industry.

Answers to the questions will be provided in next month's issue (along with a new set of 10 questions). The person supplying the most correct answers (see additional requirements below) will be awarded an industry-related novelty prize (e.g., cap, water bottle, T-shirt).

Your answers need to be sent to: The Trivia Judge, *Communications Technology*, 1900 Grant St., Suite 450, Denver, CO 80203; fax: (303) 839-1564; e-mail: CTmagazine@aol.com. To be in the running for a prize, your answers need to be postmarked, faxed or e-mailed to us by the 20th of the month of the issue date that the specific trivia test appears in. The first person who sends in the most correct answers will be the award winner. Good luck!

Trivia test #1

1) Most CATVers believe cable TV began in 1949 when Robert Tarlton built his Landsford, PA, system and named his company______ ______ Television Co.

2) The first National Cable TV Convention was held in the town of_______, PA.

3) The first aluminum sheathed coaxial cable was manufactured by_____ _____ Inc. of North Haven, CT.

4) The first fiber system was introduced by Times Fiber Communications at the Western Show in Anaheim, CA, in the year______.

5) The first MSO to record 1 million subscribers was________________.

6) The man heading up that MSO's marketing campaign (losing his beard to celebrate the first 1 million subs) was__________________.

7) According to *TV Digest*, as of Oct. 1, 1981, there were four MSOs with a million or more subscribers. In order of their sub counts they were:

- ____________ with 1,690,000 subs
- ____________ with 1,556,021 subs
- ____________ with 1,423,000 subs
- ____________ with 1,070,000 subs

8) The highest honor given in the earlier years by the National Cable Television Association was the Larry Boggs Award. Boggs founded the successful VuMore of Oklahoma, later to become Cable-Com General. If followed through its successive sales and mergers, this company today would be known as______ ______.

9) Believed by many to be the greatest drum major ever to lead the University of Alabama band,__________, in 1967 founded the MSO known as Teleprompter.

10) According to the May 7, 1979, issue of *Time* magazine,______-______, a giant in the sales of communications equipment, designed its first earth station to receive satellite-transmitted signals in 1974 and by the end of 1975 had not sold one. **CT**

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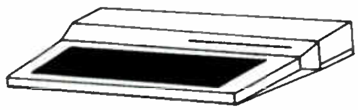

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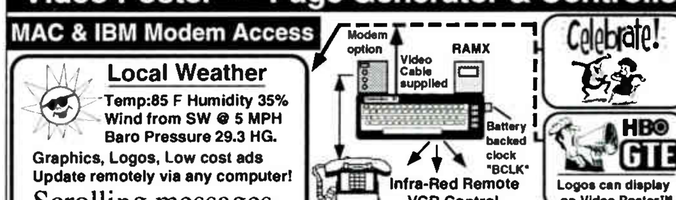

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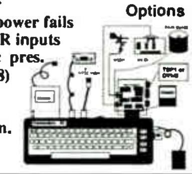

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01. ___ yes
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22. ___ Vice President
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24. ___ Manager
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27. ___ Installer
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D. In the next 12 months, what cable equipment do you plan to buy?
30. ___ Amplifiers
31. ___ Antennas
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33. ___ Cable Tools
34. ___ CAD Software, Mapping
35. ___ Commercial Insertion/ Character Generator
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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
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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

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H. In the next 12 months, what cable test & measurement equipment do you plan to buy?
70. ___ Audio Test Equipment
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72. ___ Fiber Optics Test Equipment
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74. ___ OTDRs
75. ___ Power Meters
76. ___ Signal Level Meters
77. ___ Spectrum Analyzers
78. ___ Status Monitoring
79. ___ System Bench Sweep
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I. What is your annual cable test & measurement equipment expenditure?
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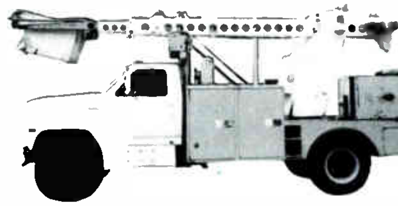

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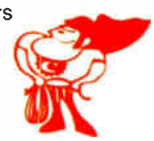

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July

7-9: Fiber U fiber-optic installers conference, Royal Plaza Hotel, Marlboro, MA. Contact (800) 50-FIBER.
10-12: Society of Cable Telecommunications Engineers Introduction to Telephony seminar, Loews Giorgio Hotel, Denver. Contact SCTE national headquarters, (610) 363-6888.
10-13: Antec Fiberworks training course, digital networks, Denver. Contact (800) 342-3763.
10-13: Siecor training course, fiber-optic installation and splicing, maintenance and restoration for CATV applications, Hickory, NC. Contact (800) 743-2671, ext. 5539.
11: SCTE Cascade Range Chapter testing session, BCT/E exams to be administered, Lincoln City, OR. Contact Cindy Welsh, (503) 667-9390.
11: SCTE Desert Chapter seminar, fiber systems and technology, BCT/E Category III tutorial, El Rancho, Beaumont, CA. Contact Bruce Wedeking, (909) 677-2147.
11: SCTE Penn-Ohio Chapter annual golf outing. Contact Marianne McClain, (412) 531-5710.
11: SCTE Southeast Texas Chapter testing session, BCT/E exams to be administered, Walden, TX. Contact Richard Grahn, (713) 579-6319.
11: SCTE Southeast Texas Chapter testing session, BCT/E exams to be administered, Houston. Contact Richard Grahn, (713) 579-6319.
11-13: C-COR training seminar, digital video and fiber-optic networking, Fremont, CA. Contact (800) 233-2267, ext. 4422.
11-13: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.
13: Society of Cable Telecommunications Engineers Satellite Tele-Seminar Program, *Advances in System Architectures (Part II)*, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.
13-15: Society of Cable Telecommunications Engineers Technology for Technicians II seminar, Loews Giorgio Hotel, Denver. Contact SCTE national headquarters, (610) 363-6888.
13: SCTE Chesapeake Chapter testing session, Installer exams to be administered, Fairfax, VA. Contact Mike Nelson, (703) 313-6480.
13: SCTE Magnolia Chapter testing session, BCT/E and Installer exams to be administered, Ramada Coliseum, Jackson, MS. Contact Robert Marsh, (601) 932-3172.
15: SCTE Cactus Chapter seminar, distribution systems, Dimension Cable office, Phoenix. Contact Harold Mackey, (602) 352-5860, ext. 135.
15: SCTE South Florida Chapter seminar, installer training, Ft. Lauderdale, FL. Contact Jim Jones, (407) 478-5866, ext. 409.
17-19: Wireless Cable Show, Grand Hyatt Hotel and Washington Convention Center, Washington, DC. Contact WCAI, (319) 752-8336.
17-21: General Instrument training course, broadband communications network design, Minneapolis. Contact Lisa Nagel, (215) 830-5678.
18-20: C-COR training seminar, broadband communications, Chicago. Contact (800) 233-2267, ext. 4422.
19: SCTE Dixie Chapter seminar, true alternate access, Arizona Rib Company, Birmingham, AL. Contact Powell Bedgood, (205) 733-1679.
19: SCTE Piedmont Chapter seminar, upgrade planning with fiber construction and restoration, Hickory, NC. Contact Mark Eagel, (919) 220-3889.
22: SCTE Big Sky Chapter seminar, data networking and system preparation for the future, BCT/E and Installer exams to be administered, Grouse Mountain Lodge, Whitefish, MT. Contact Marla DeShaw, (406) 632-4300.
22: SCTE Chaparral Chapter seminar, troubleshooting techniques, maintenance and test equipment, Sandia Preparatory School, Albuquerque, NM. Contact Bob Wiseman, (505) 761-6243.
23: SCTE Old Dominion Chapter You're Appreciated Celebration, Busch Gardens, Williamsburg, VA. Contact Margaret Fitzgerald, (703) 248-3400.
24-25: Antec Fiberworks training course, broadband cable TV technology, Denver. Contact (800) 342-3763.
24-27: New England Cable Show, Newport Islander Doubletree Hotel and Conference Center, Newport, RI. Contact (617) 843-3418.
24-27: Siecor training course, fiber-optic installation and splicing, maintenance and restoration for CATV applications, Keller, TX. Contact (800) 743-2671, ext. 5539.
25: SCTE Desert Chapter testing session, BCT/E and Installer exams to be administered, Colony Cablevision office, Palm Desert, CA. Contact Bruce Wedeking, (909) 677-2147.
25-27: C-COR training seminar, cable TV technology, State College, PA. Contact (800) 233-2267, ext. 4422.
25-27: General Instrument training course, advanced broadband applications, Baltimore. Contact Lisa Nagel, (215) 830-5678.
26: SCTE Heart of America Chapter testing session, BCT/E exams to be administered, Blue Springs, MO. Contact David Clark, (913) 599-5900.
26: SCTE Mid-South Chapter testing session, Installer exams to be administered, Time Warner office, Memphis, TN. Contact Kathy Andrews, (901) 365-1770, ext. 4110.
26-27: Antec Fiberworks training course, compressed video concepts and transmission, Denver. Contact (800) 342-3763.
28: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.
29: SCTE Cactus Chapter seminar, distribution systems, Dimension Cable office, Phoenix. Contact Harold Mackey, (602) 352-5860, ext. 135.

August

1: SCTE Ohio Valley Chapter testing session, BCT/E and Installer exams to be administered, Cincinnati. Contact Jon Schatz, (614) 221-3131.
1: SCTE Southeast Texas Chapter testing session, BCT/E exams to be administered, Walden, TX. Contact Richard Grahn, (713) 579-6319.
1: SCTE Southeast Texas Chapter testing session, BCT/E exams to be administered, Houston. Contact Richard Grahn, (713) 579-6319.
1-3: C-COR training seminar, broadband/CATV laboratory, State College, PA. Contact (800) 233-2267, ext. 4422.
2: SCTE Ohio Valley Chapter testing session, BCT/E and Installer exams to be administered, Cleveland. Contact Jon Schatz, (614) 221-3131.
7-10: Siecor training course, fiber-optic installation and splicing, maintenance and restoration for CATV applications, Hickory, NC. Contact (800) 743-2671, ext. 5539.
8-10: C-COR training seminar, broadband/LAN laboratory, State College, PA. Contact (800) 233-2267, ext. 4422.
8-10: General Instrument training course, broadband applications, Portland, OR. Contact Lisa Nagel, (215) 830-5678.
8-10: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.
9: SCTE Mid-South Chapter testing session, BCT/E exams to be administered, Time Warner office, Memphis, TN. Contact Kathy Andrews, (901) 365-1770, ext. 4110.
10: Society of Cable Telecommunications Engineers Satellite Tele-Seminar Program, *Basics of Digital Compression*, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.
10: SCTE Music City Chapter testing session, BCT/E exams to be administered, Nashville, TN. Contact Kenny Long, (615) 244-7462, ext. 392.
10: SCTE New England Chapter testing session, Installer exams to be administered, Worcester, MA. Contact Tom Garcia, (508) 562-1675.
13-15: Great Lakes Cable Expo, Indiana Convention Center, Indianapolis. Contact (317) 845-8100.
13-15: Society of Cable Telecommunications Engineers technical sessions, Indiana Convention Center, Indianapolis. Contact Great Lakes Cable Expo, (317) 845-8100.

Planning Ahead

Aug. 23-26: Rocky Mountain Expo, Snowmass Resort Convention Center, Snowmass, CO. Contact (303) 863-0084.
Aug. 28-30: Eastern Cable Show, Inforum, Atlanta. Contact (404) 252-2454.
Oct. 9-12: Atlantic Cable Show, Convention Center, Atlantic City, NJ. Contact (609) 848-1000.
Oct. 31-Nov. 2: Private Cable & Wireless Show, Miami Beach, FL. Contact (713) 342-9826.
Dec. 6-8: The Western Show, Anaheim, CA. Contact (510) 428-2225.

By **Bill Riker,** President, Society of Cable Telecommunications Engineers

New board members take seats

A I am pleased to announce that Cable-Tec Expo '95, held June 14-17 in Las Vegas, NV, was a great success. I think this year's program was one of the best to date and the comments I heard from attendees indicate they felt the same way. They expressed how informative the tutorials, technical sessions and workshops were and how pleased they were to see such an increase in the number of exhibitors this year.

As always, the Society intends to make each Expo even better than the previous one. The staff has already begun work on Cable-Tec Expo '96, to be held June 10-13 in Nashville, TN, and we welcome your ideas and suggestions for topics to be covered.

Introducing the board

Every Expo starts with a meeting of the Society's national board of directors and this year was no exception. The meeting begins with the seating of newly elected regional and at-large directors.

In addition to welcoming back reelected board members At-Large Directors Wendell Bailey and Wendell Woody, Region 6 Director Robert Schaeffer and Region 9 Director Hugh McCarley, we welcomed Region 1 Director Patrick O'Hare, Region 2 Director Steve Johnson and Region 11 Director Dennis Quinter. They join the other board members currently serving their 1994-96 terms: At-Large Director Tom Elliot, Region 3 Director Andy Scott, Region 4 Director Rosa Rosas, Region 5 Director Larry Stiffelman, Region 7 Director Terry Bush, Region 8 Director Steve Christopher, Region 10 Director Michael Smith and Region 12 Director John Vartanian.

Patrick O'Hare, regional engineering manager for Viacom Cable, has distinguished himself through his active participation in the Society's Golden Gate Chapter. He has served as its president for the past two years and previously held the positions of vice president in 1992 and director during 1984-85. He has enjoyed working on the chapter's board, and having served as a director, he understands the difficulty chapter directors have in volunteering so much of their time while maintaining full-time positions in the industry.

"As a regional director," O'Hare asserts, "I vow to stay in touch with local chapter and meeting group directors on a regular basis to assist them in the continuing success of their respective groups."

He has spoken to many members who expressed their feelings that "the actual needs and wants of the members sometimes don't get to the top." He wants to stay in close contact with local members to ensure that their wishes are the driving force that guides the path of the national board. Ideas and plans that have proven successful in his chapter will be passed on to benefit other local groups.

Steve Johnson oversees Time Warner Cable's signal leakage program and also leads the company's efforts to comply with Federal Communications Commission regulations. A Senior member of the Society, he also serves as treasurer of the Rocky Mountain Chapter. During his years of involvement with the chapter, he also has held the offices of president and vice president.

Johnson has served on the Broadband Communications Technician/Engineer (BCT/E) Administration and Membership Benefits subcommittees and is the new chairman of the EAS Subcommittee. He states that he is "very honored to have been selected in such a close race. Ron Hranac and Pam Nobles (former regional directors) have done a great job in Region 2 in the past and I hope to continue that tradition."

In his involvement with the Rocky Mountain Chapter, Johnson has worked to improve the chapter's financial efficiency "so that members get the most for their money." He feels that among the biggest issues the Society is facing are the convergence of technologies and a large number of companies merging and restructuring. "SCTE needs to stay current in its training," he believes, also pointing out that as people's lives and work schedules become more demanding, there is greater competition for people's time and the Society needs to address that issue.

Dennis Quinter holds the position of director of engineering for TWC Berks Cable in Reading, PA. He has been actively involved in the Delaware Valley Chapter and has served as its president, first vice president and second vice president. He also is an active member of the Pennsylvania Communications and Technology Association (PCTA) Technology Committee.

"I really feel it is a privilege and a great responsibility to have been elected," Quinter affirms. "SCTE has been instrumental in my career and I feel that the same is true for many other members." He is quick to emphasize how training has played a major role in his job advancement over the years and how beneficial his contact with other people in the Society has been.

"I've heard different people from many different systems say that they wish their managers would let them go to training sessions and chapter meetings," Quinter says. "We need to focus on local management and get them to understand the long-term benefits of participation in SCTE activities." He feels that if managers incorporated regular training into their employee work schedules, they would find that they could work around the slight schedule changes.

All three of the new regional directors agree that the Society's BCT/E and Installer Certification programs are invaluable to the industry and that these programs must be continued, strengthened and maintained to stay current with the changes in technology.

With so much movement in the industry, many people will be experiencing varied degrees of change in the positions they hold. Many of these people will need to acquire new skills or additional technical training to remain current. The board will work to address these issues and strive to accommodate the needs of its members in furthering technical training programs and services for the industry. **CT**


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