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AUGUST 1994

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Salary survey ◆ ATM and Cable ◆ Telephony ◆ Eastern Show

Survey: Operators feel FCC's weight

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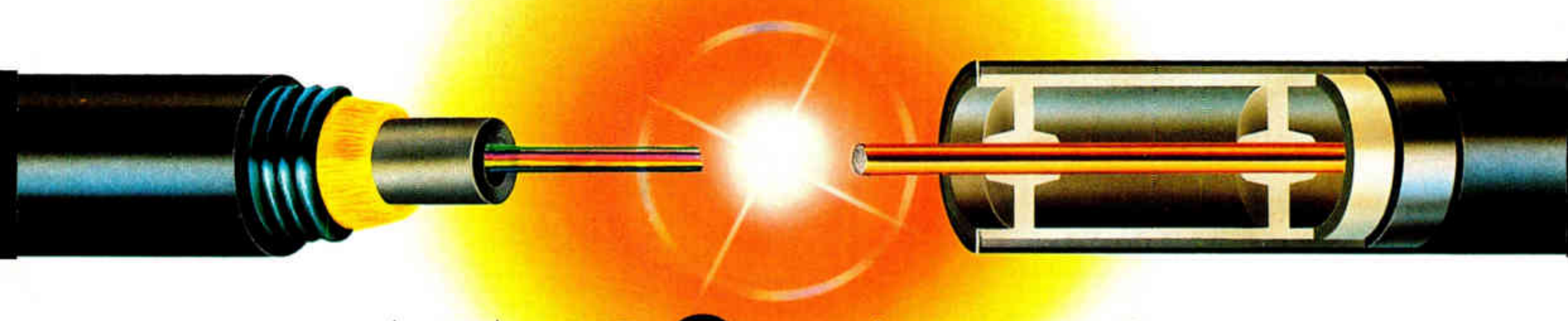

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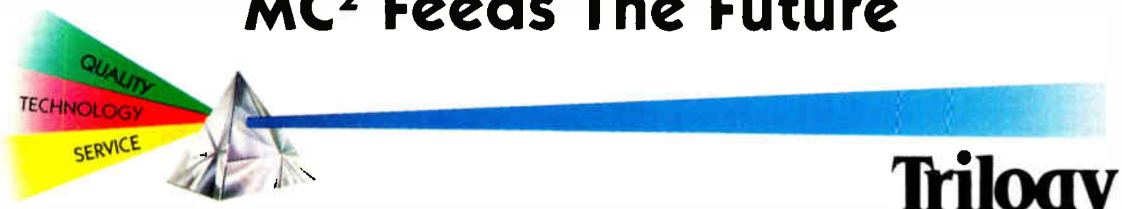

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Circle Reader Service No. 2

28 Survey says operators feel FCC's squeeze
By Roger Brown, CED

Government meddling in the form of regulations and competition came in as the top two industry concerns of the industry in the annual CED salary survey. While that isn't surprising, the tone of many of the comments is worrisome.

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FEATURES

36 The ATM payoff
By Todd J. Schieffert, ADC Telecommunications

Cable system operators who expect to offer telephony via alternate access or deliver video on demand in the future need to understand asynchronous transfer mode, or ATM, technology now, according to the author. This article explains what ATM is, how it works, how it can be integrated into a cable system and the caveats associated with the up-and-coming technology.

44 Managing multiple videos
By Bert McCoy, Prevue Networks

If the strategists are right, cable systems of the future will offer literally hundreds of channels of video, both in broadcast and on-demand modes. But how will cable systems ever be able to control the scores of video streams emanating from their headends? This story explains how Prevue Networks controls the video it sends out and correlates the network's experiences to cable systems.

46 Frequency chart
By CED staff

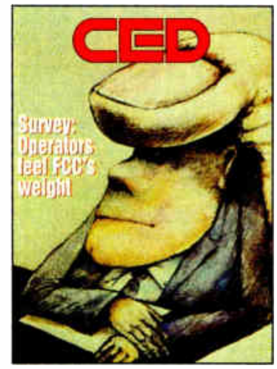
The annual Frequency Allocation Chart is included with this issue. This year's updates include Personal Communication Services frequencies and shows the cable spectrum fully channelized all the way to 1 GHz. Pull out the chart and put it on your wall for easy reference.

50 More than dialtone
By Dick Swan and C. Derrick Huang, Northern Telecom

Today, a lot of cable MSOs are wrestling with the decision of whether or not to enter the residential and/or commercial voice telephony business. It's a huge potential revenue stream, but there are numerous issues that have to be considered. This story explains the services beyond dialtone that a cable operator needs to be prepared to offer before jumping in and swimming with the sharks.

60 Making the grade
By Jonathan Kramer, Communications Support Corp.

So you've just been informed there's going to be an inspection of your cable system to be sure it's complying with the FCC's technical standards? What do you do now? This article, from someone who actually performs those inspections, explains how you can prepare for an inspection and how you should react after it takes place.



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Operators feel as though they're under the FCC's thumb. Illustration by Jerzy Kolacz.

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Hot idea.

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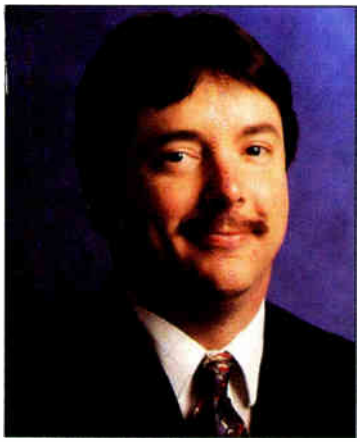

Nuts and bolts of going interactive

Given the exploding popularity of the Internet–the huge computer "network of networks" is reportedly adding millions of users every year–it's no wonder cable operators like Jones Intercable and Continental are trying to tap into the home datacom market.But so far, they've discovered that delivering data over cable networks isn't very easy.

Reports out of both camps are that some of the RF modems that are needed to send data over the cable plant are locking up and blasting the user out of the on-line connection and making it difficult to get back in. It's a problem that's apparently spotty, depending on how "clean" the individual cable system is between 5 MHz and 30 MHz.

Before I get a rash of calls from the vendors, I need to point out that the problems are not all related to their products. The sub-low spectrum reserved by cable operators for return transmissions is indeed a harsh environment, filled with noise that often drowns out any transmitted information. Cable operators have known about the phenomenon for years; along with economics, it's the primary reason that, prior to the arrival of fiber optics in cable networks, few systems ever activated the return portion of a system.

But fiber was supposed to cure two-way's ills by breaking the cable system into scores of "cells" to effectively reduce the amount of traffic coming back to the headend. However, the problems experienced by Jones and Continental are in the coaxial connection between the home and the node, which poses an altogether different problem.

Engineers say future modems may need to be frequency agile and should include such features as fault tolerance, error correction, improved shielding from ingress and network management that can detect errors before any crash occurs. These elements, of course, add cost to devices many think are already too expensive.

Another issue is standards. If the cable RF modem is to be connected with the Internet, the interface has to be right, or the two can't talk to each other. It turns out that this issue has yet to be worked out as well.

The bottom line is this: converting a one-way cable system that has reliably broadcast entertainment video downstream into an interactive network that sends signals in both directions won't be as easy as turning amplifiers around or simply dropping in return laser transmitters. It's time to roll up the sleeves and get to work on this one.

Roger J. Brown

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Alliance formed to foster wireless digital technology

With an eye toward making the MMDS industry more competitive with cable television and telephone companies, a new consortium of companies has formed the Wireless Cable Digital Alliance to develop digital technologies to deliver hundreds of channels over the air.

This new R&D alliance was created at the urging of Jon Schumacher, director of engineering and technology at American Telecasting of Colorado Springs, Colo., the nation's largest wireless TV company. It appears to be in direct competition with the Wireless Cable Research and Development Center (WCRDC), another consortium created by the MMDS industry to accelerate the growth of the industry.

Schumacher said the WCRDC was hampered in its efforts to push technology along by having multiple companies representing similar product lines as members. He said member companies were reluctant to disclose detailed information in meetings in front of their competitors.

To combat that, this new consortium chose just one representative from each major facet of the wireless industry. Companies that have committed to join the alliance include: Zenith Electronics, Microwave Filter, Emcee Broadcast Products, California Amplifier and Andrew Corp.

"We're very excited to be a big player in this," said John Taylor, Zenith spokesman. "There's a lot of enthusiasm for VSB technology in this (industry)."

Schumacher said Zenith was chosen because of its work on VSB, which was chosen by the Grand Alliance as the transport mechanism of HDTV over terrestrial broadcast networks. Given that the wireless industry uses microwave frequencies to transport video, "it makes a ton of sense for us to use it," he said.

The group intends to actually transmit a VSB signal by September of this year and show a working prototype decoder by December, Schumacher added.

In addition to developing technology that will allow consumers to receive between 150 and 300 channels, the alliance intends to focus on enabling advanced services such as near video on demand, wireless telephone and interactive television.

The wireless industry already has four experimental licenses to conduct tests of digital transmission in Colorado Springs, Colo., Little Rock, Ark., Orlando, Fla. and Ft. Myers, Fla.

NBTel plans network rebuild with ATM

Northern Telecom has been tapped to supply an end-to-end ATM solution for broadband networks planned by New Brunswick Telephone Co. of Canada (see related story, page 64). NBTel says it will invest $300 million (Canadian) to connect some 300,000 customers throughout New Brunswick to hybrid fiber/coaxial facilities by 1998, with 20,000 slated to be on line by the end of next year.

All video services will be delivered on a point-to-point, switched basis, using ATM, setting it apart from the hybrid fiber/coax designs planned by U.S. telcos and cable companies in several respects. The $750 per customer target cost, including set-top terminals, however, is on a par with the U.S. telco costs for broadband overlays.

The coaxial service areas beyond each fiber node will be limited to 80 households to eliminate all amplifiers and expand available coaxial bandwidth to 1 GHz. Seven ATM switches will be installed throughout the province, each serving about 30,000 customers. All broadband services will be routed through the ATM switches, but not all services will be "switched." Accessing multicast services would be analogous to channel changing at the set-top, only it would be done at the ATM switch. This process, where all signals are reformatted into ATM packets, means that each user consumes only the bandwidth required for the services in use at any moment, from a single data stream to the PC to multiple service streams to several TVs, PCs and other appliances. Real switching would be limited to services that are pulled in on demand from servers or to interactive multimedia communications between end users.

Each household will have an upstream link of between 3 and 10 megabits per second, allowing for packetized broadband data exchanges of several types. Telephone service, currently provided over an all-digital fiber network using twisted pair copper in the distribution plant, will remain separate for at least four to five years.

BellSouth names Atlanta video dialtone vendors

BellSouth Corp. finally announced its plans to deploy interactive television services in a 12,000 home market test in northwest Atlanta. In the application to the Federal Communications Commission seeking approval to begin the test, BellSouth revealed

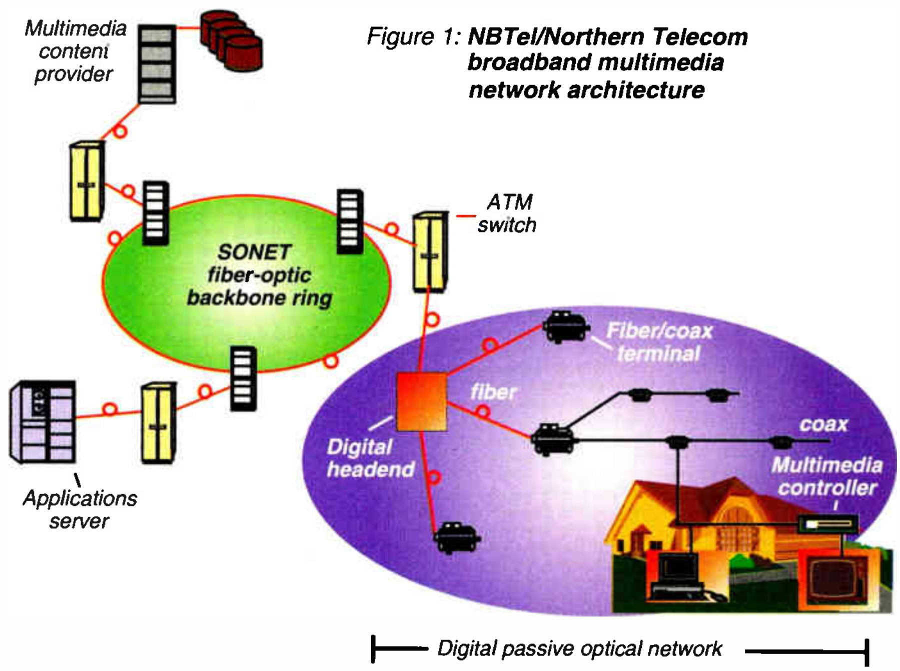


Figure 1: ***NBTel/Northern Telecom broadband multimedia network architecture***

that it plans to utilize a hybrid fiber/coax topology with a mix of traditional analog signals and digital video dialtone services.

If approved expeditiously by the FCC, BellSouth hopes to offer service as early as the second quarter of 1995. The network would be built by BellSouth Telecommunications, the local service subsidiary of the RBOC.

Plans call for BellSouth to lease about 60 traditional cable TV channels to Vanguard Cable Corp., a company owned by Prime II Management of Austin, Texas. BellSouth expects to acquire a minority interest in either Prime or Vanguard later this year.

In addition, the network will offer about 300 digital channels offering content in five broad categories, including: broadcast entertainment services, on-demand programs, interactive video services, data communication services and transactional service like home shopping.

The big winner likely is Scientific-Atlanta, which was selected to furnish a wide range of hardware for the trial. Products S-A will contribute include home terminals (both analog and digital); analog and digital headend gear, including the Broadband Integrated Gateway and related software; RF and fiber optic electronics equipment; RF passive gear; and the CoAxiom telephony over coax system.

Champagne corks probably were also popped in Boulder, Colo., the home of Probita Inc. The small software house, which is posturing to take a major role in defining how operational support systems should be developed to allow for seamless provision of services over several different networks, was chosen by BellSouth to define requirements for OSS and consult on the integration of a wide variety of vendors and technologies used in the trial.

Probita, which recently unveiled the Prose software architecture and the Prose Operations Gateway for OSS, will work with BellSouth to describe in detail the functionality needed for billing, customer service and network management as well as specs for video servers and set-tops.

Test: Transfer time not an issue in digital era

Cable engineers are sounding several warnings about the coming digital era, but one issue that apparently won't be a problem are network power transfer times, according to tests performed jointly by ANTEC and Power Guard using common ferro and redundant power supplies.

The tests took place at ANTEC's technology center in Denver in early May. According to Michael Lynch, director of product management for ANTEC, the tests demonstrated that the transfer time from main to backup battery power in redundant systems occurs with no loss of data.

During the test, a 2.304 megabit per second data stream was generated using a Fireberd 6000A bit error rate test set. The data was then applied to ANTEC's digital telephony system to simulate the delivery of digital telephony signals to a customer. QPSK data passed through 3,000 feet of RG-11 coaxial cable with three line extenders to a subscriber terminal.

A power failure was simulated by switching off the six-amp power supply. This caused the inverter module within its redundant system to switch to battery back-up. The resulting data stream from the subscriber terminal was identical to the original data sent by the test set.

Cable engineers are also assessing how other parameters will be affected by the advent of digital technology. Issues under consideration are high-level digital compression, the effect of microreflections and impedence mismatches caused by poor in-home wiring, and a host of others.

In a separate and unrelated announcement, ANTEC said TCI has begun testing its Cable Loop Carrier-500 broadband digital telephony system in the MSO's south Florida system.

The field trial of the data/voice-over-cable technology is reportedly one of the first to employ cable-telephone technology in an operating business environment. In south Florida, it involves a work-at-home application for a TCI supervisor and two CSRs.

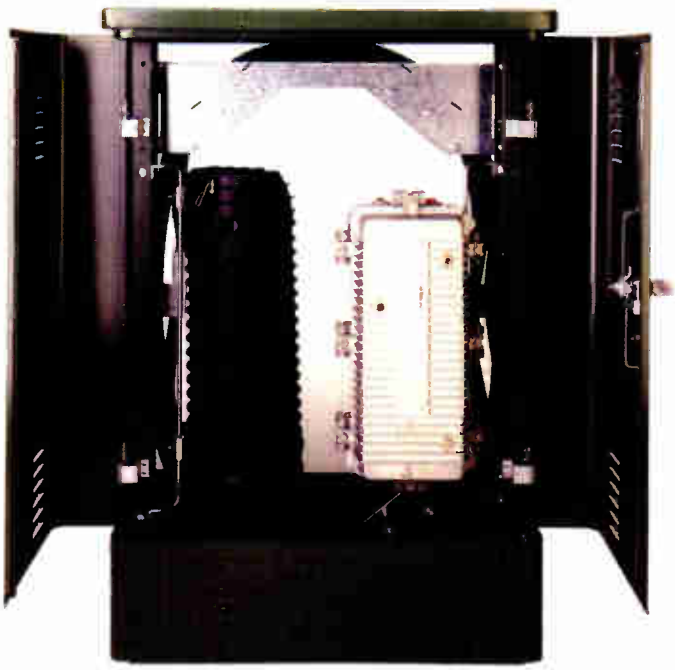
The project provides two telephone lines and a data link to each home. Calls from customers arrive at TCI's headend and are routed from the PBX into a headend terminal, where downstream data and telephony signals are diplexed onto fiber using frequency division multiplexing in a 25 MHz block of spectrum located above 460 MHz.

At the hub divider (where fiber transitions to coaxial cable), video, telephony and data signals are integrated on coax and delivered to the home. A directional coupler/splitter delivers video signals to the set-top and voice signals to the CLC-500 subscriber unit.

The subscriber unit converts the downstream digital telephony service into analog to make them compatible with telephone handsets; digital data is routed through a modem for connection between TCI's main computer and the CSR's home PC.

Jottings

David Large, the well-known engineer who held positions with Intermedia Partners, **Gill Cable** and a couple of manufacturers, has teamed with two colleagues from Intermedia to form a new consulting company. Large, along with regulations and operations guru Dave Rozzelle and Ted Liebst, a financial analyst, have created **Media Connections Group**. "There are a lot of new manufacturers who need guidance, cable companies and cities who don't understand the new rate structure and CAPs and RBOCs who need to know more about our business," says Large. He can be reached at 510/939-9988 . . . The **SCTE** is looking for authors to present papers during the 1995 Conference on Emerging Technologies, slated for Jan. 4-6 in Orlando. Abstracts are due by Sept. 1. Fax 'em in at 610/363-5898 . . . It's beginning to look like a real shoot-out between the QAM and VSB factions. **Zenith** announced it has licensed 16-VSB technology to **Xing Inc.** of Japan for an on-demand karaoke multimedia network that presently uses ISDN to send programs over phone lines. Eventually, Xing intends to enter the movie-on-demand arena. Meanwhile, General Instrument Corp. has licensed its flavor of QAM technology to Samsung Electronics for use in the manufacturer's digital television products . . . **AT&T** and **Silicon Graphics** have jointly formed a company to design and manufacture video servers. The new company is called Interactive Digital Solutions . . . **The Primestar** DBS service owned by a consortium of cable operators has signed an $80 million multi-year agreement to use TCI's National Digital Television Center to compress, encrypt and uplink Primestar programming . . . **LodgeNet Entertainment** has been selected by The Ritz-Carlton Hotel Co. to supply its interactive TV system to 6,300 rooms in 19 hotels. LodgeNet will offer movies on demand, Nintendo video games and services including guest surveys, inventory control and information directories . . . It's official! Bell Atlantic last month was given formal federal approval to commence the nation's first commercial roll-out of video dialtone service in Dover Township, N.J. Signals will be transported via BroadBand Technologies' switched fiber to the curb system, while digital set-tops will be provided by Philips Consumer Electronics and Compression Labs . . . **AT&T** will sell off its U.S.-based copper-exchange, cable, cords and custom cable assembly business to Cable Systems International, a new company formed by members of AT&T's Phoenix manufacturing facility and Citicorp Venture Capital. The sale was a strategic one, given that AT&T Network Systems has chosen to invest in multimedia, networked computing, wireless and broadband applications. CED



Bauer: Cable's reality checker

By Leslie Ellis

Few could match Bill Bauer's versatility. He's been a carpenter, a disc jockey, a lumberjack and an inventor. Technologically, he's designed everything from burglar alarms and school intercom systems to a patent-pending crop fertilization system using global positioning satellites with 10 centimeter accuracy.

As he recounts each career adventure, he concludes with a broad smile and the same three words: "I loved it."

He seems to also love his current position as owner, president, chief engineer and reality-based strategist for Windbreak Cable, which delivers cable to about 200 subscribers sprinkled throughout two tiny towns in rural Nebraska. But Bauer isn't the typical tiny cable system owner–he's intimately involved in technology issues that are at the core of the industry's future.

One hint at his entrepreneurial vigor: non-standard working hours. On the day of the interview for this article, for example, Bauer spent the morning assisting in the repair of a 300-foot radio tower in Nebraska. (In addition to his multiple roles at Windbreak, Bauer is a contracted chief engineer for 10 Nebraska radio stations.) He flew into Denver for a "suppertime conversation," as he called it, and for some "other business," which he planned on completing after the interview. Such is the never-ending schedule of an entrepreneur.

But there's more. Bauer, a long time volunteer at the county fair near his hometown of Gering, Neb., rubs shoulders each year with musicians from Johnny Cash to Bruce Springsteen. Last year, for instance, he propped up country star Joe Diffy–not against a jukebox, but in his pickup–when Diffy needed a lift from the fair to a hotel.

Big things in small packages

Perhaps surprisingly, this small system owner spends most of his windshield time–he puts in 3,000 miles per month driving "the loop" between his Gering home and his two systems, in Harrison and Lyman–thinking about high-tech issues.

"My biggest challenge will be to find a single platform which delivers telephony, video telephony and high speed data to systems with 1,000 or less subscribers," says Bauer, a degreed engineer from Southeast Technical Community College in Milford, Neb. He adds: "More than 7,000 of the nation's 12,500 cable systems have less than 1,000 subscribers. If we can solve these problems in the tiny systems, we can solve them more easily in the larger systems."

Not that he isn't trying. Bauer, who calls himself a renegade amongst some of his engineering contemporaries, is now deeply entwined in CableLabs–an organization he joined four years ago simply because he wanted access to its weekly technology news bulletins.

These days, Bauer's activities far surpass passive information consumption. Two years ago, he joined the group's Telecommunications subcommittee; last year he was picked to chair CableLabs' Internet working group.

"They (other CableLabs MSO representatives) don't know what to do with me at times," Bauer laughs. "I'm the smallest operator they have, so that sometimes means I'm the voice that brings discussions back to reality."

Hyped by reality

For Bauer, those cable realities surfaced eight years ago, when he acquired the Lyman cable franchise. At the time, Bauer was doing custom carpentry work during the day and DJ-ing for a local radio station at night. "I knew I had to either add about 10 people and grow the business exponentially, or start thinking about a different line of work," Bauer recalls.

In the end, the different line of work won out. Bauer's younger brother already knew the cable construction business, from a stint with TCI. So, the two borrowed a trencher, pickup truck and bucket truck from neighboring Cable USA "in the winter, while they weren't using it," and built the 123-customer Lyman system.

Two years later, in 1988, Bauer acquired the Harrison franchise and built it with his father, who had recently retired. "He helped me every day," Bauer says. "It was like finding a new friend, all over again."

It's that kind of camaraderie that seems to characterize Bauer's neck of the woods–or cornfields, as the case may be. During Nebraska snowstorms, for example, the local snowplow operator waits for Bauer to swallow the last few drops of hot coffee at Sioux Sundries, a local Harrison restaurant, before plowing off into the storm–with Bauer following close behind.

At home in Gering, Bauer and his wife Janet this year will celebrate their 20th wedding anniversary. Bill and Janet, a substitute teacher and mastermind of Windbreak's billing and receipt system, have two daughters: Erin, 11 and Meagan, 8.

Somehow, amid the cable systems, CableLabs projects and myriad other unmentioned projects (like the cellular air time Bauer resells, for example, and his participation within the Gering school district, where he promotes Internet activities), Bauer manages to squeeze in interests in experimental aircraft, Clive Custler novels and a chocolate bar each day at 3 p.m.

So avid is Bauer's obsession with communications, in fact, that family members say he'd have a cellular phone surgically implanted, if only the procedure was available. Indeed, he carries a cellular phone and two pagers with him at any given time.

Bauer says people tell him he's too serious. Still, he has this to say about his colorful background: "If it's not fun, it's not worth doing."

Ain't that the truth. CED

Interface comes down to the wire

By Wendell Bailey, VP of Science and Technology, NCTA

Perhaps we're getting to the end of a long and difficult road. Our negotiations with the Consumer Electronics Group of the EIA (Electronic Industries Association) have been long, difficult and personally troubling for some time.

As you know, Congress mandated that cable television and the consumer electronics industries work together to find ways to improve compatibility between cable systems and new consumer electronics products such as TVs and VCRs. The FCC, acting upon this impetus from Congress, first sought information in a notice of inquiry (NOI) to which the two industries responded together. At about the same time, the two industries began to negotiate on how to actually get all of this compatibility done.

For the most part, the negotiations produced a lot of the details the Commission eventually adopted in its May 4th report and order on compatibility. But the Commission at that time decided not to adopt one of the items that had been tentatively negotiated–the definition of what constitutes a decoder interface connection for a cable-ready TV or VCR.

The Commission said it recognized the importance of this particular methodology for connecting TVs and VCRs to cable television and that it understood all of the technical details were not yet worked out. Therefore, it gave the two industries an additional 90 days to finish.

If the two industries could not come up with a finalized definition and details for this connector by August 5, 1994, the Commission said it would take the job unto itself. Nobody wants to see that. The already difficult issues that have arisen in these negotiations seem to have intensified greatly as we try to settle the last few details of this decoder interface.

Of the hundreds of technical details necessary to finalize this item, the vast majority are not, in the traditional sense, controversial or argumentative in any way. What we come down to however, are two philosophical issues that have caused a great deal of strife in the group negotiations.

The first one is the issue of mapping. In mapping, a cable operator sends a specific channel on a certain frequency to a home, but the set-top box in that home displays a different channel number than the one that is actually carrying the signal. This is done mostly to solve problems with television tuners and direct pickup. In a meeting last year in Chicago, the two groups agreed that mapping was a necessary activity. In order to satisfy the concerns of the consumer electronics industry as to the confusion this might cause a customer, we agreed to include language in our report to the FCC detailing what a cable operator would be required to do to inform consumers that they might have a channel that's in an unusual place.

Notwithstanding this agreement, the EIA recently decided to ask the Commission to prohibit mapping. This caused a lot of commotion during a meeting held recently here in Washington between the two groups. We've asked that the channel identification plan which has been jointly submitted to the FCC contain an asterisk that points out that the list of channel numbers and the frequencies that they occupy be annotated with a legend for that would say "except for mapping."

This would leave the cable operator free to map as long as he provided sufficient information so a consumer with a set-top or cable-ready TV or VCR could find the channel they want.

The second, and perhaps the most important issue, is the command set. We presume that if we connect a set-back device consisting primarily of a descrambler to the decoder interface point on a TV or VCR that the customer-owned remote control must be able to communicate with that set-back device through the IR receiver and electrical connections leaving the TV set in the form of a plug.

Certainly, the remote control will be able to control many functions of the TV set, but some functions are unique to the set-back decoder–and we would like those functions to be accessible through the TV set or the VCR.

The debate between the two groups comes over the fact that we on the cable side would like a full and complete command set. We simply don't know for sure what services or functionality we might wish to supply to our subscribers that might need commands from the consumer side of the television.

The consumer electronics industry, on the other hand, wishes to limit their commands to the smallest set possible. One would suspect the motive is to eschew built-in features that might compete with features supplied by other vendors. Indeed, a consumer electronics manufacturer was heard to respond to the suggestion that more commands were good this way: "I'd rather sell them a new TV set than have a competitor supply these functions."

The fact is, we need to have commands, as do the competitors who'll be in our business, whether we like it or not. It's in everyone's best interest for there to be a full and complete set of commands.

We have tentatively agreed on a set of commands proposed by the consumer electronics side along with a group of function keys that will allow us to define the basic set of commands in a variety of ways. This issue is not yet resolved completely, but progress has been made. We're all shooting to have an approved document by the deadline.

I'm hopeful that we meet this deadline but we not only need to be timely, we need to be complete and we need to be satisfied with what we've done. I'm hoping we can get there from here. CED

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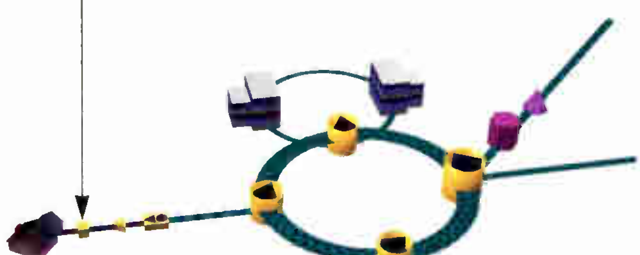

REGAL by ANTEC

Circle Reader Service No. 8

Encryption fundamentals and the DES

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

The terms encipher and encrypt became known as the process of disguising the original message such that it could not be read by unauthorized parties. This process was initiated at the transmitting or originating location. The inverse process of unraveling the encrypted message became known as decryption or deciphering.

In the general model of an encrypted channel, the message signal, called the plaintext message, is encrypted by the use of some sort of mathematical, invertible transformation. In other words, the incoming information was rearranged according to one of an almost infinite number of potential algorithms. The one algorithm or transformation of the data selected at any given instant is determined at the transmit end by a key. The output of this process is called ciphertext (encrypted information) which can then be transmitted via an insecure public channel.

When an authorized receiver receives the ciphertext, along with the decryption key, it decrypts the signal with the inverse transformation to gain access to the original plaintext message. While the key may generally be used for a considerable number of transmissions, it is interesting to note that if the need arises, the key can be changed on a continuous basis for very secure transmissions.

Types of encryption

Encryption generally falls into two categories called either block encryption or stream encryption[1]. In block encryption, the original plaintext message is separated into blocks of information of a fixed size. Each block is then encrypted separately from the others with the sequence of symbols generated with the key. With stream encryption, there are no blocks. Instead each bit of information in the data stream is encrypted with the sequence of symbols generated with the key. If the key stream repeats itself every so often, the encryption system is called periodic.

The major requirements of any encryption system are that it provides an inexpensive and relatively simple means of sending encrypted information to any authorized user who has the appropriate key while making it difficult and very expensive to decode the information without the key. Such systems might be classified as either unconditionally secure, or computationally secure.

Unconditionally secure means that no matter how much computing power is available to a potential thief, the encryption system simply will not be broken–perhaps because of an infinite number of keys that are being changed continuously. There are some systems that can be proven to be unconditionally secure, but they are not typically very practical. Therefore, most systems are classified as computationally secure, which means that given that the potential thief is using state-of-the-art computing technology, the system encryption could be broken in some period of time, generally specified in years.

The well known Data Encryption Standard (DES), which is being used in a number of varied applications throughout our industry, was originally developed by IBM and then approved by the National Bureau of Standards (now known as the National Institute for Standards and Technology) for governmental use back in 1977. In 1981, that same standard was adopted by ANSI, the U.S. commercial standards organization, as ANSI X3.92, the "American National Standard Data Encryption Algorithm." In 1986, DES almost became an international standard when the International Standards Organization approved it as ISO 8227. At the last minute, however, the ISO voted not to standardize cryptography, and the standard was never published[2].

DES, as an ANSI standard, is therefore a widely published[3] block encryption system that employs a variable 56-bit key. An input plaintext block of 64 bits is encrypted into a new ciphertext symbol first through an initial permutation of the plaintext bits, then 16 rounds of key-dependent computation, with another permutation added for good measure. For decryption, the same algorithm is used but is taken in reverse order.

Days are numbered?

Over the years, the DES algorithm has served the industry and government well in a number of different applications. Its days may be numbered, however. There has been some sensitivity that because the National Security Agency (NSA) has been involved in the original design, that it would be able to tap into any DES encrypted message through "trap doors" that only it knows about. In addition, many researchers have felt that the 56-bit key is simply not large enough, given the level of computational power available today to just about anyone who wants it.

It has been estimated, for example, that DES can be broken by exhaustive attack in an average of eight days using equipment that costs around $1 million constructed from 1992-technology DES chips. Other estimates say that, using technology available in the year 2000, DES could be broken within one week at an equipment cost of $500,000. It follows that, with the development of custom ICs and a $1 million investment in equipment, DES could be broken in a couple of hours[4]. To date, however, no evidence of successful attack has yet been published. DES is reviewed every 5 years by the U.S. Government as to its suitability for use and has been reaffirmed in 1983, 1988, and again in 1993.

Only time will tell. CED

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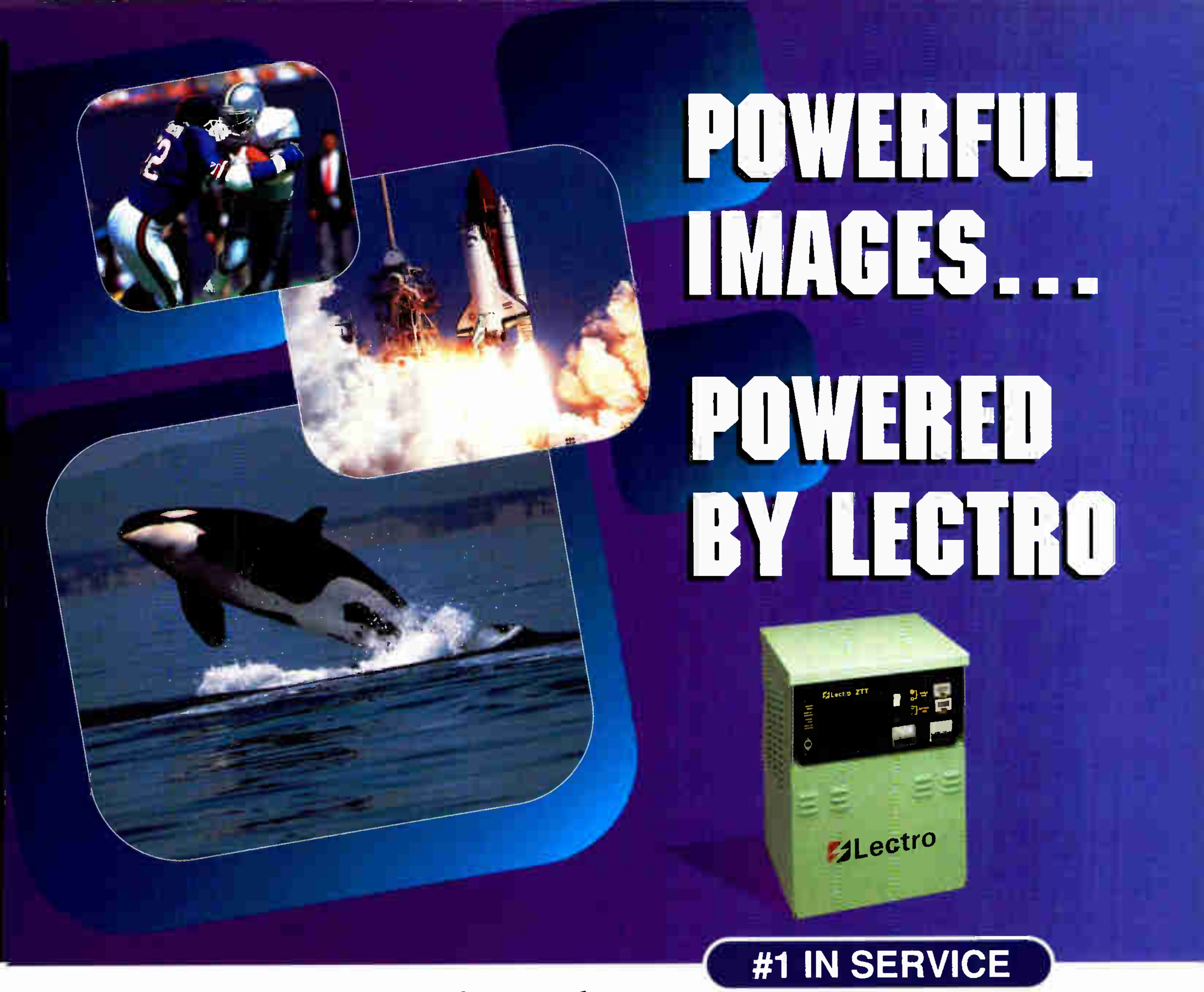

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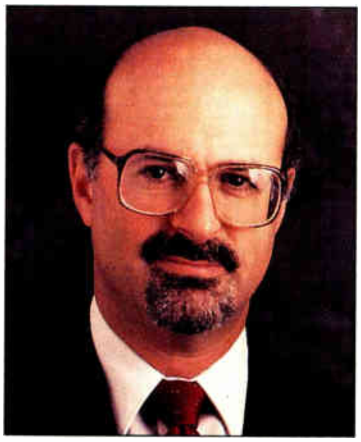

By Jeffrey Krauss, polishing apples in the information supermarket and President of Telecommunications and Technology Policy of Rockville, Md.

The FCC's recent decision on equipment compatibility contained a few surprises, one of them being a prohibition on altering the codes used by infrared (IR) remote controls. It was a surprise because the FCC gave no notice it was considering such a rule, and nobody claimed there was any actual problem that needed to be corrected.

But the FCC evidently continues to believe cable operators will do anything to inconvenience their paying customers, including changing IR codes to disable customer-owned remote controls.

The FCC never asked for comments on the need to regulate IR codes. This FCC docket was supposed to deal with compatibility between set-top convertors and TVs, allowing subscribers to watch one scrambled program while recording another, and related issues. The decision also prohibited cable companies from disabling the remote control receivers in their set-top convertors, so that subscribers can purchase and use universal IR remotes. But there was never any proposal to regulate the codes used by IR remote controls. It was apparently tossed into the decision at the last minute.

The specific rule in question is Section 76.630(c) of the FCC Rules. It says: "Cable operators may not alter the infrared codes used to operate the remote control capabilities of the customer premises equipment they employ in providing service to subscribers." It was adopted on May 4, 1994 in Docket No. 93-7.

What the FCC has just done, by prohibiting changes to IR remote control codes, is prohibit technological change in the cable industry. And that's a bad idea.

What are infrared codes, anyway?

The IR code is a numerical value (for example, 7) that is assigned to a specific function on the remote control, such as on/off or channel up. Different convertor models, even those from a single manufacturer, might use the same code (i.e., numerical value) to represent different functions. Model 100 might use 7 for on/off; Model 200 might use 7 for channel up; and Model 300 might use 7 for a parental control function.

While IR codes are important, the IR transmission method, which the FCC did not consider, is as important as the IR codes for achieving the FCC's goal of protecting the subscriber's investment in IR remote controls.

There are at least two different types of IR remote control transmission methods in use today, including pulse position modulation (PPM) and carrier modulation. Pulse position modulation employs pulses of IR that are sent at specified intervals. IR carrier modulation employs a carrier frequency to modulate the IR source, and turns the carrier on and off at specific intervals.

Many cable IR remotes use a 38 kHz carrier frequency for IR carrier modulation, but others employ a 26.67 kHz carrier frequency. Those two groups of products are not interoperable; a set-top convertor that receives 38 kHz IR signals cannot easily receive 26.67 kHz signals.

And the FCC should also have considered pulse widths. In some convertors, the digit "zero" is represented by a pulse width of 12 milliseconds; the digit "one" is represented by a pulse width of 8 milliseconds. But in others, a "zero" is represented by a pulse of 2.25 milliseconds and a "one" is represented by a pulse of 4.5 milliseconds. And there are a wide range of other values, as well.

If the FCC had followed its normal procedures and sought comments on regulating IR remote control technologies, it would have known that regulating the IR codes alone would not be sufficient. But it would also have learned that there was really no reason to regulate.

Stifling innovation and competition

This FCC rule stifles innovation. It has the effect of discouraging cable systems from deploying convertors that use modern IR technology. The rule prohibits a cable operator from switching from the older PPM technology to the newer IR carrier modulation technology. And what if more advanced remote control technologies are developed in the future?

What about a multi-format IR receiver? Could it receive both the newer and older IR technologies and codes? Such a receiver would need to determine whether the IR transmission is PPM or carrier modulation, which carrier frequency is being used, and would need to detect and receive a wide range of pulse widths. But this is probably very difficult to design and manufacture at a reasonable cost. I don't believe any such IR receiver now exists.

The FCC rule stifles competition as well as innovation. As a practical matter, a cable operator will not be able to change to a new equipment vendor, because different vendors use different IR codes, and some treat their IR codes as proprietary (copyrighted, in effect). Those vendors do not permit competitors to incorporate their IR codes.

More punishment

This rule was adopted (purportedly) to protect a consumer's investment in a remote control, and to protect against a cable company maliciously changing its codes to inconvenience its subscribers. But that's not likely to happen. How much do remotes cost today–$10 to $15? Subscribers don't need this regulatory protection. This looks like more punishment for the cable industry. As a result, numerous companies have asked the FCC to reconsider this decision. We'll wait and see whether reason prevails. CED

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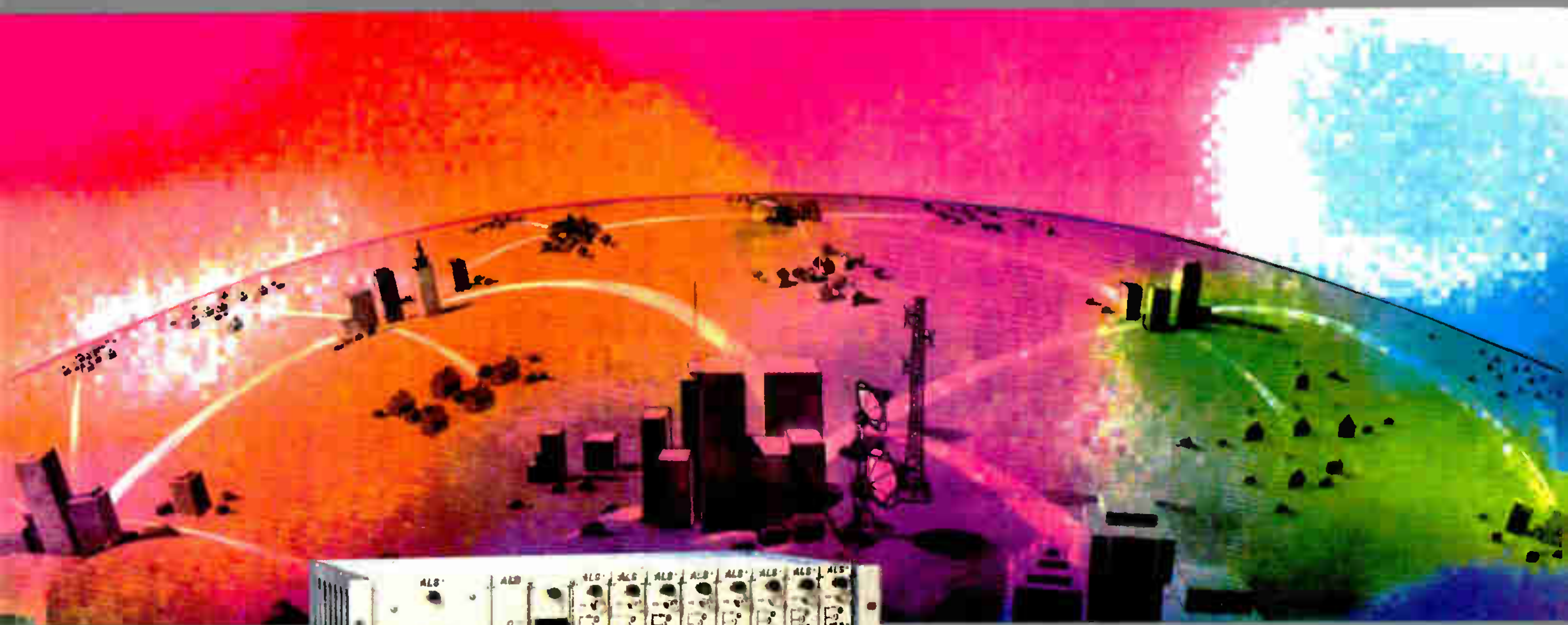

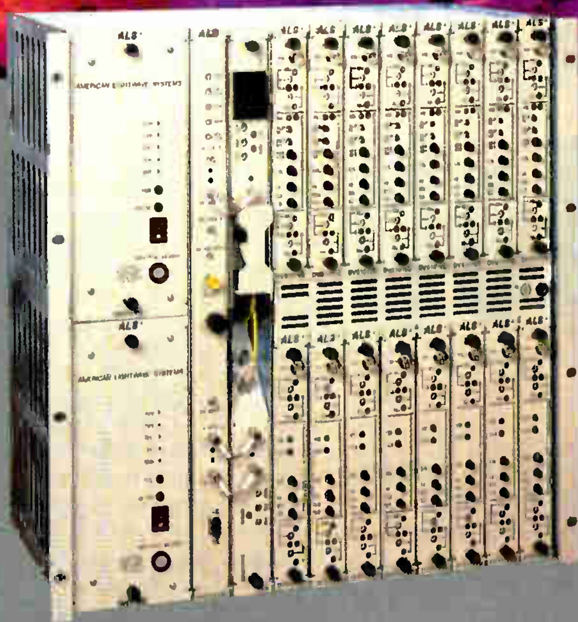

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Circle Reader Service No. 16

side and increased workloads resulting from a lack of help pushing on the other, many techs are feeling the pinch. "Being on call half of my weekends and holidays gets old," notes a 46-year-old tech from the Southwest. "I feel that I am stagnating here. I don't know how much longer I can tolerate the boring routine."

The average tech we found is about 39 years old and is an industry veteran of 12-15 years. He's been with

Manager snapshot

Average age:	*41.34*
Tenure in industry:	*12-15 years*
Tenure in company:	*7-10 years*
Avg. no. subs in system:	*10,000-19,999*
Avg. monthly cost medical insurance:	*$82.84*
Avg. monthly cost dental insurance:	*$22.82*
Average number of vacation days:	*16.60*
Average number of personal/holidays:	*8.35*

the same company for 7-10 years and most work in small systems of between 1,000 and 5,000 subs. He gets 13 vacation days and eight holidays per year.

On average, techs make $28,500 per year. Our survey found the highest-paid tech made $58,000 and the lowest-paid made $15,000. Medical insurance costs techs about $83 per month and medical benefits cost $17.50.

Beyond competition and regulation, techs say their biggest concerns are struggling to stay current on new

1994 Salaries by region

	Northeast	Southeast	Midwest	West
Managers	$47,792.30	$42,627.27	$37,288.23	$41,601.53
1993	$45,310.61	$40,258.18	$35,864.06	$40,061.03
Engineers	$43,448.47	$39,735.89	$40,811.84	$43,853.85
1993	$42,564.63	$38,380.56	$39,214.19	$41,909.38
Technicians	$29,797.50	$30,533.33	$25,532.08	$29,955.82
1993	$28,476.25	$28,342.86	$25,072.67	$29,393.55
Overall	$44,557.75	$41,123.26	$37,088.71	$40,678.87
1993	$43,003.91	$38,894.13	$35,408.24	$39,112.01

technology. In addition, they feel it's difficult to advance up the ladder into a better paying job. When it comes to their jobs, most techs say they're overworked, running around at a frantic pace and hampered by old technology that needs to be upgraded but may not be because of shrinking capital budgets.

Should I stay or should I go?

Other highlights of the survey include:

✔ Of all questions asked, respondents are most satisfied with their job security and least satisfaction with their opportunity for advancement. Ranking in between the two, but still above average, financial compensation.

✔ Safety training in the workplace is apparently not much of an issue with most who sent surveys back, while training on new technologies is. Survey respondents were most satisfied with safety training, then technical training, followed by personnel management training and then by new technology training.

✔ On average, it takes a bit more than a year on the job to earn a week of vacation; two years to earn two weeks off; six years to get three weeks of vacation time and 12 years to get more than three weeks away from the job.

✔ Nearly 93 percent of those surveyed said their employers pay for them to take education or training courses.

✔ A whopping 77 percent said they have taken advantage of that offer by enrolling in education or training courses. Of those, most have enrolled in National Cable Television Instute courses. After that, SCTE is most the most popular method of gaining information.

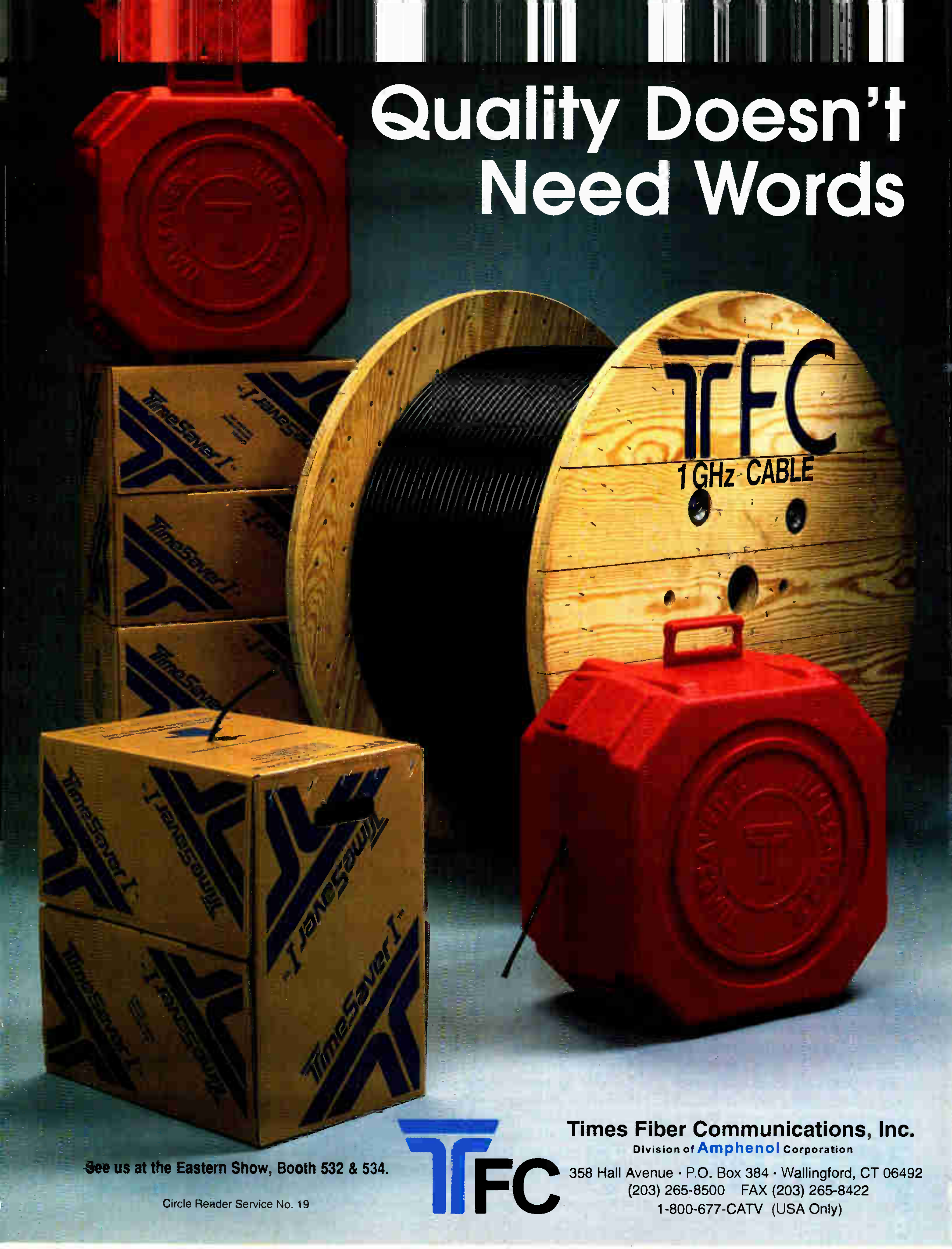
✔ Once again, about 90 percent of those who sent back surveys, when asked to speculate about their futures, said that they expect to be in the cable industry three years from now. Considering all the uncertainty over mergers, acquisitions, regulations and competition, that might be contradictory. Either that or the respondents feel as though their jobs are safe for at least the next three years.

Those who said they would be leaving the industry for reasons other than retirement most often cited job stress and "burnout" as the reasons why. Others, of course feel overworked and underpaid. "The cable industry seems to want more and more from individuals while giving less monetary compensation than it did just a few years back," writes a 36-year-old California engineer who makes $34,000, yet plans to leave the industry. "The regional engineer used to be located here, but he quit. I may be next."

A tech in Virginia feels he may have to leave because he can't be certain he can keep the cable plant up and running. "My MSO is reluctant to hire more people," he says. "With all the responsibilities I have, I do not feel comfortable with CLI and proof testing. There is not enough time for test preparation to ensure a passing grade."

Final thoughts

So, while some are sounding cable's death knell, others simply admit they're overworked, understaffed and need more training but see a bright future for the industry. It's impossible to know for sure what the future will hold as the industry consolidates and pursues new revenue streams such as datacom, telephony, transactional services and more. But this much is for certain: the technical personnel appear ready to accept the challenge. CED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loaded into ATM cells for transport between ATM switches and ATM multiplexers, then returned to an MPEG-2 stream for delivery to customers' set-top convertors (ultimately, the ATM network will likely extend all the way to the set-top).

Traffic shaping transforms the bursty signals associated with compressed video into smooth, constant flows; since the rhythms of movement in a typical program are so irregular, extra bits must be stuffed into the signal so that the quantity of transmitted information is steady. Finally, rate synchronization is the means by which video signals are matched to the network timing reference. This ensures accurate bit framing, which is required at the set-top for proper decompression.

A competitive position

Cable companies are in a strong position to provide competitive access for business services. For one thing, it takes more than an ATM switch to build an ATM network–the capacity to support high-bandwidth ATM applications is also needed. Cable companies have this capacity in their fiber/coax networks, which they're continuously upgrading with state-of-the-art technology. In fact, many networks have been intentionally overbuilt, with extra fiber added for future needs. Considering the RBOCs' position, many cable companies are likely to conclude that the future is now.

Telcos and cable companies both may ultimately use ATM technology for the same purpose.

The RBOCs may have awesome spending power, but they also have important regulatory restrictions and an enormous embedded infrastructure that simply can't be abandoned. They are, however, moving ahead with ATM, albeit conservatively.

They need it to overcome their current, awkward practice of "backhauling"–using multiple overlay networks in which several redundant lines of communication carry protocol-specific information along the same route (the improvement is like dispatching a single translator who speaks every language instead of a delegation of translators who each specialize in one language).

Of course, the RBOCs are also lining up a video threat, and they'll use ATM in that effort, too. So, though telcos and cable companies confront a different set of issues in the near term, both may ultimately use ATM technology for the same purpose–to create a single platform for broadband video and business services delivery. Cable companies have an opportunity to reach this goal first and establish a strong position. Since they know they can move quickly and they're aware of the RBOCs' impending video threat, it's likely that many will take advantage of this opportunity.

"I can see that ATM is really taking off," says Rudy Welter, director of research and development for Cablevision Systems Corp., which is running a trial ATM network on Long Island linking a cancer research center with a university hospital in a medical imaging application. Welter believes the technology shows tremendous potential, especially for creating new service opportunities, though he cautions that at this stage ATM has yet to prove itself in large networks where congestion control would be a concern. He also cites interoperability and user-friendly service interfaces as important issues that need to be ironed out.

Adding ATM to the network

Important questions remain about implementing ATM technology. How is ATM equipment added to an existing network? Will ATM nullify the value of previous investments? How are video and business services integrated? Unlike some promising developments, which fall apart when they meet the real world, ATM holds up remarkably well. Because it handles information of all sorts, for example, it actually enhances the value of previous investments by working productively with existing equipment.

Engineering an ATM network to handle video and business services simultaneously is another straightforward matter. It requires the use of a modular switching platform that accommodates both new and existing services and protocols. With a universal switching chassis and a set of circuit modules supporting frame relay, switched multimegabit data service (SMDS), cell-relay and constant-bit-rate (CBR) services, network operators would simply load the chassis with modules to meet the needs of the area it serves. The SMDS module would accept a data feed from an SMDS module and convert it to ATM cells; the CBR module would do the same with a video feed. Once information is packaged in cells, the switch itself doesn't care what it's switching.

Engineering an ATM network to handle video and business services simultaneously is another straightforward matter.

Each switch chassis should be located where it can most efficiently collect and distribute information. In today's structured, high-bandwidth cable networks, the logical place would be a master headend or remote headend, depending on the traffic volume it must support. This contingency, based on the fact that real-world markets are diverse and prone to change, has motivated some industry suppliers to develop switches that are both modular and scalable. The availability of small ATM switches that can be expanded easily has several consequences:

- ✔ there's no need to operate in a major market to make good use of an ATM switch;
- ✔ a large market can be served with a distributed set of small switches;
- ✔ buying a very large ATM switch may be a ticket to inflexibility;
- ✔ buying a switch that's too small may limit capabilities.

An important issue with scalable switches is the capacity of individual building blocks. A switch with a 1.2-gigabits-per-second (Gbps) backplane, for instance, would be insufficient in many scenarios and would expand in very small steps; a 20 Gbps switch, on the other hand, would expand in giant steps, proving itself cumbersome and inefficient in most situations. In other words, you don't want to build a wall with shingles or boulders, but with bricks.

A small but capable switch, with a backplane capacity of around 5 Gbps, could be installed initially in the master headend. As service requirements increase, it could be expanded. With further traffic growth, additional switches could be placed in remote headends, with the larger switch in the master headend serving as a backbone. The key, then, is to find an ATM switch that can meet both present and future needs.

Managing the network

The real challenge is managing an ATM network. Management systems vary according to each manufacturer, so it would be wise to compare network management capabilities. But beware: the talk on this topic can get very complicated very quickly. Although the aspects of network management are nearly endless, a few key issues stand out, such as billing, performance monitoring and system control.

Billing will take on a whole new light in the age of interactive, integrated networks. A residential customer will want to pay a unit price for a movie, whether it's an hour-and-a-half or two hours long. But some businesses sending data files may want to pay only for the number of cells transmitted, while others would prefer a fixed monthly rate. The point is that the billing system must be flexible enough to support appropriate pricing schemes for diverse services. This is essential for preserving the customer's satisfaction and the system's profitability.

Billing should be flexible in other ways, too. It's possible to establish peak-time and off-time rates, as well as different rates for different levels of quality. ATM switches can be designed to support many different Quality of Service (QoS) levels, which establish a pecking order for throughput based on information stored in the cell header. By offering several QoS levels, customers can choose to fly first-class, coach or stand-by.

A related issue is the switch's buffer capacity. The buffer serves as a sort of waiting room for stand-by passengers; if it's too small, the buffer will overflow and cells will be lost. Buffer capacities range in today's products from around 30 cells per second for customer premises switches to as many as 125,000 cells per second for hub switches.

The switch's statistics collection and performance monitoring capabilities are also important, because they provide the proof of service quality and therefore justify the existence of different price levels. Evidence of network reliability is required to attract many business customers, such as financial institutions. Performance statistics also can be used to fine-tune the network for maximum efficiency.

Finally, it's important to know the capabilities of the management system's controller, which ties all its parts together. How powerful is it? Does it have an intelligent or a dumb processor? Is it easy to use? How does it provision services and process data? Cable companies should be especially eager to acquire a capable system because, while they may have broadband networks in place and the ability to move quickly, they face a competitive disadvantage when it comes to network management. Since the RBOCs have traditionally delivered a lifeline service, they have had to manage their networks well; their systems may be aging, but their results have been outstanding.

Lingering doubts?

If you're interested in ATM, what's holding you back? Some people are worried about adopting such a new and different technology. They can be assured that ATM is not the concern of a small clique. In fact, the development of ATM is among the most widespread and intense areas of research in communications today. Its development has been tied to standards groups–such as ANSI, ATM Forum, Bellcore, Frame Relay Forum, ITU-T (formerly CCITT) and the SMDS Interest Group–from day one. The results are appearing already, with frequent deployment announcements in telco, cable and end-user networks.

In the end, each cable company will decide for itself whether–and when–ATM will play a role in its operations. When seen as an integrated solution for both video and business services, the "leap to ATM" looks instead like the next logical step. CED

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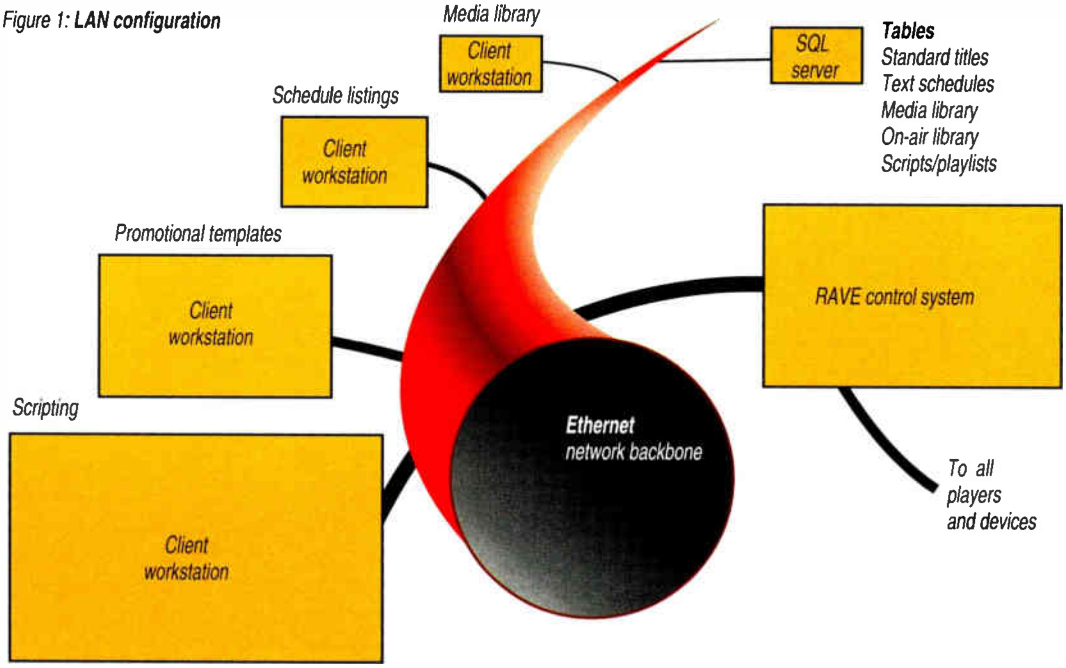
How to manage random access video

Catch the RAVE

Figure 1: LAN configuration



By Bert McCoy, Director of Research and Development, Prevue Networks

We've all heard the terminology: information superhighway, video file servers, video on demand. But the fact remains that these things, though much discussed and written about, mean different things to different people. What's more, there are so many claims concerning the state of technology, we're constantly forced to confront the question of what is real and ready for production, and what is only in a research lab.

When the information superhighway arrives, with all the fabulous claims of hundreds of channels and mountains of information, the challenge to cable engineers is this: how do we manage the delivery of these channels and all this information to thousands of locations?

Consider the problem of how to schedule, program traffic, and control over 3,000 videos a day, from a library of more than 50,000 unique video programs. What MPEG offers is very dynamic, and provides hope for very reliable and flexible video player/recorders of the future. But at Prevue Networks, on a network level, we're already dealing with these challenges on a daily basis, and many of the things we've learned may provide lessons for the cable system engineer of the "information superhighway" future.

How do we manage the delivery of this information to thousands of locations?

Prevue's Random Access Video Effects (RAVE) control and management system is the heart of Prevue Networks' open architecture Network Control System (NCS). While some analogies relating a network system to a cable system certainly will not provide apples-to-apples comparisons, much of what Prevue has developed for its unique network needs is illustrative of the cable system of the future.

The Prevue 10-minute program cycle, five-minute national break and several special programs in a typical hour provide a challenge for video management and control. The system has several hours of video available in the "on-line" inventory, and selections are made to be placed on-line from a large off-line library. This is similar to the problems faced with near video-on-demand and video-on-demand file servers in cable system headends of the future: how are videos selected by both the system and the subscriber, and how are these videos played when requested?

One of the fundamental ingredients of the system to manage such an inventory is a database which describes the videos, audio, play schedules, promotional philosophies and availability models. At Prevue, a Microsoft SQL Server is utilized, operating on a Dual Pentium, Windows NT Advanced Server. Working with this server are a number of "client" applications. These have been developed in Visual C++ and Powerbuilder (a GUI application development language for SQL).

Applications that operate on a client PC include:

- ✔ setting a promotional philosophy
- ✔ establishing a schedule of when programs are to air
- ✔ media library
- ✔ a prelog process to filter data
- ✔ an edit list to present data for final user approval
- ✔ a scripting engine
- ✔ the on-air hardware control and media

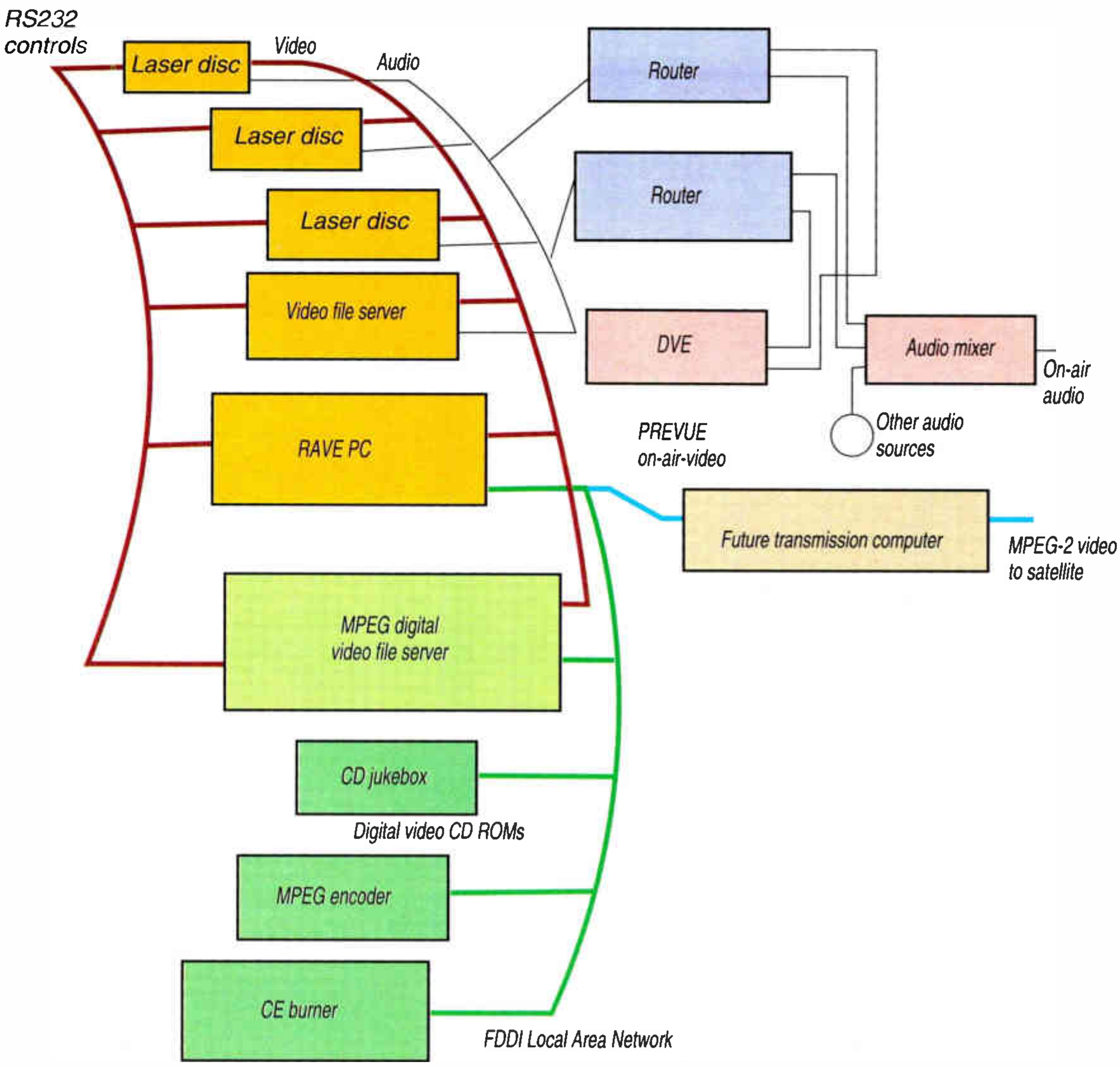
The first application in the system is the media library. It's important to describe media (video) in as much detail as possible. This will allow for computer systems to search, find and play media, depending on the needs of the user (in our case, this encompasses our promotional philosophy–on a system level, the needs would depend on the amount and type of video-on-demand a system intends to offer). Items described in the media library at Prevue include video or audio tags, and languages.

Because Prevue supports several languages including French, German, English and Spanish, this is a key factor in managing the

video needs. A cable system with a large number of subscribers who speak foreign languages (e.g. Spanish) might have similar needs. The media library also provides tracking for the media, and allows restrictions by network, digital record parameters and length.

In the Prevue model, the selection process is first qualified by using program schedules of the national networks and local outlets. This schedule is compared to the videos available for promotion by a prelog process, which includes a group of broadcasters and a date range. An edit list application allows editors to refine videos selected to go on-line. Editors then use specified edit lists to obtain the needed video (via satellite or videotape), edit the off-line library to laser discs, merge scheduled ads, and to move videos from the off-line digital library (CD Juke Box) to the on-line video file server/player system.

Figure 2: ***Digital player configuration & beyond***



Play configuration

Once the videos to be placed on-line are decided, the scripting engine (or in the case of a local system, the user input) determines the precise play configuration. This includes the hardware limits of the system, as well as the promotional philosophy. See Figure 1.We call our system RAVE, which is an acronym for Random Access Video Effects. The key words here are "random access," something imperative to Prevue's ongoing operations, and a crucial element in the cable system of the future.

On-line hardware in Prevue's current system consists of multiple laser disc players, right and left video/audio routers, a digital video effects (DVE) unit, and an audio mixer controlled by a primary and backup computer system

The multiple laser disc players offer several hours of on-line video to be selected by the on-line system. Laser disc players offer a random access selection method, meaning videos can be chosen from any disc, anywhere on the disc. The only instruction the system needs is a player number and a starting frame.

One of the fundamental ingredients of the system to manage such an inventory is a database.

The right and left video/audio routers allow the system to select any two players from the multiple laser disc players for the quarter-screen, two-source Prevue promotional philosophy (which makes up Prevue Channel's unique on-screen look in 35 million cable homes). Different audios can be switched with different videos so that video can be played from one laser disc, with the audio being played from a different disc.

The DVE unit allows the system to shrink full-screen video to quarter- or half-screen in real time–perhaps a unique requirement for Prevue's needs, but nevertheless demonstrating the versatility of the system. The unit can also store a series of key frames as one digital effect to perform real-time spinning, resizing or turning of the video picture. Up to 100 effects can be stored in the unit, which can be recalled at any time by the on-line system.

The audio mixer provides selections of different audio inputs including mixing of background music from other audio sources such as digitized audio on a PC.

The computers which actually control the hardware are 486-class PCs, with multiple port serial cards operating under Windows for Workgroups. The primary computer retrieves the "script" from a file server, and copies it

Although Prevue will eventually evolve to using MPEG-II digital hard disk drives, the network presently uses high quality laser disks for source material.

Prevue Network services are collected and assembled at Prevue's Tulsa, Oklahoma headquarters.

onto its local hard drive to begin the playing process. The script drives the system, telling the computer where the videos reside, what digital video effect to perform, what external audio needs to be mixed in, and when to play the promotional spot. One script entry usually plays one promotional spot.

Since the players all have intelligence, the RAVE control computer is informed when a failure occurs. This allows several error recovery paths, including alternative routing when necessary.

National ads

Prevue Networks services are advertiser-supported, and the cable system of the information highway future will no doubt continue to look to local advertising for a portion of its revenue stream. While Prevue provides national advertising through its national network system (and, of course, allows affiliate systems the opportunity to sell local avails), perhaps another analogy could be drawn in this scenario. In order to assure the best possible promotional impact for our national advertisers, a third-party software system is used, based on Nielsen demographics scheduling and formats which are widely accepted. The ads are merged with the program schedule during the scripting process, matching the ideal scheduling as closely as possible.

The RAVE system then logs all advertising for affidavits in case make-goods are needed. With so much intelligence in the play system, the RAVE computer can detect any failure of its devices and report problems. Final affidavits still come from monitoring the network from several sites.

The script

As a television show or a movie begins with a script, so the Prevue system depends on a script for its operational blueprint. The script entry is broken down into multiple events, each associated with the time an event occurs. One script entry can be broken down into many events, such as laser player "seek and plays," routing of video and audio, and selection of the video and audio effects.

On the horizon at Prevue is the replacement of the laser disc players with MPEG players.

Scripts can be changed or updated in the background as needed, as promotional spots are being played.

On the horizon at Prevue is the replacement of the laser disc players with MPEG players. The playback concept is essentially the same, but instead of seeking and playing on laser disc players, MPEG files are opened and played on the MPEG players. Also, instead of having scheduled disc changes with laser disc players, videos are updated in the background on MPEG players.

Digital network control

Prevue is in the final testing and development stages of a digital network control system, incorporating MPEG video into each Prevue Networks service. Initially, this will

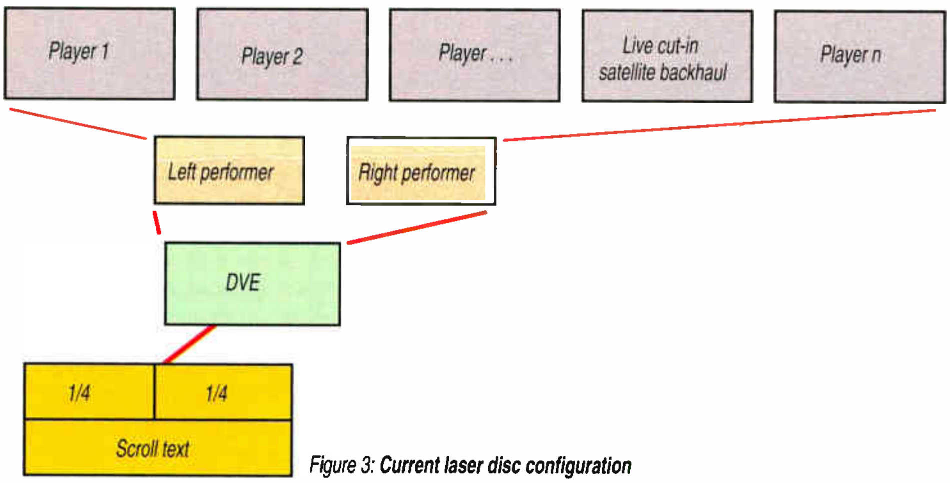


Figure 3: Current laser disc configuration

allow for trafficking of random access video, with conversion to analog before transmission. However, this will establish the digital library which can be transmitted digitally to cable headend file servers when systems are equipped with the proper hardware.

Prevue's staff of editors receive raw video from broadcasters, studios and network promotional feeds. The library of work tapes they build includes several promotional videos for use on Prevue Channel and Sneak Prevue. The digital MPEG encoder is set up to encode several videos from the same tape with a "batch" file for processing. This batch file is created by the prelog application (see section on "applications") and the edit application, allowing final quality control of the videos to be encoded. Once encoded, the produced videos are stored on a Winchester (computer) hard drive until enough are accumulated to transfer to a CD ROM.

A set of CD-ROM juke boxes (typically 250 CDs with 4 CD drives allowing storage of more than 150 hours of video) form the off-line library. All CDs are cataloged into the database for quick retrieval. A video is copied to the on-line digital MPEG player a few hours before air time to allow a safe margin. The RAVE system then selects the video and plays it using the same random video concepts developed for laser disc playback. The on-line player uses a RAID 3 SCSI system, which is available from several vendors. Currently, Prevue is using Micropolis VOD technology, allowing more than 12 hours of video storage.

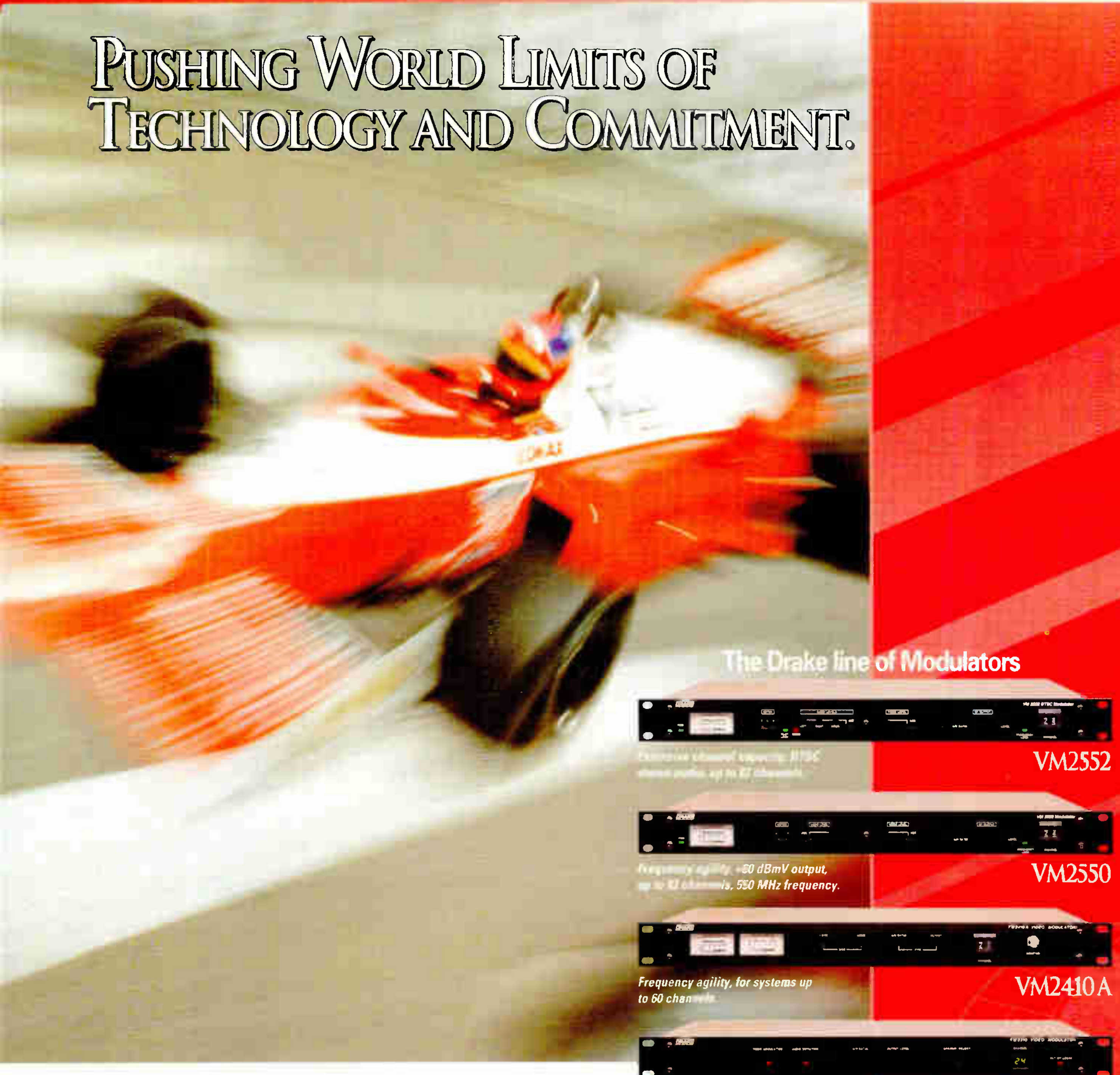
Conclusion

Prevue's open architecture platforms support state of the art technology, while helping to create the gateway to future technologies and applications. Although Prevue has been developing its services with MPEG-1 and enhanced MPEG-1 products, the intent is to launch digital services using the cable industry standard of MPEG-2. All support applications have been developed, and are in the final testing stages as Prevue prepares to launch MPEG-2 applications when MPEG-2 decoders and IRDs are received.

MPEG-2 has been endorsed by many major set-top vendors as the system of choice for the future.

MPEG-2 has been endorsed by many major set-top vendors as the system of choice for the future. Prevue has been involved in the technology as it has evolved from DVI to JPEG, to MPEG-1 and finally to MPEG-2. Though there are likely to be future versions of MPEG, MPEG-2 forms a solid foundation with sufficient quality and cost savings in bandwidth reduction.

MPEG-2 is the best solution for our customers. Launching an interim digital technology destined to become an obsolete dinosaur would be a disservice to the 3,000 cable headends served by Prevue. New digital services will embrace the best digital compression technology, but Prevue's ability to deal with complex video management issues today means a smooth transition as the industry transitions to the reality of the brave new world of video on demand and the information superhighway. CED



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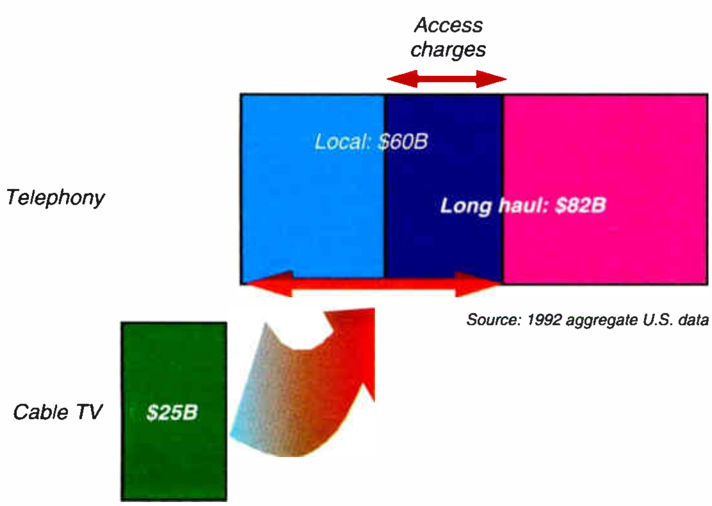
Entering the voice telephony market

Dialing for dollars

By Dick Swan, Director, Strategic Marketing, and C. Derrick Huang, Manager, New Business Development, Northern Telecom

Traditional barriers once separating cable TV providers and telephone companies are disappearing, a change driven by increasing re-regulation of cable revenues and stagnating growth in the telephone industry. As a result, cable companies are exploring ways to provide telephone services over their existing distribution infrastructure, while telephone companies look to offer video services through the deployment of broadband technologies. The two industries—along with their once neatly segmented markets—are converging.

Figure 1: ***Why telephony?***



In this transition, both camps find themselves in the position of defending their own markets while trying to gain access to the other's. For cable companies, this means offering profitable telephone services, among other things. But how should they approach a market that is historically reliant on a single provider, the telephone company? To be successful, cable companies must do several things right: develop a workable entry strategy that attracts (and retains) customers by differentiating themselves from telephone companies, build a low-cost infrastructure, and provide the supporting operational functions.

Entering the voice market

The U.S. local and long-distance telephone market generates five to six times the revenue of the cable industry. The sheer size of the market is alluring. While many see the monthly fees as the key attraction, an even more appealing source of revenue, hidden to casual observers, has the potential to yield substantial profits for new entrants: the access charge.

A long-distance carrier typically keeps only 60 cents of every dollar it collects; the balance is "remitted" through tariffs to the local telephone companies connected on either end of the call. A long-distance carrier may own a cross-country network but still must pay, in the form of the access charge, local telephone companies (or other carriers) for the connections to end users. The amount of access charges collected in the United States in 1993 was approximately $25 billion, representing almost 40 percent of local telephone companies' total revenues and roughly equivalent to the size of the entire cable industry (see Figure 1). This amount is so large that companies have been established solely to connect businesses directly to long-distance carriers to "bypass" local telephone companies for a share of the access charges.

Cable companies are in a position to capture part of the access charges by providing access service to residential users and small businesses. Approximately one-seventh of residential subscribers (15 million lines) and two-thirds of business lines (20 million lines) are "high-toll" users, spending $100 or more per month on long-distance calls (see Figure 2). This group of high-toll users is potentially the target segment to generate access revenues for cable companies.

One obvious incentive for conversion is discounted long-distance rates—cable companies can undercut telephone companies' current access charges while still making profits. Once cable companies enter the telephone market through this segment, they are in a good position to offer services to all telephone subscribers. While most large businesses are already connected directly to long-distance carriers through private lines, the preponderance of small establishments ensures a large enough market to court aggressively over a long period.

Ironically, a successful campaign by cable companies to enter voice telephony may trigger dramatic and fundamental changes in the industry. Telephone companies, alarmed at the loss of a key source of revenue, are likely to press regulators for more competitive—and lower—access charge tariffs. Therefore, it is important not to build a business case based on fixed regulations and tariffs over time.

A long-term strategy

Initial price incentives offered by cable companies are not sustainable: telephone operators can easily snap back customers with a better rate. To maintain a competitive advantage over time, cable companies will need to differentiate themselves from telephone companies on service offerings in ways that are difficult for traditional carriers to match. Bundling voice and video services is one. For example, a subscriber package that includes basic telephone service and a set of cable TV channels would be an attractive offer to many people.

Ironically, a successful campaign by cable companies to enter voice telephony may trigger dramatic changes.

Another area cable companies can exploit to attract and retain telephone subscribers is the provision of advanced features. Telephone companies currently charge, on average,

Figure 2: ***An entry model: targets***

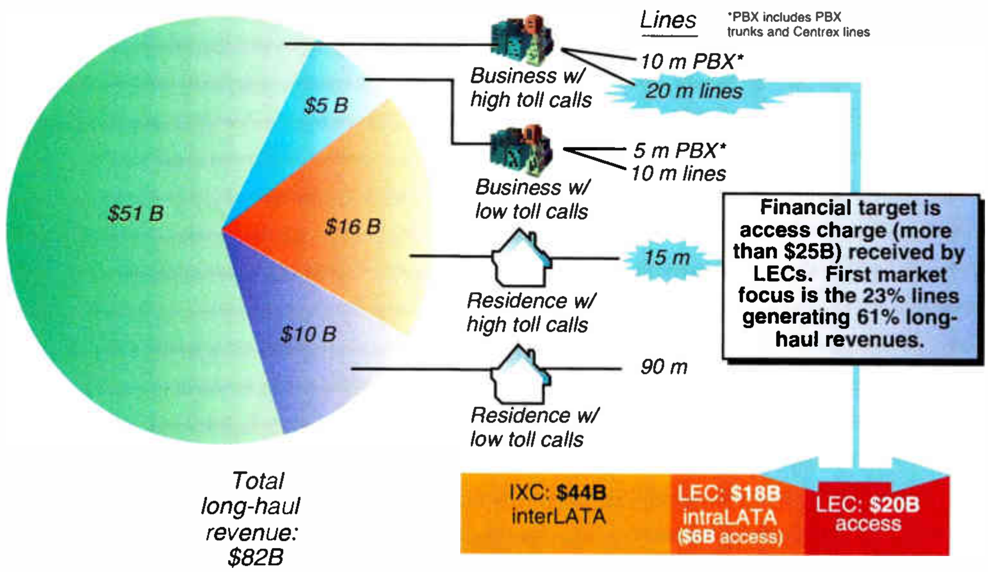
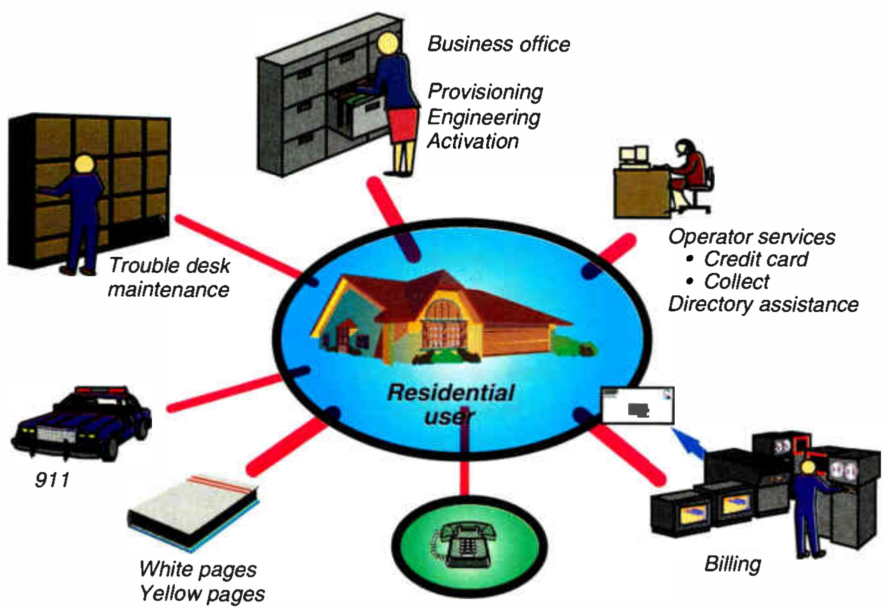


Figure 3: ***Infrastructure for customer interfaces***



between $3 and $6 a month over regular monthly fees for custom calling features—such as call waiting, call forwarding and conference calling. Because the additional cost of providing such services is relatively low, cable companies could bundle and offer these features and services at a competitive rate as an incentive to attract new subscribers. Because the revenue from the features is important to the telephone companies, the danger that they would retaliate and match the offer is minimal.

More than dialtone

Much effort—and progress—has been made in solving the technology issues inherent in providing voice telephone services over existing cable networks. A comprehensive definition of "voice telephony," however, extends beyond building the physical network to provide dialtone (see Figure 3). Cable companies' telephone users would expect a level of service as reliable and responsive as that of the established local telephone companies. The components of service discussed below, among others, are critical to a cable company in entering the telephone market:

✔ White pages—When subscribers sign up for voice service through a local cable operator, they would expect that their telephone numbers be listed in a directory and that a set of white and yellow pages be delivered to them each year. An ideal solution would be to list all numbers in the existing local telephone directory. Telephone companies, however, typically charge between 50 cents and $5 per directory number. They may even deny the listing of competitors' numbers. Access to white pages may, therefore, turn out to be an entry barrier.

✔ 911—Not only does the subscriber need a reliable and direct link to a 911 center, but the cable company must also have the ability to automatically download specific data about the calling party—location, for example—from a database to the emergency bureau. Today, cable companies should be able to pass on 911 calls to service centers with relative ease.

✔ Operator services—Customers expect to receive operator service from a telephone provider. Because of the complexity and cost associated with such operation, chances are that many cable companies may not want to establish their own, at least initially. Fortunately, they can outsource this function to third-party operator service providers. As cable companies' telephone business grows, they may want to run operator service themselves and even use it to generate additional revenues (by leasing to others, for instance).

Today, technology is the least likely entry barrier to the voice telephone market.

✔ Billing service—The real-time, transaction-based billing of telephone service is quite different from (and a lot more complex than) traditional flat-rate cable TV billing. As with operator services, third-party firms can transform calling data (generated automatically by the telephone switch) into customer bills and usable records for the cable companies.

In addition, other components need examination and implementation. Among them are trouble desk and business office. Any subscriber that a cable company enlists is likely to take these things for granted and will quickly become disillusioned if such provisions are absent or substandard.

Technology

Today, technology is the least likely entry barrier to the voice telephone market. Some solutions already exist; others are far along in the development cycle. Many vendors are planning access products that upgrade the existing cable TV plant to provide voice telephone services. Most of these products plan a multi-vendor connection to a telephone switch using either the industry-standard TR008 interface or its next-generation TR303 version.

The TR008 or TR303 interface makes the cable TV network appear like the existing local telephone company voice distribution plant (see Figure 4). The TR008 interface is the easier to implement but requires more switching equipment, because it lacks a good bandwidth "concentration" capability as that of TR303.

Most of the available telephone switches used by the local telephone company are applicable to the initial cable company requirements. On the access side, many of these switch products already have the TR008 and TR303 interfaces. The trunk side uses standard DS-1 circuits (consisting of 24 digital voice channels). Trunk groups to the local telephone company are required for cable subscribers to talk to other phone users in a local calling area. Direct trunks to long-distance carriers that bypass the local telephone company are necessary for cable companies to retain their share of access revenues.

To ensure that the cable company can offer the same modern services, such as caller identification, provided by the local telephone company, signaling on the trunks should employ the modern Signaling System No. 7 (SS7) format—which uses a data link for call control—rather than the older tone and pulse signaling. Additional trunks are required for specialized applications like operator services, directory assistance services, and 911 emergency bureau access.

Digital telephone switches can serve from less than 1,000 to more than 100,000 subscribers. While it is possible to deploy a switch for every headend, a more likely architecture would use a large switch to serve multiple headends within a community. A consortium of adjacent cable companies could even share ownership and operation of one switch.

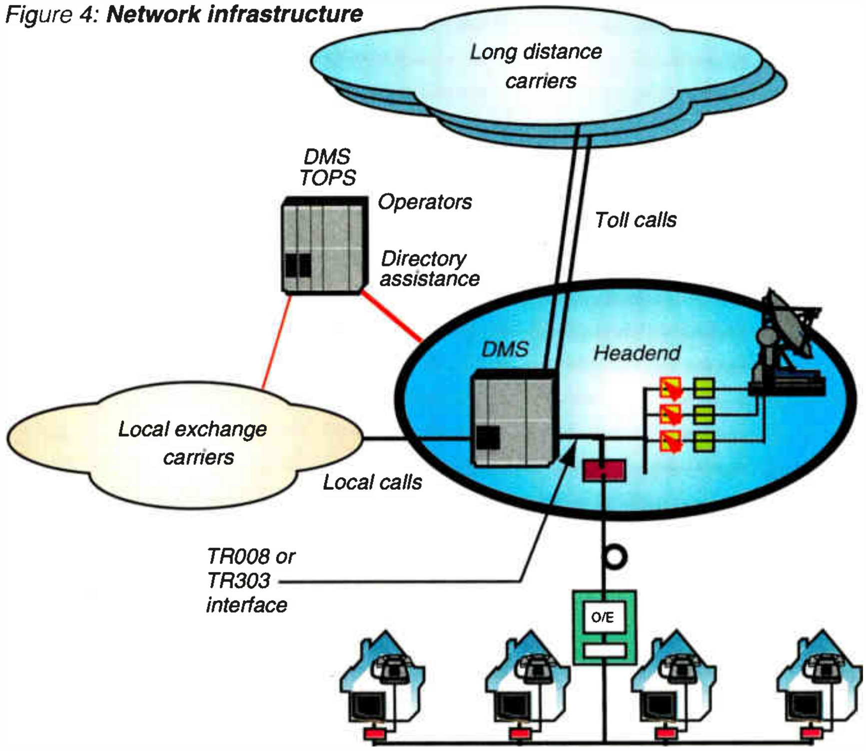
Regulation

While technology may be stabilizing, regulation at both the federal and state levels is transforming. Although it seems inevitable that competition in the telephone market will happen, the rate will vary from state to state, because some are ahead of others in liberalizing local telephony.

Three key issues drive the regulatory discussions on allowing cable operators to enter the voice telephone market: numbering, interconnection, and carrier status.

✔ Numbering—Cable companies need to supply their subscribers with telephone numbers if incoming calls are to be recognized by the public network. There is a procedure for companies other than telephone operators to get numbers, although it is not without controversy. As voice customers migrate to cable companies, the ability to keep the same numbers, an issue known as "number portability," becomes important. Resolution will require coordination among telephone companies and competitive carriers (like cable operators). Voice telephone business cases should not depend on number portability—it is not likely to happen in the near future because of the cost and complexity involved.

Figure 4: **Network infrastructure**



✔ Interconnection—To complete calls within a local calling area, cable companies need to connect to the facilities of the local telephone operator. The interconnection is regulated on a state-by-state basis, and in some areas telephone companies can block any competition from connecting to their networks. How easily and cost-effectively the interconnection can be made will have a major impact on the viability of a cable company's voice business.

Current tariffs are one-sided in favor of local telephone companies; in some cases, the interconnection fees may be as high as the total revenues from local calls. It is beneficial for cable companies to drive regulatory changes to a more mutually compensated tariff.

✔ Carrier status—If cable companies providing voice telephone services are classified as co-carriers (that is, full peers to the telephone operators), the interconnection charges may be lower, but they are likely to be subject to similar stringent regulations that govern telephone utilities. Re-sellers, on the other hand, are less regulated but may have to live with many unfavorable tariffs posted by telephone companies.

A promising future

The opportunities for the cable industry in voice telephony are enormous, and learning to understand and strategically approach the market can be both challenging and fun. If traditional wireline telephony is blocked as an entry point, wireless personal communications services (PCS) or partnerships between cable operators and long-distance carriers —areas that are just beginning to be explored—can become feasible alternatives for delivering voice services to local subscribers.

Voice telephony over cable networks is neither as simple, nor as complex, as it first appears. With due diligence, cable companies are almost assured of a share in the vast telephone market. What remains to be seen is how far the marketplace will accept alternate providers, and to what extent, and in what fashion, regulators will allow competition to take shape. CED

What remains is determining whether the response variation of each test channel at the

Although the standard multiburst does not provide a packet at 3.75 MHz (the FCC specified

THE PREMIER MAGAZINE OF BROADBAND COMMUNICATIONS AUGUST 1994 57

◇ BACK TO BASICS

Table 1

Burst (MHz)	Amplitude in IRE units		Difference (dB)
	@ Mod. input	@ HE output	
0.5	80	82	+0.21
1.0	82	84	+0.21
2.0	81	90	+0.92
3.0	78	77	-0.11
3.58	60	55	-0.76

determined above, the channel is certainly within specifications. If it does not, the next step will be to subtract variations that occurred before reception by the cable system. That is covered below.

The most straightforward method of measuring multiburst packets is to demodulate the signal and display it on a waveform monitor which has a line select capability that allows individual lines of video to be displayed. Figure 2 shows the test setup. It is essential that the demodulator used not contribute significant in-band variation of its own or it will mask the variation of the equipment being measured. Laboratory demodulators are available from several sources, but many operators get by with a carefully selected RF, non-volume-control convertor feeding a good headend-quality demodulator.

Tune to the channel to be tested and select the proper line for multiburst display. Measure and record the amplitude (in IRE units) of each of the bursts up to and including 3.58 MHz.

The response, given in the FCC's units, is calculated using the following formula:

$$\text{Response } (\pm dB) = \frac{1}{2}\left[20 \log\left(\frac{\text{MaximumBurstAmplitude}}{\text{MinimumBurstAmplitude}}\right)\right]$$

Measuring as-received variation

If the variation at the headend test point is within that allowed the headend equipment, the channel passes the FCC criteria. If it does not, or if it is desired to determine the actual contribution of the headend equipment, then the next step is to determine the response at the headend input.

For modulators, this is simple. Connect the waveform monitor directly to the output of the satellite receiver or video source and record the level of each packet. This can be done without interrupting programming if the monitor is connected after the modulator input, replacing the terminator, as shown in Figure 3. Note that the monitor must now provide a proper termination for the video signal or the modulator will be over-driven.

Now record the level of each of the bursts for the channel being tested and compare them to the data taken at the headend test point. Calculate the dB difference using the following formula:

$$\text{Difference}_n(\text{dB}) = 20 \log \left[\frac{\text{Output amplitude}_n}{\text{Input amplitude}_n}\right]$$

Table 1 shows a set of typical data. From this it can be calculated that the contribution of the headend to the total frequency response is the difference between the largest and smallest numbers in the last column or +0.92 -(-0.76) = 1.68 dB, or in the FCC's terminology, ±0.84 dB.

Processor channels are handled in exactly the same way, except that instead of connecting the monitor to the video input, the agile demodulator is connected to the RF input signal.

Channel with no VITS

If the programmer does not provide usable VITS signals, the simplest solution is to insert VITS at the headend using inserters available from several manufacturers. This has the added advantage of providing a flat source, so response can be measured directly at the headend test point. Full field test signal generators are less expensive, but require removal of an active channel from the system and are not recommended.

Another solution is to substitute programming from another video source that has usable VITS, but that is not recommended for the same reason.

Processor channels are more of a problem if the programmer hasn't provided usable VITS. One solution is to combine an RF sweep signal with the normal antenna input, as shown in Figure 4. The sweep level is carefully raised to give a relatively clean response curve on the spectrum analyzer, but not so high as to disturb the AGC action.

The picture will have noticeably higher interference while the measurement is taking place and operators may decide to simply take the channel off the system for the test duration.

Measuring the system as a unit

Measuring the headend and plant together avoids mathematically adding the worst plant contribution to the worst headend channel and, therefore, arguably results in more accurate results for any given channel. If it is desired to make the measurements that way, use the techniques given above for making the headend test point measurements at each test point for each channel. If, at any test point, the in-band response exceeds the FCC limit, then use the above procedures for making measurements at the headend input (in the case of television broadcast stations, that will typically need to be done quickly, as atmospheric conditions can affect response over time, making the subtraction of as-received response meaningless).

If any channels that the system wishes to include in the test plan have no usable VITS, either VITS or an RF sweep signal (for processors) will have to be inserted before the field measurements are made.

Conclusions

All this sounds like a lot more work than it really is:
✔ Determining plant response is a few minutes work, given standard sweep trace photographs.
✔ Most satellite programmers and broadcast stations provide clean, usable VITS.
✔ Most of the time a single measurement on each required channel at the headend test point will be sufficient.

With regularly swept plants and well-maintained headends constructed using reasonable equipment, the in-band response test should not be a major burden for testing or compliance. CED

Measuring the headend and plant together avoids mathematically adding the worst plant contribution to the worst headend channel.

ATM causes MSOs to rethink digital

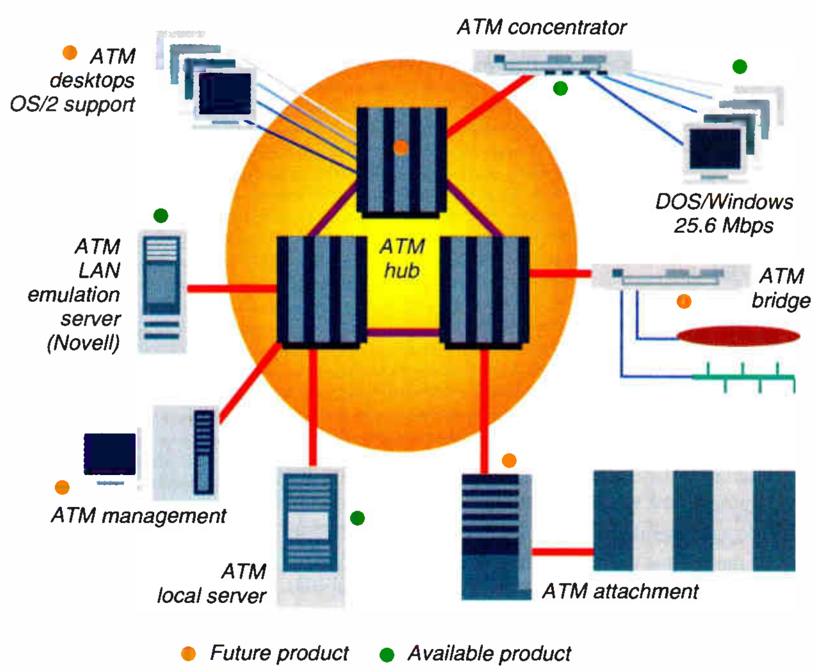
Support for standard is growing

By Fred Dawson

Accelerating progress in asynchronous transfer mode technology suggests the time has come to rethink approaches to implementation of digital communications over cable and telephone networks. Where strategists mapping first-generation interactive broadband networks have proceeded on an assumption that frequency division multiplexing, combined with high levels of advanced modulation techniques, will be the best approach to supporting a vast array of multicast and point-to-point services in the years immediately ahead, a small but growing number of network engineers are beginning to question this assumption.

"Our job is to build a network that uses unified transport technology to support delivery of services to whichever appliances the services are intended for," says Jim Chiddix, senior vice president of engineering and technology at Time Warner Cable. What this means, Chiddix explains, is avoiding segmentation of services by frequencies, which locks a system into bandwidth allocations to various services and their associated appliances.

Figure 1: **IBM's campus networking concept**



"We think what really makes sense is integration of all signals into a single digital transport scheme," he says. "ATM provides a very interesting basis for that transport function." Chiddix makes clear he isn't talking about "full-load" switching, where every signal passes through an ATM switch. Instead, ATM transport means packetization of all signals, possibly including telephony, though that's uncertain at this point, in order to permit "dynamic assignment" of bandwidth from the headend and to allow an end terminal to readily read what type of communication is coming in so as to route it to the appropriate appliance.

Contacts with ATM Forum

Chiddix has been in a distinct minority with regard to anticipation that ATM technology will be available as a cost-effective solution to achieving these ends in time to affect early rollouts of broadband networks. Most engineers argue that ATM, now in commercial use for LAN interfaces to external networks and for high-speed data routing at major switching centers, is a long way from having agreed-on protocols for desktop applications in the work environment, let alone at the set-top.

But in expanding contacts between certain cable interests and the ATM Forum, the ad hoc group of companies which has been setting the standard, initial steps toward achieving a broadband network compatible transport version of ATM are underway. Such a version would simplify the five-byte header of the 53-byte cell, eliminating processing and network management functions that are superfluous to the transport task, thereby lowering the cost of implementation.

Dr. Richard Green, president of Cable Television Laboratories, who addressed the ATM Forum in a widely circulated speech last summer, reports tremendous interest among participating companies in the possibilities of achieving a cost-effective solution. But, he adds, "we're a long way from unanimity on the subject within the cable industry."

Nonetheless, according to informed sources, Time Warner and Tele-Communications Inc., working with CableLabs, are cooperating in an informal effort to map out an ATM transport requirement for the cable industry that would give ATM Forum members better guidance as to industry needs. The parties were not available to comment on this development at press time.

Adding steam to the possible use of ATM in networks is the recently announced commitment of Northern Telecom to supply an end-to-end ATM solution for broadband networks planned by New Brunswick Telephone Co. of Canada (see related story, page 8). NBTel says it will invest $300 million (Canadian) to connect some 300,000 customers throughout New Brunswick to hybrid fiber/coaxial facilities by 1998, with 20,000 slated to be on line by the end of next year.

As described by Gary Disher, project manager for Northern Telecom, the coaxial service areas beyond each fiber node will be limited to 80 households versus the typical level of 500 in the U.S. This eliminates all

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Commitment to the switched broadband design at such low costs represents a leap of faith

amplifiers and expands available coaxial bandwidth to 1 GHz, versus 750 MHz with amplifiers. Seven ATM switches will be installed throughout the province, each serving about 30,000 customers, Disher says. All broadband services, whether they are local broadcast, satellite, video on demand or something else, will be routed through the ATM switches, setting up a dedicated link between the switch and each customer.

This doesn't mean all services will be switched in any traditional sense of the word, Disher adds. Accessing multicast services would be analogous to channel changing at the set-top, only it would be done at the ATM switch. This process, where all signals are reformatted into ATM packets, means that each user consumes only the bandwidth required for the services in use at any moment, from a single data stream to the PC to multiple service streams to several TVs, PCs and other appliances. Real switching would be limited to services that are pulled in on demand from servers or to interactive multimedia communications between end users.

Disher says each household will have an upstream link to the switch of between 3 and 10 megabits per second, allowing for packetized broadband data exchanges of every type, from PC-to-PC communications to interactive community games on TV. Telephone service, currently provided over an all-digital fiber network using twisted pair copper in the distribution plant, will remain separate from the broadband network for a period of four to five years, Disher adds.

Disher and Johnston acknowledge that commitment to the switched broadband design at such low costs represents a leap of faith, insofar as ATM technology has a long way to go before it is commercially viable for use in household terminals. Nonetheless, Johnston says, "we think we can design the network to fit the state of the art one year to 18 months out and come up with something much better than if we didn't bet on ATM."

This is not a farfetched estimate, says Roger Pience, director of engineering at the NCTA's Science and Technology department. "That's within the crystal ball," he comments, "but it takes someone like Northern Telecom to make an aggressive commitment to the capability. I'm elated at the news."

The role of IBM

One newcomer to the ATM race who could have a major impact on the process is IBM. Where Big Blue has been a traditional leader in networking gear for LANs and private data networks of every description, the company now recognizes that ATM will shift economies of datacom networking toward the public broadband networks, where it must sell its gear if it is

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to remain competitive.

"The switches in the family of products we're announcing include components at the end point in the neighborhood as well as the central office," says Gary Byrd, program manager for the Nway Switch Product Group. "And there are other elements tied to mass media communications which we're not prepared to talk about yet."

The core of the switching technology is a new ATM chip, which has 16 entry and 16 exit ports, all operating simultaneously. The first high-end "Nway" broadband switch, coming on line in mid-'95, will operate at a net switch aggregate throughput of 25.6 gigabits per second, the company says, with a 51.2 gbps switch slated for introduction at an unspecified later date.

Along with switches that address the network node points, from public networks down to private LAN interfaces, IBM is also jumping into the end terminal game, where ATM is at a fledgling stage of implementation. "We can do this now by providing a high-speed clear channel connection to the desktop without worrying about specific ATM applications," Byrd says. "Our product is positioned to add those applications as they are defined by the Forum and as the market begins to use them."

As things stand now, full implementation of ATM capabilities at the desktop, where video, voice and data are easily mixed and bandwidth is assigned dynamically, is too costly for most users. As a result, the migration path seen for ATM to the desktop involves "LAN emulation" so that a token ring or Ethernet LAN can become an ATM conduit through insertion of a special adapter card at the desktop PC (see Figure 1). Byrd notes the LAN emulation protocols have yet to be finalized by the ATM Forum, but IBM, as have some other vendors, is moving forward with production of LAN emulation adapters which are compatible with the functions as defined so far. IBM's system works over existing wiring, while most other emulation systems require rewiring.

Help for in-home wiring problems

IBM's move into ATM comes as the market for equipment is picking up steam, especially in the area of increased bandwidth requirements for wide area networks. A recent survey of 500 corporate network managers by Communications Week found significant increases in networking budgets, with most of the spending targeted to LAN and internetworking equipment, where ATM purchases are commonplace.

As vendors wrestle with the question of bringing complex multimedia ATM functions to the LAN environment, the rising demand for ATM routing at the network interface levels bodes well for driving costs down in areas of application that more directly apply to the needs of mass media communications. "There are some real synergies going on between what the cable companies are looking for and where ATM is fitting into the traditional datacom marketplace," notes an executive at a leading ATM supplier, asking not to be named.

If the optimists are right and ATM does turn out to be a cost-effective solution for transport to the home sometime within the next two years, the technology, in conjunction with deeper penetration of fiber, would be an answer to one of the more daunting challenges facing implementation of digital compression over hybrid fiber/coax networks. As CableLabs' Green notes, digital services represent a major marketing challenge, given the difficult electronic environment for digital signals in the home.

ATM could be an answer to the daunting challenge of implementing digital compression over hybrid fiber/coax.

CableLabs has just completed research into the general condition of wiring throughout the U.S., which, says Green, "is all over the lot, even from one house to another in a given community." In typical home wiring environments, impedance mismatches at connection points create microreflections that break up digital signals in cases where advanced modulation techniques are used.

Green says the data show that in a large majority of cases, the household wiring is good enough to support 64 QAM if the set-top boxes are provided with equalization or error correction devices. But such devices add to the cost of the boxes, and, in an as yet unspecified percentage of really bad cases, are ineffective, which means lower levels of modulation would have to be employed or new wiring installed.

However, the situation for digital signals is worse than these data indicate, Green says, because error correction devices cannot take care of the problem of transient noise that enters the home wiring system from use of household appliances or from other sources. "The transients are the real issue, because we have to teach the customer to live with the problem," Green notes.

Where, today, analog signals are robust enough to withstand interference from electronic noise generated by vacuum cleaners or other equipment, tomorrow's digital modulation techniques will not be so robust. "Everytime my wife uses the vacuum, the digital music service we get over cable goes out," Green says.

Overcoming such problems would require much tighter wiring connections than are presently used throughout the U.S., which would add a huge expense to the cost of building digital networks. This is one big reason that NBTel has opted for an ATM solution over fiber to 80-home nodes. By extending fiber deep enough into the system, Disher notes, the ratio of homes to coaxial bandwidth is low enough to avoid the microflection problems associated with advanced modulation techniques. "We don't have to go to 64 QAM, even though everything is digital," he says.

If, as many people believe, the early opportunity for digital services will come in data connections to the PC, the argument for ATM will be even stronger. "If you're going to be providing everything from work-at-home to on-line CD-ROM type entertainment to the PC, you may as well go with a standard packetized data scheme from the get-go," says a leading cable engineer, speaking on background. "ATM, with broad market support in datacom, is an obvious answer as far as we're concerned." CED

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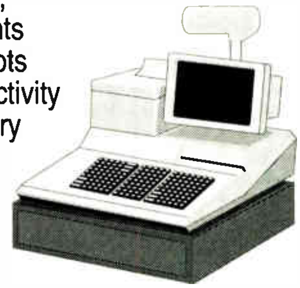

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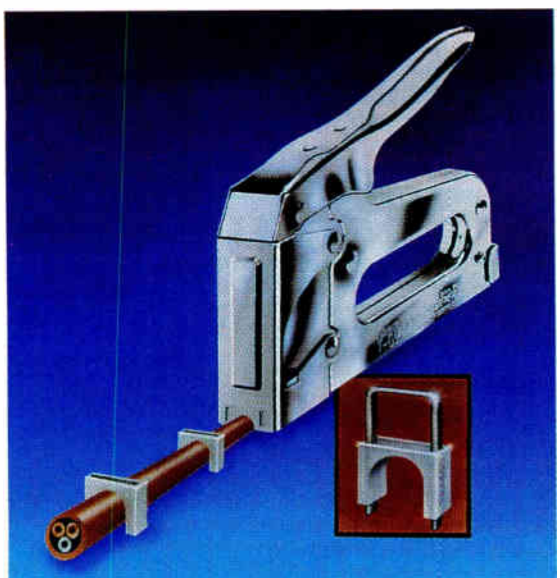

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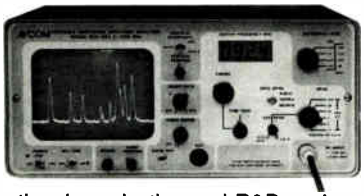

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The issue: Emerging technologies/services

The advent of new technology has promised to revolutionize the cable industry and make cable network providers an integral part of the nation's telecommunications fabric. But are the promises mostly hype, or are they a reflection of the industry to come? We'd like to know what the operators think.

The questions:

1. When do you think digital video compression will become commonly used to transmit video to the home in most large, urban cable systems?

❑ 1996 ❑ 1997 ❑ 1998 ❑ After 1998

2. Do you think your job will be significantly impacted with the advent of digital networks?

❑ Yes ❑ No ❑ Don't know

3. Has your system considered constructing redundant fiber rings to improve network reliability?

❑ Yes ❑ No ❑ Don't know

4. How familiar are you with technologies such as synchronous optical network (Sonet) and asynchronous transfer mode (ATM)?

❑ Very familiar ❑ Somewhat familiar ❑ Not familiar

5. Does your system presently offer data transport services for use by local businesses?

❑ Yes ❑ No ❑ Don't know

6. Is your system interested in providing transport for on-line data services such as Internet, Prodigy or America Online to residents?

❑ Yes ❑ No ❑ Don't know

7. Is your system interested in providing alternate access/telephone bypass services?

❑ Yes ❑ No ❑ Don't know

8. Does your video network design allow for the eventual provision of telephony services to local businesses and/or residents?

❑ Yes ❑ No ❑ Don't know

9. If it was up to you, would you partner with your local telco to provide telecommunication services?

❑ Yes ❑ No ❑ Don't know

10. Has your system made any plans to activate the return path of your network?

❑ Yes ❑ No ❑ Don't know

11. As of today, how many sheath miles of fiber are in your cable plant?

____

12. How many sheath miles of fiber will you have one year from now?

____

Your overall comments:

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Your job function:

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RESULTS

The issue: Outages

The perception among many cable subscribers is that their systems are unreliable and fraught with outages. Cable operators say they've made tremendous strides in providing more robust networks by adding fiber optics and more reliable components. This survey asked your views on the subject of outages.

Although cable operators have made progress in reducing outages over the past several years, most believe they can do even more, according to the results of our fax-in poll.

While nearly everyone said a loss of signal for five minutes is an outage, there is wide disparity among operators as to what constitutes an "outage" (three or more subs served by the same device, any interruption of service affecting two or more subs, all channels off for any length of time are some examples). Nevertheless, three-quarters of those who responded said they have taken specific steps to reduce outages, including improving preventive maintenance, using better equipment, emphasizing training, installing standby power and surge protectors and installing fiber optics.

Causes of outages were most often tied to weather and problems in the power grid, which frustrates the operators because they can't control either cause. And while most said their power company is reliable, nearly half said they have worked with the local utility to reduce outages.

Finally, although nearly everyone said it is important to track the location and cause of all outages, fewer than half have asked their customers how they feel about outages and how the cable system performs.

The results:

1. Would your system term a loss of signal for five minutes or less an "outage"?

Yes	No	Don't know
82%	**18%**	**—**

2. What is your system's specific definition of an "outage"?

See story at left

3. How many outages does your system suffer in a typical month?

Average = 9.5 **High = 55** **Low = 0.33**

4. Has your system taken specific steps within the past couple of years to attempt to reduce the number of outages it experiences?

Yes	No	Don't know
73%	**27%**	**—**

5. If so, what steps were taken?

See story at left

6. Do you think your system could do more to reduce the number of outages it experiences?

Yes	No	Don't know
64%	**36%**	**—**

7. In comparison to two years ago, has your system reduced the number of outages it suffers, on average?

Yes	No	Don't know
73%	**27%**	**—**

8. What is the source of the majority of your system's outages?

Electronics	Cable cuts	Accidents	Weather	Other
14%	**6%**	**14%**	**38%**	**24%**

9. Has your system performed surveys to determine subscriber attitudes about outages?

Yes	No	Don't know
45%	**55%**	**—**

10. Do you feel it's important to track the location and cause of all your system's outages?

Yes	No	Don't know
91%	**—**	**9%**

11. Has your system worked with the local power company to reduce outages?

Yes	No	Don't know
45%	**55%**	**—**

12. Overall, would you consider your local power company to be reliable?

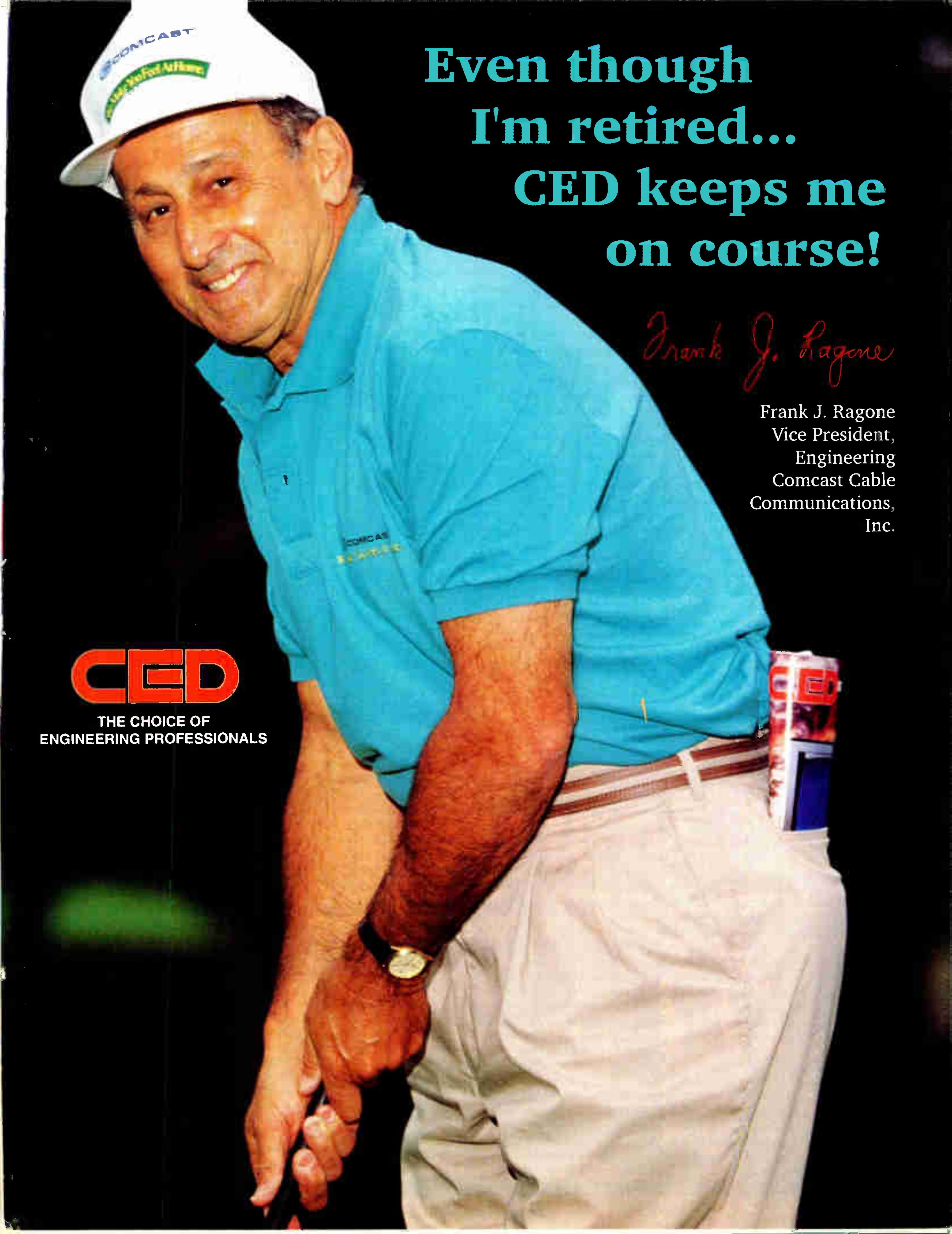
Yes	No	Don't know
64%	**36%**	**—**

Your comments:

"We probably have more service interruptions from federally mandated testing than from equipment failure."
– *Ron Peterson, Post-Newsweek Cable, Bisbee, Ariz.*

"When tracking outages, it's important to track the subscriber impact as well as the number and types of them."
– *Keith Hayes, GCTV Dekalb, Ga.*

"Trouble comes in bunches. We may go a year without a major outage, then have two or three in a row. Most come from thunderstorms."
– *Roger Lee, Cablevision of Parsons, Kan.*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Tips on grounding the service drop

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

The National Electrical Code, (NEC 1993), is the direct descendent of an electrical code first published by the National Board of Underwriters in 1895. It is currently sponsored by the National Fire Protection Association. Its purpose is the safeguarding of persons and property from hazards arising from the use of electricity. It is enforced by local and state authorities who are responsible for interpreting the rules and for waiving specific requirements where equivalent public safety objectives can be achieved.

Bonding TV and electric service

The single, most critical requirement for safety with respect to cable TV service drop installations is to assure a robust direct metallic connection (bond) between the coaxial shield of the TV service drop and the grounded service conductor (neutral) of the electric power system, at or near the service entry.

Effective "grounding" to the earth is an important and complex, but separate issue, best handled by the electric utility. "Bonding" between the coaxial sheath and the grounded neutral should be the primary safety consideration when installing cable TV service drops. The electric power entry conduit, meter base, and service disconnect enclosure are normally bonded to the electric neutral, often at several points [NEC 250-50].

TV sets, convertors and VCRs are the only appliances in the home that are generally connected at the same time to both the electric power system and the cable TV coaxial cable. Switching transients and nearby lightning are likely to induce extremely large voltages between the TV coaxial shield and the electric neutral. Unless they are effectively bonded together at the residence, the TV appliances could be damaged or set on fire.

Connections to earth by means of ground rods, water pipes or other approved grounding electrodes do not provide effective bonding, because of relatively high earth resistivity. Although several hundred feet of No. 12 copper wire have less than 1 ohm resistance, bonding conductors should be as short as possible because of the transient impedance to momentary current surges with 1 microsecond risetime.

The best arrangement (i.e. safest) is to place the cable TV ground block close to the electric service entry and bond directly to the meter base, entry conduit or service disconnect enclosure with the shortest possible length of properly sized copper wire, usually No. 10 or 12 depending on the drop cable used [NEC 820-40].

Sometimes, however, the most convenient point of entry for TV is at the opposite side of the house from the electric service entry. Nevertheless, from the safety point of view, the TV ground block should be located as close as possible to the electric service entry, even though this means "wrapping the house" with extra coaxial cable. This more effectively equalizes the voltage difference between the TV and electric systems than the alternative of wrapping the house with a long bonding conductor which would have substantial transient surge impedance. Driving a ground rod does not solve the problem.

Non-compliant electric service

In most cable TV communities, there are likely to be some older residences (including even a few with "knob and tube" wiring) in which the electric neutral conductor was never grounded nor bonded at any point on the premises, not even to the main disconnect enclosure [NEC 250-50]. Moreover, in some newer or remodeled homes using Romex or plastic entry conduit, the electric service grounding conductors may have been completely concealed behind drywall or other structural features.

Unless the utility permits bonding to a meter base enclosure that is in turn bonded to the neutral, the "accessible means for connecting intersystem bonding" required by NEC has not been provided [NEC 250-71(b)]. Only a licensed electrician can correct this situation. Under these circumstances, a safe TV service drop cannot be installed until an electric service bonding point has been located, perhaps necessitating cutting into and restoring parts of the wall. These are indeed delicate and unattractive options.

Driven ground rods for cable TV are not required by NEC, and cannot safely be substituted for bonding to the electrical system ground. Bonding to a hose bibb (outside water faucet) is effective and safe only so long as the hose bibb is also connected by metal pipe to the electric system ground.

TV safe if bonded to electric service

Conduit protection for bonding conductors exposed to physical damage has been specified by NEC in order to assure that bonds will not later be interrupted by accident [NEC 820-40(a)(5)]. The requirements that underground metal pipe be in contact with the earth for 10 feet [NEC 250-81(a)], and that bonding connection to interior metal pipe must be made within 5 feet of the entry wall [NEC 250-81], have been introduced because of the growing use of plastic water pipe.

Failure to comply with such NEC maintenance requirements does not indicate a presently unsafe condition if the TV shield is, in fact, electrically connected to the power service ground. It only means that the installation lacks NEC protections against the risk that it could become unsafe at some future time if the bonds were broken.

Any cable TV installation is safe just so long as the coaxial drop cable shield is directly bonded through metallic conductors to the grounded electric service conductor close to the electric service entry point. CED

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