DECEMBER 1994 CED

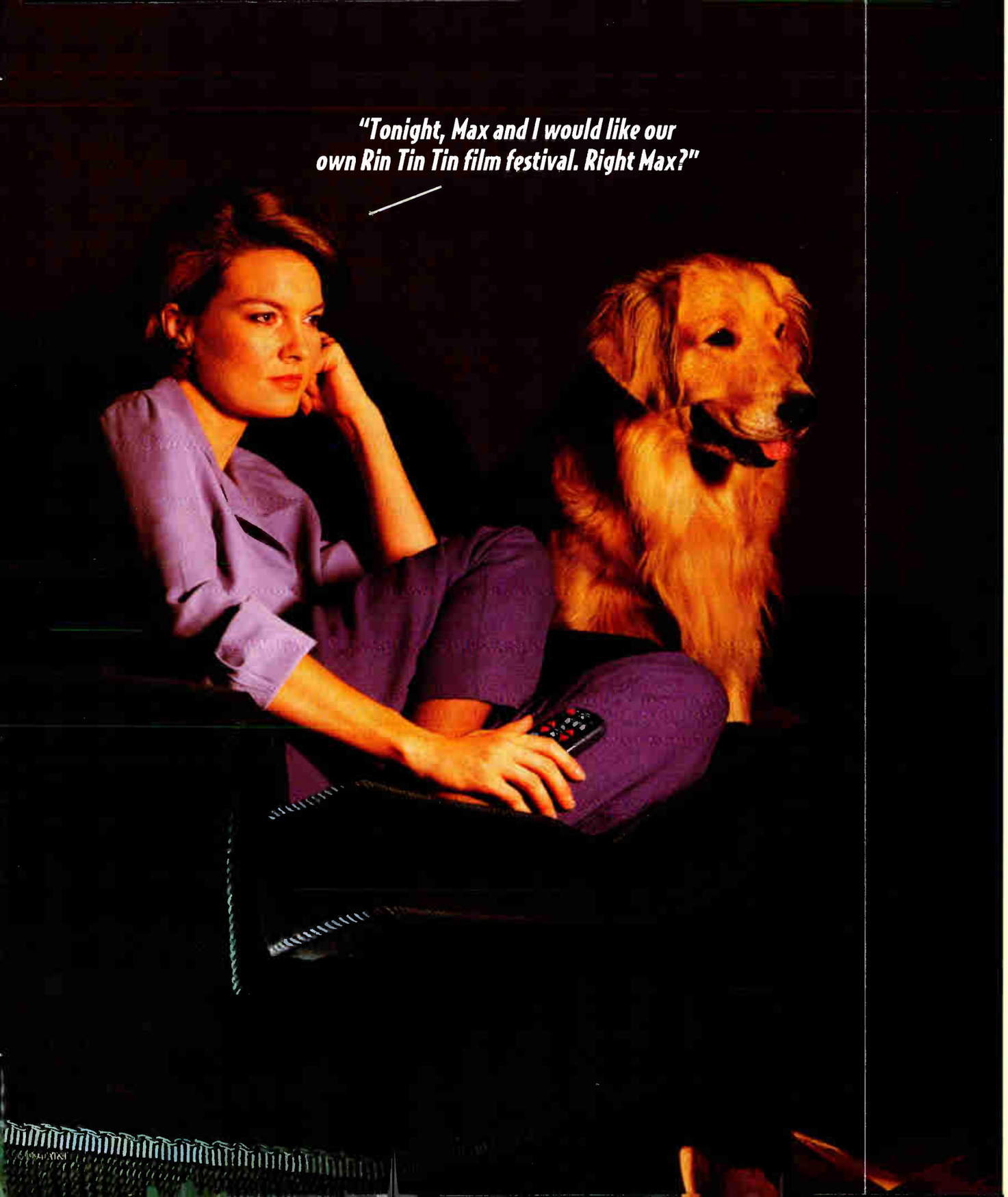
QAM vs. VSB ◆ Data security ◆ Return band ◆ Western Show issue

CED

THE PREMIER MAGAZINE OF BROADBAND COMMUNICATIONS

Editorial Index inside

# Future shock: The industry's wild ride




Is it time yet to invest in interactive? Here's a thought.

The latest research tells us that 55% of Americans are willing to spend at least as much every month on interactive services as they are on cable TV.[1]

That's an additional $5 billion a year. With who knows how much more for other broadband services.

Of course there are issues to be resolved. What program delivery standard? Which set-top box? But once you're ready, you'll need a partner who can move fast, to help you capture competitive advantage. Which is where AT&T Network Systems comes in.

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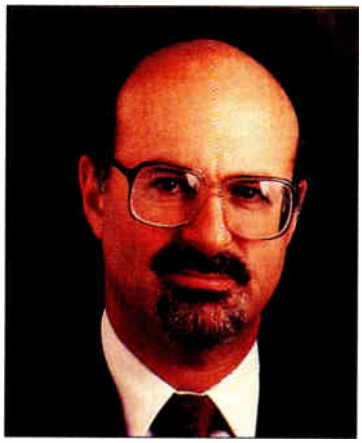
[1] FIND/SVP telephone survey

# The need for telephone number portability



*By Jeffrey Krauss, paddling upstream in the information waterway and President of Telecommunications and Technology Policy*

If you want to get into the telephone business, you'll have to worry about telephone numbers. Your biggest worry is that most customers won't want to give up their current phone number in order to subscribe to your service. In order to compete with the phone company, you need "number portability."

There are actually three types of number portability. If you move to a home across town, "geographic portability" would allow you to keep your telephone number. If you want people to be able to reach you at a single phone number, whether in your car, at home, or in the office, this capability is known as "service portability." And if you want to keep your phone number when changing from one telephone company to another, this is called "service provider portability."

All three of these kinds of number portability are desirable, from a subscriber's perspective. They all enhance the usefulness of telephone service. But it is the third–service provider portability–that is essential if local telephone service competition is to thrive. Changing a phone number is inconvenient, and many customers will be unwilling to accept this inconvenience. Without number portability, they would be forever locked into their original service provider, the telephone company.

## 800-service number portability

This issue came up first with 800-service. The long distance carriers complained for many years that AT&T had an unfair advantage because many 800-service subscribers had built up customer recognition of their 800 numbers, and they were unwilling to switch to a different long distance carrier if it meant giving up their 800 numbers. The FCC began studying these issues in the late 1980s. But it was not until August 1991 that the FCC concluded that a database of 800-service subscribers, with access by means of Signalling System #7, was a technologically feasible way of implementing 800 number portability. Now when you dial an 800 number, your phone company looks into the database and finds out which long distance carrier to deliver that call to.

May 1, 1993 was "800 Independence Day," the day 800 number portability went into effect. On that day, MCI announced that more than 50 corporations and four state governments would shift more than 1,000 800 numbers from AT&T to MCI. But AT&T announced that it had persuaded thousands of business customers to switch their 800 service to AT&T. And Bellcore, administrator of the 800-service database, noted that the database access system now allowed a customer to specify the routing of 800-service calls to different long distance carriers, depending on time of day, day of week, originating location, or some allocation percentage.

## E-911 and the telephone number database

Telephone number databases already exist. For example, they play an essential role in Enhanced 911 service. "911" is the nationwide emergency telephone number; calls to 911 are routed directly to designated public safety agencies. With Enhanced 911 service, the calling number and the location of the caller are displayed for the call taker (except for calls from wireless phones). This is accomplished by accessing a database of telephone numbers.

These databases are owned by the telephone companies. They "maintain" the databases, keeping them correct and up-to-date every time someone moves in or out of town. Some telephone companies base their pricing for Enhanced 911 service, in part, on the number of database lookups they do.

While most of the U.S. population is served by a few large telephone companies, there are more than 1,000 smaller phone companies, as well. In areas served by multiple phone companies, the phone companies have entered into contracts that allow them to look into each others' databases in order to provide the calling location to the 911 call taker. The same approach could be used for local number portability.

## State policies on number portability

Local phone service is regulated by state public utilities commissions, not by the FCC. As these state commissions have begun to consider competition, number portability has emerged as an important issue. Maryland is one state that authorized competition. Earlier this year, the Maryland PUC granted "co-carrier" status to MFS Intelenet to compete with Bell Atlantic. As part of its decision, the PUC approved an interim arrangement for number portability. This interim approach is based on call forwarding technology, not database access.

Interim solutions are needed because industry-wide database standards for local phone number portability are three to five years away. The official telephone industry standards body, which used to be called the Exchange Carrier Standards Association, but recently renamed itself the Alliance for Telecommunications Industry Solutions, has a committee working on it, and hopes to produce a recommendation "real soon now."

Not surprisingly, some telephone companies are dragging their heels. They argue that local number portability isn't really essential for local competition, and they aren't in any hurry to support it. After all, we've lived without local telephone competition all these years, so what's a few more years! CED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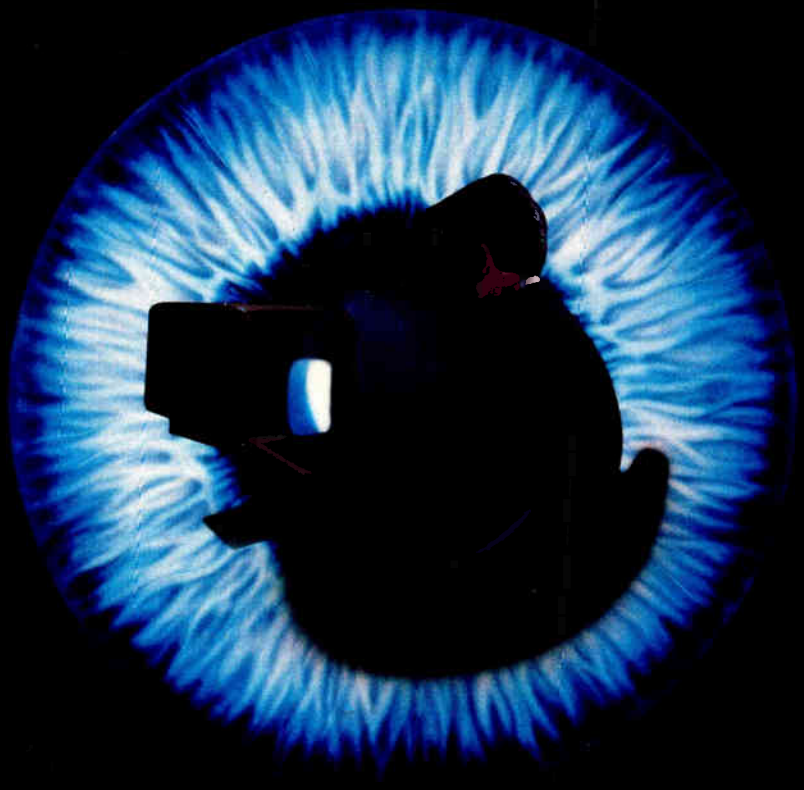

# INNOVATION

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True leaders of any high-tech industry are those who dare to take new paths in search of improved technologies. The accepted ways may be adequate to the job, acceptable in the marketplace. Complacency rules the day. But a true leader will take the risk of developing maverick thinking into revolutionary advances. And the conventional suddenly gives way to a new tradition of innovative progress. That's how the Trilogy tradition began, and continues to this day in the coaxial cable field.

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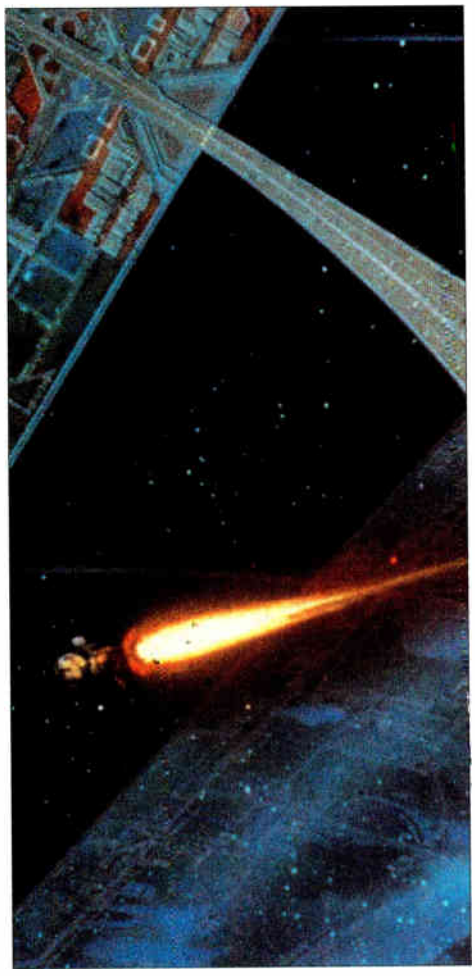

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The return band is problematic, to say the least, but the technical challenges must be overcome, if true interactivity is to be a reality.

SCTE®

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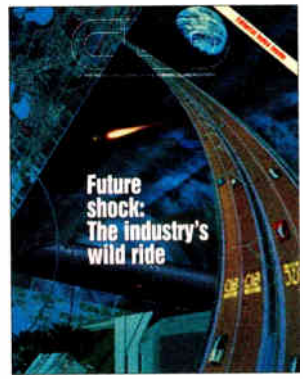


**About the Cover**

*MSOs go boldly where no man has gone before. Art by Jinsei Choh.*

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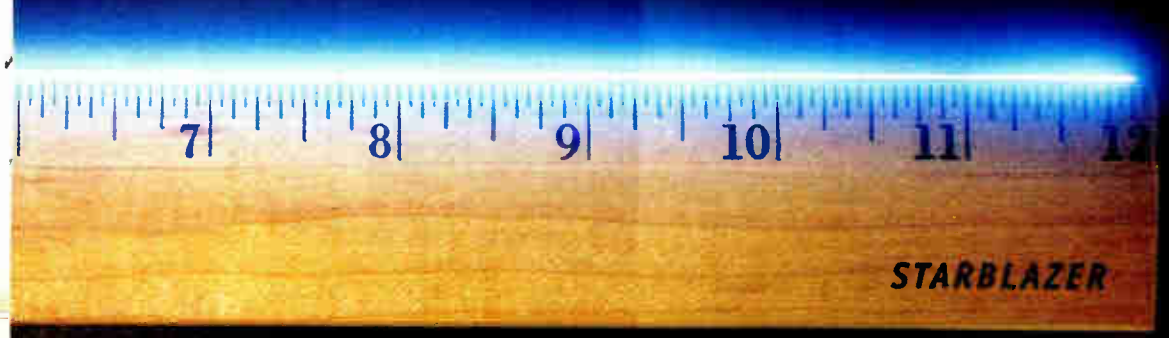


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# David vs. Goliath: David wins again

As the cable and telephone industries become ever more closely linked, it's amazing how different the two industries really are.

This isn't a new revelation: everyone knows the telcos are giant hulks that have employed hundreds of thousands of people, while the cable companies are, comparatively, diminutive Davids. Telcos have enjoyed a guaranteed rate of return that fostered a tangled web of internal bureaucracies that often choked off innovative thinking and quick reaction; cable entrepreneurs, on the other hand, have reaped the rewards of risk-taking.

The telco "bigger is better" mentality has come home to roost in the new era of competition. The RBOCs are laying off thousands of people in an effort to reduce costs. They're losing market share to competitors that react faster, offer lower rates and provide better service. And now it appears they may unload their research and development facility.

In October, the *Wall Street Journal* carried a story about the possible sale of Bellcore to either a big investor or perhaps to the public via a stock offering. One quote within that story caught my eye: "Ten years ago the research consortium was a great idea. Ten years later, it just doesn't make any sense," said an unnamed executive.

More properly, I'd say the way Bellcore is *structured* is what doesn't make any sense.

Contrast the way Bellcore is set up to the way its tiny cousin CableLabs works. They both derive funds from their members, but Bellcore spends more than $1 billion per year provided by its 7 member companies. CableLabs has a budget of about $13 million taken from about 70 members. And yet CableLabs has been able to please most of its members most of the time, while Bellcore has many of the RBOCs wondering how they can rid themselves of a perceived dinosaur.

Members of Bellcore can contract with it to do proprietary work that isn't shared with any other member. CableLabs members can't do that. All research undertaken by the Labs is disseminated to each and every member, from TCI on down to Windbreak Cable.

That works to a point, but what happens when things get competitive? It's one thing to fund tests to make sure PCS works over cable, but when MSOs begin competing for PCS customers, CableLabs must shift its focus to the next-generation technology–and determine how all members can benefit equally, says Dick Green, president and CEO of CableLabs.

You might think balancing the needs of small operators with big operators and rural vs. urban interests would be a daunting challenge for CableLabs, but in fact, it turns out the opposite is true. "That disparity drives us to find workable solutions for everyone," says Green. A case in point: the "headend in the sky" concept was created for small MSOs that can't afford to build a digital infrastructure. "The job is harder, but in the end the solution is much more viable," Green says.

Once again it appears that the telcos' size has been less than advantageous. Perhaps if they could focus on a common set of goals, they could reap the benefits of so much talent. Just imagine what could be done with $1 billion of research every year.

Roger J. Brown

Roger Brown
Editor

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In addition, C-Cube offers a frame-based encoder that doesn't support adaptive field/frame processing, priced at $8,000. This unit can be used as an alternative for encoding film-based video, such as movies and TV programs.

PAL versions of both are also being offered.

The new unit is an upgrade to C-Cube's CLM4600, which has been deployed by DirecTv, Scientific-Atlanta's "Orbit" program and every other trial, including Time Warner in Orlando, US West in Omaha and Bell Atlantic.

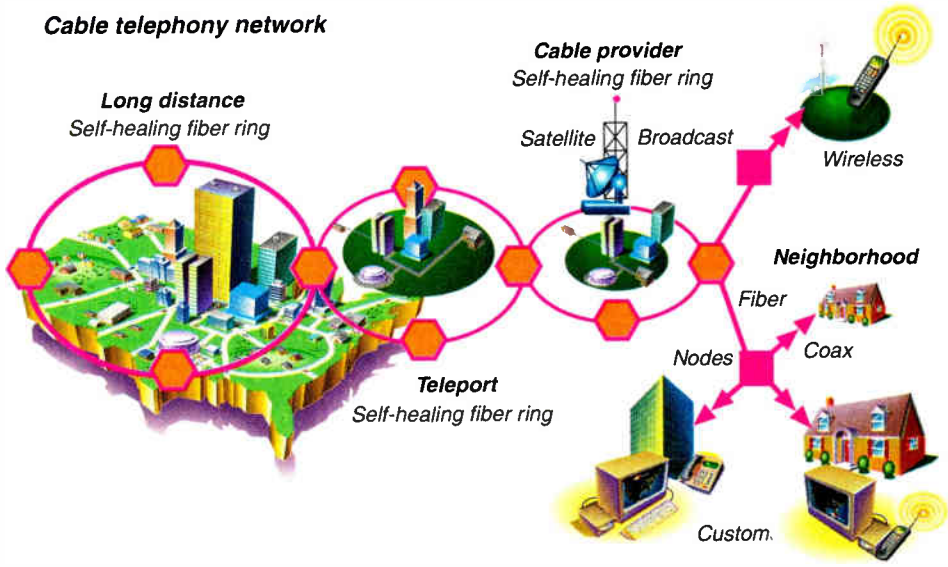
## Quest for open standards begins for new group

Representatives from more than 60 companies and organizations, including Antec, AT&T, Scientific-Atlanta, CableLabs and others, met in Washington in late October for the charter meeting of the North American Digital Group, a newly organized entity that is trying to develop a non-proprietary digital television standard. The formation of the group was spearheaded by TV/COM International.

The group is closely modeled after the European Digital Video Broadcast Group, which has successfully developed a standard for the European continent. A stated goal of the NADG is to take the standardization process beyond MPEG-2 to achieve interoperability and open architectures. Specifically, the group wants specified modulation (including forward error correction and interleaving), information data rate ranges, transport stream syntax, service information tables, ancillary data services, closed captioning and vertical blanking interval services, among others.

During the meeting, an ad hoc working group was formed to expedite the group's agenda. Standards data will be gathered from the approximately 28 other U.S. standards groups and shared with the larger group during the next meeting in January 1995.

Anyone interested in joining the group is asked to contact Andrea LaVorgna at TV/COM International, 619/451-1500.




## MSOs ally with Sprint; telcos turn up the heat

You need proof that the cable companies plan to compete with the telcos and vice versa? Read on.

In late October, an alliance between Sprint, TCI, Comcast and Cox was announced. The venture was put together to package local, long-distance and wireless telephony with cable-delivered entertainment video services as a competitor to the established local exchange carriers.

Between the four partners, there are almost 290,000 miles of cable in place, passing approximately one-third of all American homes. Additional cable partners will be actively sought through incentives. Telepart Communications Group, which is owned by several cable operators, will provide local access for long distance services, a direct link to business customers and expertise in competing against LECs. The TCG network, which serves 19 metro areas, will link adjacent cable TV systems and provide local access to Sprint facilities and other carriers.

The joint venture will be 40 percent owned by Sprint, 30 percent by TCI and 15 percent each by Comcast and Cox. The group intends to pool its resources and bid for spectrum in the upcoming PCS spectrum auctions.

Six days after that announcement was made, Nynex, Bell Atlantic and Pacific Telesis said they had each committed $100 million over the next three years to form two companies to deliver entertainment, information and interactive services. First, they have formed a new media company that will license, package, acquire, invest in and create traditional and interactive entertainment and informational services.

In addition, the three RBOCs will work with Creative Artists Agency to develop a branding and marketing strategy for the new programming, including the elements of a system "navigator."

Secondly, a new technology and integration company has been formed to support the development and distribution of the programming over video dialtone networks. Technical support systems for video delivery, customer management, business support, content encoding, billing and application development and navigation tools will be the primary focus of this company.

## Microsoft puts focus on broadband networks

Never one to miss an opportunity to run networks, Microsoft is working with a wide variety of companies to develop what it calls "an end-to-end software solution for interactive broadband networks." The announcement came during last month's Advanced Consumer Technology Summit.

Specifically, Microsoft announced it is working with some of the world's largest systems integrators, network operators and set-top box manufacturers to test new products and provide input on their functionality.

Joining the fold are network operators Deutsche Telekom, Telstra Corp. of Australia and US West. They join Rogers Cablesystems, NTT and SBC Communications as previously announced partners, in addition to TCI, which is testing Microsoft product in the Seattle area. These companies will test early versions of the

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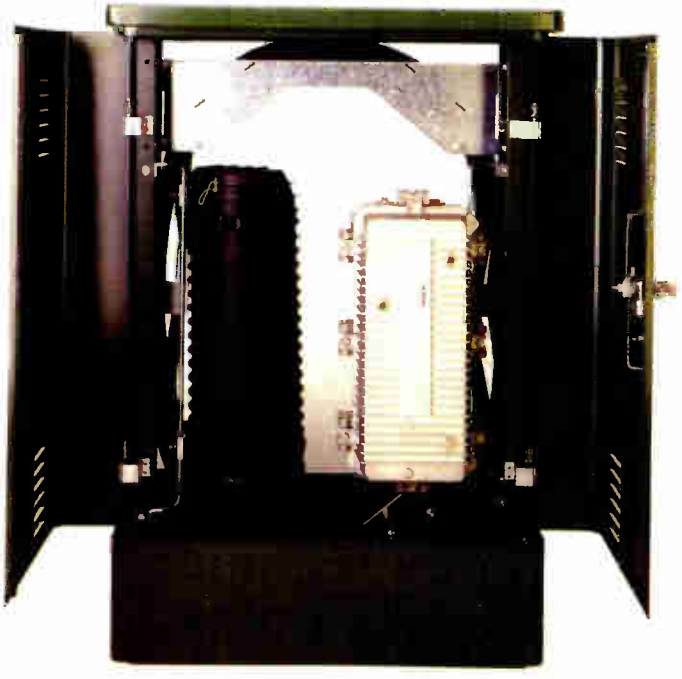

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software and provide feedback.

Hewlett-Packard and NEC join General Instrument as companies committing to develop set-tops that are compatible with the Microsoft system, although an HP spokesperson said there was no commitment to actually use Microsoft software. GI announced its alliance with Microsoft some time ago.

System integrators Alcatel, Andersen Consulting, Lockheed Missiles and Space Co., NTT Data Communications Systems and Olivetti all have committed to provide service and support for the testing and global deployment of the system.

Finally, NEC joins Compaq and Intel as companies committing to build media servers compatible with Microsoft equipment.

During the Summit, Microsoft outlined the details of its software architecture and business model for a fully switched, digital broadband network including distributed operating system software connecting set-top boxes and personal computers with headend devices, media servers that deliver video on demand and a core set of interactive applications.

## Future set-tops begin taking shape

Even though they've been repeatedly delayed by the MPEG standardization process, the inner workings of the first-generation digital set-top boxes are beginning to come into focus.

Hewlett-Packard, the newest kid on the block with purchase orders for set-tops in its pocket from TCI and Comcast, has chosen Integrated Systems to supply a resident real-time operating system for its first-generation box, due out in mid-1995. The pSOS+ system will allow H-P to provide low-cost set-tops, according to Casey Sheldon, brand manager for H-P's home products division.

Integrated Systems supplies similar operating system software for cash registers, automatic teller machines, lottery machines and other transaction-oriented devices, which makes it perfect for H-P's set-top, Sheldon added. Such a system can respond in a predictable manner to interrupts and transactions like viewer requests.

In addition to getting real-time functionality, Oracle and Sybase software can be run over the operating system seamlessly, Sheldon said. H-P has previously announced agreements with those companies.

Future generations of set-tops may or may not use the pSOS+ system, depending upon the outcome of work with Microsoft. "We think they (Microsoft) will be an important player," said Sheldon.

Separately, DiviCom and Broadband Technologies are working together to ensure that BBT's switched digital video system will be interoperable with DiviCom's compressed video encoding and decoding scheme.

Both companies were selected by Bell Atlantic to supply equipment for the video dialtone trial in Toms River, N.J. Additionally, both companies support the development of industry standards like asynchronous transfer mode (ATM) and MPEG.

Finally, Zenith will use Macrovision anti-copy technology in its Media Access digital set-tops that are being developed jointly with Philips Consumer Electronics and Compression Labs Inc. The anti-copy technology makes it much more difficult for consumers to record programs on their VCRs, which could convince film studios to release movies to pay-per-view much sooner than they do today. Network operators will be able to select copy protection by individual program and set-top.

The inclusion of copy protection is in anticipation of the need for hardware manufacturers to help protect copyright owners' intellectual property in a digital era.

Further news in the world of set-tops: Jones Intercable has committed to purchase 150,000 DigiCable digital set-tops from General Instrument Corp., making the total number of commitments for GI digital terminals in excess of 2.5 million units.

GI has also received an order from Time Warner Cable for 1.5 million next-generation analog addressable boxes, to be deployed over the next three years in systems located across the country. The move is part of Time Warner's ongoing program to increase the number of subscribers who have access to addressability.

## ADC targets MSOs; partners with Electroline

ADC Telecommunications, which has historically focused its efforts on the telephony market and been content to service the cable industry through its American Lightwave Systems subsidiary, will be aggressively marketing its products to cable operators, beginning in 1995.

As such, the company will broaden its product line to include RF amplifiers and other coaxial products, including a new line of taps designed to support video and telephony over hybrid fiber/coax networks, which was announced in late October. The new power-passing, remotely addressable taps are the result of an agreement between ADC and Electroline Equipment of Montreal, Canada, whereby Electroline will manufacture the taps and market them to cable operators, while ADC will market them to telcos and competitive access providers.

While the deal doesn't give ADC access to cable operators, company executives have stated the company will offer other products, including F-connectors and amplifer/node stations that will support voice and video either through partnerships or by manufacturing those products in its own facilities. "Stay tuned," promised Lynn Davis, senior VP and GM of ADC's Broadband Connectivity Division.

## Jottings

**Zenith** has souped up its "Homeworks" RF modem that provides data over cable TV networks. The new Homeworks Elite system runs at 4 megabits per second (mbps), as opposed to the 500 kbps offered by the first generation system. In addition, Zenith is working with Viewpoint Systems to supply interactive videoconferencing and collaborative computing capabilities over cable TV systems. Users can work from Windows on their PCs over Ethernet data networks to conduct meetings and work together . . . **Broadcom Corp.** has developed a single-chip 64-/256-QAM digital receiver for use in cable television applications. In the 256-QAM mode, the receiver achieves speeds of 40 mbps. In the 64-QAM mode, a 6-MHz channel can carry 40 mbps of data, or about 10 movies in MPEG-2 format . . . **Hewlett-Packard** has chosen LSI Logic's ATMizer architecture to provide asynchronous transfer mode (ATM) transmission of digital video for the H-P Media Stream video server. H-P was attracted to LSI's product because it has a fully programmable, single-chip design . . . **MCI** almost single-handedly jump-started the singlemode fiber market when it bought thousands of miles of fiber cable from Corning. Now, MCI has become the first long distance carrier to deploy dispersion-shifted fiber so it can support enhanced imaging and multimedia services over its network. Using wavelength division multiplexing (WDM), MCI can now increase transmission speeds four-fold while reducing noise . . . Voice transmissions between the United States and Europe via underwater fiber optic cable are nothing new, but now **Vyvx** and **British Telecom** are doing the same thing with video. The "AtlanticVision" service will be offered at 45 mbps, beginning in January 1995. The service is targeted at the occasional use market, including broadcasters, production houses, businesses and resellers . . . . CED

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# For Rosas, the sky's the limit

*By Dana Cervenka*

Rosa Maria Rosas thinks that she's very ordinary. She's very wrong. Just ask her pet iguana.

How many people could say they started out in cable without even owning a television set, eventually climbing the ladder to become the general manager of 10 cable systems, as well as Region 4 director for the Society of Cable Television Engineers (SCTE)?

In her current position as general manager for Lakewood Cablevision, encompassing several systems around the Lake Conroe and Lake Livingston area of southeast Texas, Rosas is a jack-of-all-trades: personnel director, trainer, safety coordinator, PR guru, customer service facilitator and budget wizard. "There's never a dull moment," says Rosas, which is just the way she likes it. At present, her major project is overseeing the rebuild of 10 miles of the system's plant–the majority of it upgrading electronics and resplicing–to keep up with the FCC's Proof of Performance standards.

## From no TV, to cable TV

So how did her long, strange trip into the world of communications begin? In 1981, Rosas was pondering career options when a good friend, Roy Moore, at the time chief technician for a local cable company, paid her a visit. Moore was in a bit of a spot, as his dispatcher hadn't shown up for work in three days. Out of respect for Rosas' natural abilities, he offered her the dispatcher's position immediately, even though she not only had no knowledge of cable, but didn't even own a television set at that time. "He personally installed my cable and loaned me a television set," recalls Rosas. "I will never forget that day. I was really impressed with the [technology]–I was in awe."

As soon as Rosas got her foot in the door as a dispatcher at Longview Cable, she made up her mind that she would one day be general manager of a cable system. Her next step was a move to office manager at Kilgore Cable, about 15 miles away from Longview.

Somewhat frustrated over not yet being named a general manager (though she had only been in the industry a few years!), Rosas began looking for the tools to make it happen. Recognizing his friend's ambition, Moore, who had baptized Rosas in cable, also introduced her to the SCTE, which she joined in 1987. Since that time, she has completed tons of hours of technical training, earning certification as both a broadband communications technician and an installer technician, as well as piling up credentials in distribution systems, and engineering management and professionalism.

What began as a desire for higher education became a commitment to training the industry as a whole. In October of 1989, Rosas was elected vice president and secretary for the Southeast Texas chapter of SCTE. She has been chapter president twice since then, and in June of '94, was elected to the SCTE board of directors, representing Region 4 (Texas and Oklahoma). In her capacity as a director, Rosas nurtures all of the meeting groups in her two-state area, attending their meetings, reporting to national headquarters, assisting them with their paperwork, and basically, encouraging their commitment, while giving back to the association that has helped her so much.

In the meantime, her new skills were making her dream a reality. In 1988, Rosas joined Galaxy Cablevision in Onalaska, Texas as regional manager, and took on responsibility for two offices serving 6,900 subscribers in seven cable systems. With the acquisition of Galaxy by Moffat Communications International, she became a general manager. "I can't adequately express my feelings of gratitude to [Galaxy]," says Rosas. "They gave me the opportunity to prove my ability as a manager."

As someone who has invested heavily in industry training, it's no surprise that Rosas immerses her staff in the same. In fact, maybe she trains them too well. "My biggest challenge is finding, training and keeping good employees–especially on the technical side," she explains. "I've noticed that we have so many different technologies working within our system...that when we get people trained, they become very valuable to other companies."

## Reptiles? No problem!

And yes, she does have a pet iguana, or more accurately, "Mr. Iguana" belongs to her four-year-old daughter, Maria Fernanda. The 18-years married Rosa was somewhat taken aback when husband Gonzalo brought the little dear home in a burlap sack one day ("Look what I bought for Maria, honey!" ). Nevertheless, Rosas took the news with characteristic equanimity.

What's next for Rosas? Well for one, her second child, due in February. Professionally, she's set her sites on continuing to work as a GM, either for a larger system in the United States, or possibly even in a Latin American system. The challenge of the latter would be technological and managerial: some systems are installing very high-tech equipment, leapfrogging over older technologies, while others "need everything" from a safety program to a formal training program, according to Rosas.

For now, she is quite happy to drive to work through the beautiful piney woods of Sam Houston National Forest. And if this busy working mother can someday shop and conduct other business from home, reaping further benefits from the infrastructure she has helped to establish, so much the better. CED

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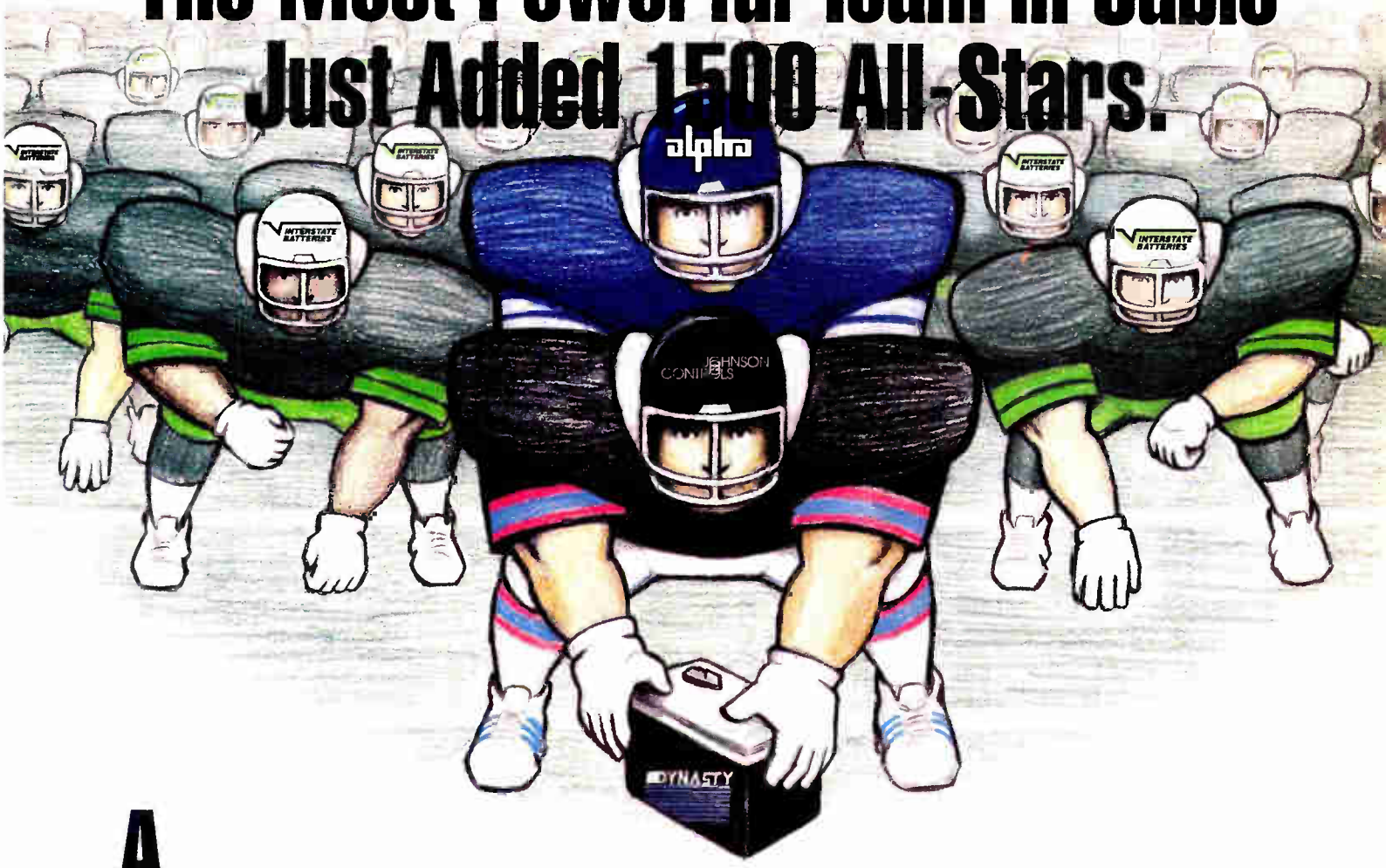


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# Don't lose sight of the pivot point

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

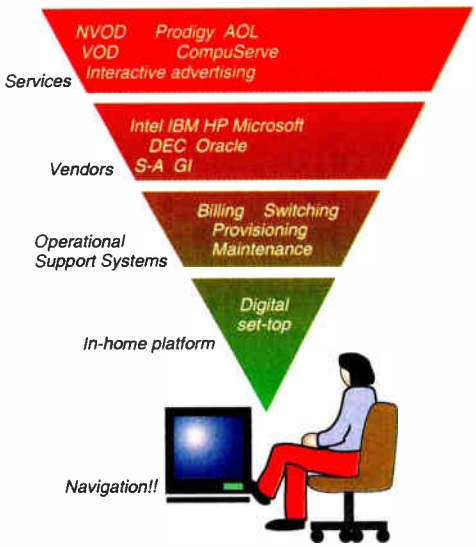
With all of the hoopla surrounding the Information Superhighway, the 500-channel universe, content on demand, and the "anytime/anywhere" hype we hear so much about, we often have a tendency to lose sight of the most important part of the equation–the consumer.

The consumer, as he or she navigates through myriad services we intend to provide, will call the shots as to whether or not we can claim success at the end of the day (See figure).

It's not hard to imagine the multitude of services that might possibly be offered on the full service networks of the future. These services will be an array of "interactive" services that must ultimately make their way to the consumer by a variety of different in-home technologies and interfaces. Telephony services with advanced features and functionality will be offered, along with traditional lifeline service via both traditional and "smart" telephones. Some low-speed transactional services such as home banking will continue to be accessed via telephones with touch-tone capability and alphanumeric displays. High-speed data services will be capable of being accessed via the customer's home computer for heavy-duty work that may require a significant amount of keyboard entry, or even via the remote control and the TV from the comfort of an easy chair for more entertainment-oriented access.

On the other hand, services such as near-video on demand (NVOD), video on demand (VOD), interactive advertising and other more traditional entertainment services may be accessed almost exclusively via the remote control and the consumer's television set, but they will also be provided via a window as "background" content through a proliferation of video cards in PCs. There is no doubt in my mind that there will always be a place for all three terminal devices in the full service network of the future. The key question we need to be asking ourselves is: for which of these services will the consumer actually be willing to pay?

***The Pivot Point: the consumer***




Our vendors are scrambling furiously to develop the widgets that will be required to support this proliferation of services. Unfortunately, without the proper leadership and guidance from the marketing and engineering portions of the operations community, they will be flying blind. After all, the vendors can't possibly know our customers as well as we do!

In addition, due to the potential new-product bonanza, major new players are beginning to find their way into the traditional CATV vendor pool. Players such as Intel, IBM, HP, Microsoft, DEC and Oracle are being added to the likes of General Instrument, Scientific-Atlanta and Zenith, with each hoping to develop a major stake in the full service network deployment. Major alliances are also beginning to form among various members of the vendor community in the hopes that their proprietary hardware and software products will win out in the long run. The stakes are high!

Note, however, that if we as an industry ever hope to branch-out beyond our franchise boundaries and truly become part of the global telecommunications infrastructure, the continued deployment of proprietary products and systems will be our downfall. While the CATV industry has traditionally not been a standards-based delivery media, the successful deployment of full service network products and services as part of a future network-of-networks will require that we work with our vendor base to ensure that standardized, rather than proprietary interfaces are the order of the day.

## Operational Support System

Just as the products that our vendors are developing must be capable of supporting, through standardized interfaces, the services we intend to provide across network boundaries, so must operational support systems (OSS) be developed to support the deployment, operation, maintenance and billing of these products and services–across network boundaries.

As an industry, we have a unique opportunity to create well-designed and fully integrated operational support and management systems. Unlike the telcos, who currently have in place a web of independent OAM/OSS software modules that are extremely complex to maintain and grow, we have an opportunity to develop and deploy fully integrated and very flexible systems that are simple to maintain. This advantage should not be underestimated.

Planning, development and deployment of network infrastructure, products, services and support systems will be for naught, however, without a focus on the consumer's wants and needs. Providing customers with what they want, when they want it, by giving them the navigational capability to find the products or services they are looking for, will be crucial to the success of our business. In a truly competitive environment, while the content may be essentially equivalent from competitor to competitor, the look, feel and overall presentation of that content via the navigational interface that is provided may spell the difference between success and failure.

The consumer interface we provide, both from a hardware and a navigational software perspective, is our only way of developing a continuous value-added interface with our subscribers. Let's not blow it again with a proprietary set of interfaces that will become obsolete with the next generation of consumer electronics devices. Let's do it right the first time. CED

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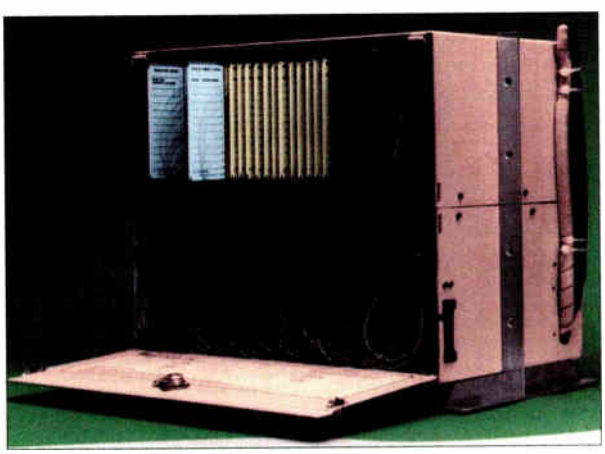
# Streamlining headend fiber organization

## The "hub in a box" concept

*By William J. Seim, Senior Specialist-Technical Services, 3M Telecom Systems Division*

The race to develop technologies that are more cost efficient, streamlined and flexible is a competitive one. The cable television industry is no exception, especially with advancements in fiber optics and the role fiber will play in the "information superhighway" phenomenon. As cable television headends and hub sites migrate to a fiber-rich distribution scheme, the need for a new, high-density fiber organization system has become increasingly evident.

In the past, fiber optic applications in cable networks have been limited to trunk links between headends and other high-traffic links. These applications involved few optical fibers. Typically, a 12-fiber cable would accommodate all the traffic demands.



*3M's "hub in a box."*

However, recent developments in cable TV architecture, in which fiber is used as the primary link in the distribution networks (i.e., fiber to the neighborhood), have significantly changed the quantity of fiber present in the headend or hub office, necessitating a new approach to fiber management.

### Addressing new fiber distribution needs

Hub offices are distributed throughout a metropolitan area to serve as centers for residential signal distribution. They commonly serve 100 electro/optical nodes. The current applications involve three to eight (typically six) optical fibers between each node and the hub office. Using the typical node and fiber counts, a cable TV hub office would have to accommodate 600 optical fibers for distribution purposes.

Fiber organizing schemes which are currently used for the fiber-rich distribution networks are based upon traditional FC, SC and ST connectors with distribution cabinets accommodating 48, 72 and sometimes 144 fiber optic connectors stacked in equipment racks. Most fiber distribution cabinets cannot accommodate the fusion splices required to splice the connectorized pigtails to the bare fiber. Therefore, separate fiber splice storage cabinets are needed.

Further, the optical splitters and attenuators used in cable TV architectures have been traditionally stored in separate cabinets. Accommodation for fusion splices and/or connectors have to be made for the splitters and attenuators.

The fiber-rich hub offices require several fiber connections. For example, connections are required on the transmission side from the lasers to the optical splitters to the field cable. Connections on the return path are required from the field cable to the optical attenuators to the receivers.

Fibers can be connected in several ways. Fusion splices can be used, however, they significantly reduce system flexibility. Further, the ability to replace or test a defective device is much more difficult. In the event of a failure, system restoration is greatly hampered when fusion splicing is the predominate connection method.

Connecting with traditional connectors offers greater flexibility for system maintenance. This method ensures the ability to test any component of the circuit and to easily replace a defective component. However, there is a significant price to pay in terms of cost, space and complexity associated with traditional connectors. Traditional low-density connector systems, along with their splice storage cabinets and splitter/attenuator cabinets, demand a large amount of rack space.

### Saving space, increasing flexibility

An ideal high-density fiber-based hub system would eliminate traditional connectors, couplings, pigtails and jumpers. It would use 900 µm single-mode optical fiber for jumpering. New high-density connectors would provide insertion loss and back reflection values equivalent to the best factory polished connectors.

The newest technology offers one 11-inch rack-mounted cabinet which can accommodate 408 optical connections. This is the highest density available in a single unit today. For applications requiring more than 408 connections, the cabinets can be stacked.

Connectors are mounted on edge cards (12 connectors per card). The connector cards are available in five configurations to provide simple organization of all of the following functions:

- ✔ termination of laser fiber
- ✔ termination and storage of optical splitters
- ✔ termination of field cable
- ✔ termination and storage of optical attenuators
- ✔ termination of receiver fiber.

Jumpering between the multi-function connector cards is accomplished with 900 µm singlemode fiber, using a simple strip-clean-cleave technique. The use of bulky 3.0 mm pigtails and jumpers is eliminated, as is the need to fusion splice cable fiber to pigtails.

In a high-density system using 900 µm jumper fiber, the need for elaborate cable and jumper raceways is minimized. Computer software to calculate the length of pre-connectorized optical jumpers and to specify the exact routing of the fiber jumpers is no longer required. CED

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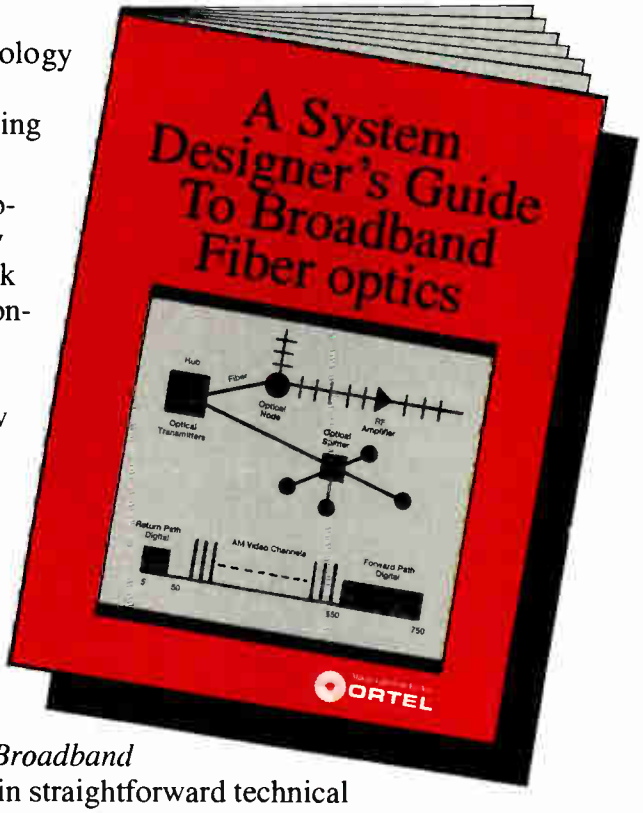


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Circle Reader Service No. 14

# Cable networks in the next millennium

## What will they look like?

ILLUSTRATION BY JINSEI CHOH

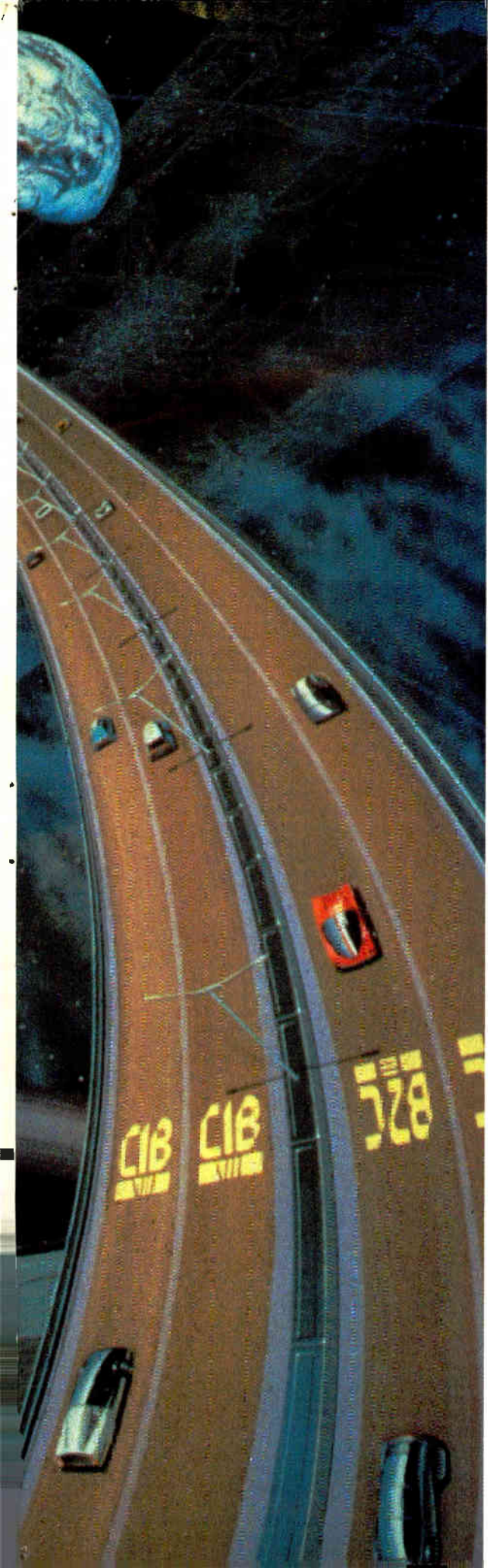
*By Dana Cervenka*

Predicting the future is not an easy business. But throwing caution to the wind, eight prominent engineering executives have pulled out the crystal ball to do just that.

For *CED's* engineering roundtable, we polled execs from five cable MSOs, as well as engineering specialists from three manufacturing companies, for their views on everything from the network of the future to cable's competitive position in the provision of telecommunications services. The manufacturers are, of course, prognosticating on behalf of their customers.

Participants are: Bill Bauer, owner/president, Windbreak Cable; Chris Bowick, group vice president/technology, Jones Intercable; Jim Chiddix, senior VP, engineering and technology, Time Warner Cable; David Fellows, senior VP, engineering and technology, Continental Cablevision; Bob Luff, chief technical officer, Scientific-Atlanta, Broadband Communications Division; Andy Paff, executive VP of strategic planning and technology, Antec; Geoffrey Roman, senior vice president, technology, General Instrument; and Joe Van Loan, senior VP engineering, Cablevision Industries.

*CED:* **When do you think digital services will be available to a majority of the homes your companies serve?**




**Bauer:** Data I see in nine to 12 months, because of the tests that we are running right now. There is one hitch–an RF modem–the one piece we don't have. I don't see video for 18 to 24 months, and it will be in limited distribution. I know everyone will be shocked by that, but I think the costs involved in putting it into the system are going to be a little bit pricey, and the set-top box issue has to be solved first. The other issue is when the standard for HDTV will be set, and how everyone will play in that.

**Bowick:** There are many things out there that we will be providing to our subscriber base, but there's no way I can give you any feel for how quickly those will roll out, because it's going to be extremely market-dependent. Not all of those services will fly across all markets. Most of the MSOs in the industry are looking at a regionalized approach to serving their customers, trying to find an area in which they feel they can become a dominant provider of these kinds of services.

**Chiddix:** By the end of 1998, all of our major cable systems will be upgraded with fiber to the neighborhood and will be ready for digital services. Between now and then, we will be exploring a variety of digital services, including interactive television in Orlando; telephony over cable in Rochester, N.Y.; and when we find the right product, PC interconnection services.

So I would fully expect that well before 1998, one or more of those services will be available to the majority of our cable subscribers.

**Fellows:** If you mean digital video, 500-channel universes, I think it starts about a year from now. The 1992 Cable Act has really fogged up the crystal ball in terms of being able to predict how quickly it gets rolled out. But I would expect that at the end of five years from now, digital will be available to almost all of the homes my company serves.

**Luff:** That process has already started. We have the Sega Channel, going out for large deployment over the holidays. And digital set-top trials have already started in a couple of the major MSOs and RBOCs. We see production and availability of the product, and demand from our customers beginning at the end of '95, and it just accelerates in '96 and '97.

**Paff:** I have to believe that the majority of the digital direct customers are coming from high-end cable customers. Given that, there'll be a fairly strong incentive to offer competing, and probably a lot better, technical and service options in '95.... Services like the Internet, and America Online, if you want to talk about interactive, or Sega, if you want to talk about just downloading digital games, are out there. That's going to be a very strong impetus for interactive digital in the next year or two years. The constraint there will be in cost-effective technology, cost-effective modems....

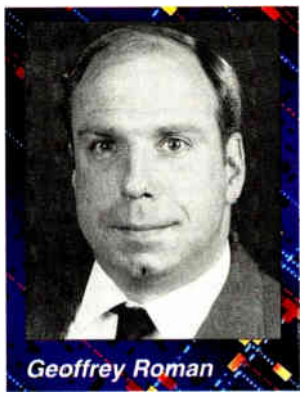
***CED:*** **Do you think MSOs can agree on common protocols and work together to develop regional interconnects? Should these come about through a standards committee?**

**Bauer:** I don't think there will be any problem developing regional interconnects. For the smaller oper-

ators in the rural markets, it's a great advantage. We gain a lot, and we don't come to the table with this set of demands that the other person has to meet, or vice versa. We simply go ahead and make it work. I think that will happen, and in fact, it's starting to happen already.

**Bowick:** The short answer to that is yes, I think we can. The other short answer to that is yes, I think we have to, in order to ensure our very survival. This is something I've been harping on for a very long period of time. There is no way that we, as an industry, can continue to operate in very small, isolated franchise areas. We are going to become, like it or not, a network of networks. As an industry, we will just have to change our ways and become more standards-based.

There are already several standards committees out there, and it's going to come as a mix of standards committees and MSOs putting their heads together... There are some people who say standards simply slow the deployment of new products and services, and I think that's probably true, to a dergree, until the standard is developed. Once it is developed, the applications and services that ride on top of that stan-


Geoffrey Roman

dard flow very quickly....

**Chiddix:** I'm very distrustful of standards committees. They move very slowly; each member of the committee fiercely guards his or her own best interests, and what they produce is usually far less than optimal, because it's a political compromise. I think that MSOs can and will work together to develop regional interconnects, and the protocols required for regional interconnects are probably familiar telco-type protocols.

For brand-new digital services, we are entering a very innovative time when various manufacturing companies will develop initially proprietary systems, and out of that may come de facto standards. Cable operators can, to some extent, sit back and watch, using the best that emerges from that innovative process (because) we operate broadband systems, and our broadband networks can be used by more than one digital transport system simultaneously.

**Fellows:** We are developing regional interconnects, and common protocols are the least of our concerns. If you are talking about digital video compression, most of the programming will be available to me in a DigiCipher II/MPEG-2 format. And I think every company that I buy set-tops from, Zenith, GI and S-A, all have signed cross license agreements for a digital video standard. If we are talking about voice or digital ad traffic, there are Sonet standards and other common protocols that we use.

In terms of should these come about through a standards committee, you probably know that CableLabs is not a standards-setting committee. And in general, that's one of the things that is lacking in the cable industry. We've never really had a set of standards. If we really had to set a serious standard, we'd have a difficult time doing it. You can see that in our efforts to take ATM and make it more amenable to carrying video into people's homes.

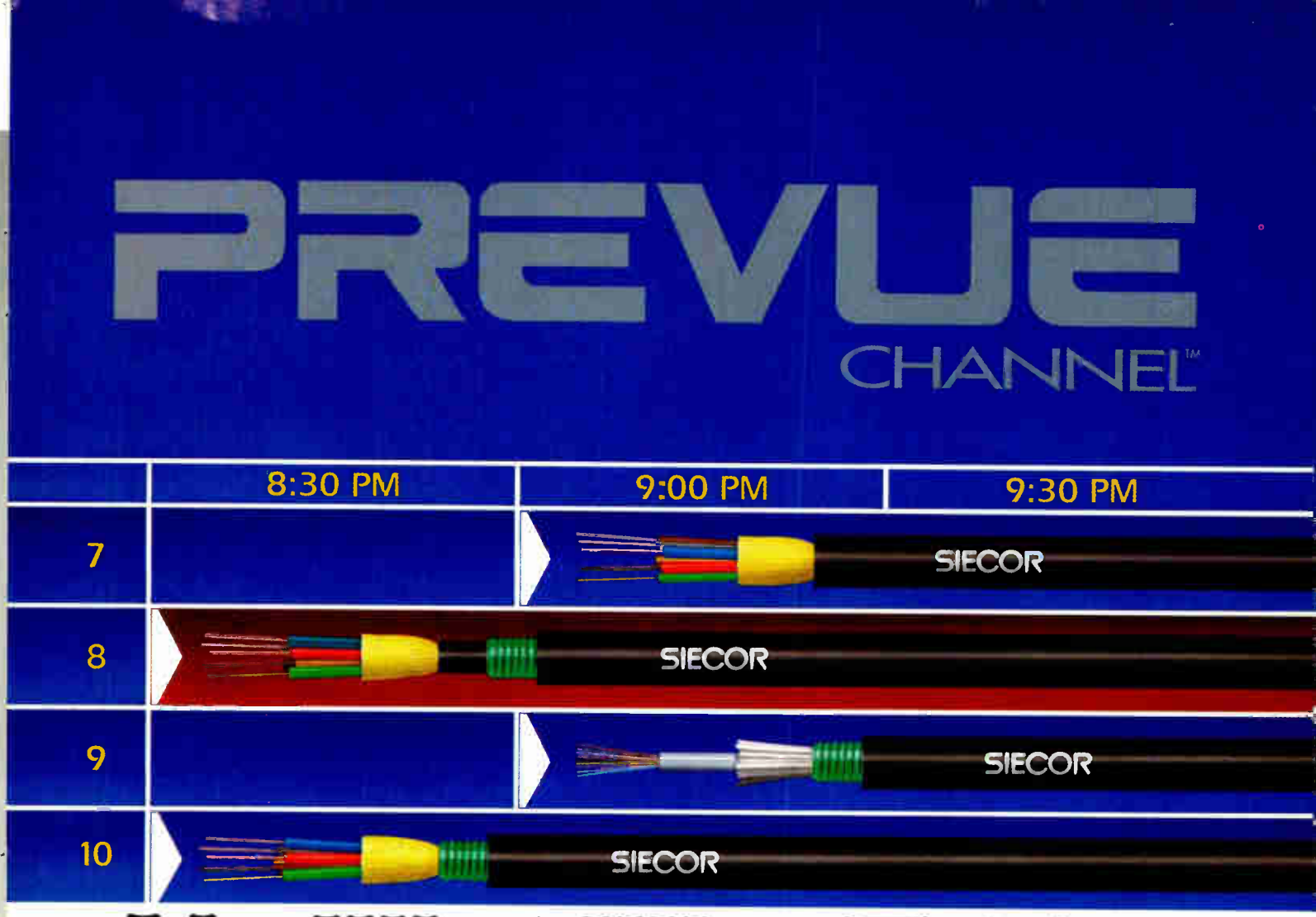
**Paff:** There may be a common platform, which I would view as Sonet right now. And that's going to be driven by the need to interconnect to the public network efficiently. Sonet's logical in that it will transport ATM and MPEG and some of the things near and dear to cable TV, in addition to things like telephony.... Whether or not broadcast video gets integrated into a Sonet platform seems to be the question. Even if that were to occur, what the standard would be for that is in question. So I think what you will see is cable operators adapting standards that have been developed along the way.

**Roman:** The MSOs can agree, and will probably agree and implement (technologies) faster than standards will be set. It will be very much the way most of the other real standards have been set. They wind up getting set around what people do, rather than someone trying to set a standard first, and then everyone adopting it.

***CED:* How interested is your company in providing residential telephony? When do you think you'll do it?**

**Bauer:** I am absolutely interested in providing residential telephony. Now, my scenarios will be different from anyone else's. I will be doing it in six months. (You will see a lot of raised eyebrows on that one.)

It will be an integrated system, but again, it will not be what you think it will be. The system will be powered in-home, probably with battery backup.

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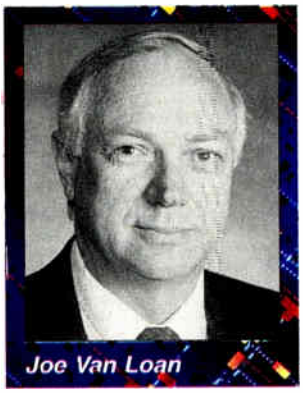
I don't think cable should try to offer lifeline service. That's not our forte. The telcos do a good job of lifeline service. Why should I try to duplicate what they are doing when it doesn't fit well into the infrastructure I have in place?.... There's a lot of stuff that we do 10 times better, 100 times better, than what the telcos can do. Let them do what they do well; we'll do what we do well. We do entertainment; we have the installed infrastructure for high-speed data.

**Bowick:** Absolutely interested. Residential telephony, though, comes in a lot of different flavors. You can talk about mass market telephony, whch is telephony to the home, but there are other possible solutions to that, and those are things like shared tenant services: the provision of telephone service to multiple dwelling units, or major complexes. And we are very interested in participating in both of those. When? The answer to that, I think, is as soon as regulatory approval is granted and a decent business case warrants. We have a trial ongoing in Alexandria. And the intent is in the first quarter of next year to include the Chicago area as part of our trial for residential telephony.

**Chiddix:** We are very interested in telephony. We are going to do it next year, and it will be an integrated system. There is still discussion going on within the company about how it will be powered. We are looking at all powering possibilities. But we do want to make sure that we provide highly reliable service. Powering strategy is a key element in providing a high degree of reliability.

From a technical standpoint, I think we need to have a quality of service that is sufficient to offer lifeline service.


Joe Van Loan


Bill Bauer

**Fellows:** There's no doubt that we will be offering residential telephony service as soon as we are able to do it. At the moment, that will be state-by-state warfare.

I currently believe we will do it via an integrated system. I will use Siamese drops, but what will go on the twisted pair is powering–not the actual voice.... So we are going to need an integrated system. The same physical media, the same fiber, the same coax that carry the video channels will also carry your voice. It would be too expensive to overlay a new system.

**Roman:** You will see some real market deployment probably about the second half of next year. It will probably not be a real business for anyone much before '97 or so.

(You will see) everything. I don't think operators will converge on a single approach too quickly. You will see fully independent overlaid networks, you will see combination fiber networks and then twisted pair and coax separately to the home. You will see some integrated HFC telephony approaches....

I don't think most consumers will have a second choice for residential telephony much before the end of the decade. And I do not think in all markets it will be the cable operator who is that choice. In terms of lifeline, I would not be at all surprised if there is some kind of regulation which will require anyone who offers the service to offer lifeline...

**Van Loan:** Our interest level is extremely high. We would've liked to have had a trial running this year, and the only reason we aren't close to doing that is we can't get our hands on the necessary hardware. The applications are moving faster than the technology development. We are hopeful that (it will happen) in early '95. Our system will be integrated and powered through the network.

For consumers to have a second choice, it will probably be more than five years, less than 10. And yes, the cable operator will be the provider, in concert with someone else–a distant RBOC, a long distance carrier.

***CED:* Describe the state-of-the-art network of the year 2000, including, the amount of fiber there will be, new services, bandwidth requirements, etc.?**

**Bowick:** Who knows? We'll obviously be deploying fiber deeper and deeper into smaller and smaller service areas, and the service area size that we ultimately end up with is going to be dictated by the market demographics and an in-depth traffic analysis for the needs of our

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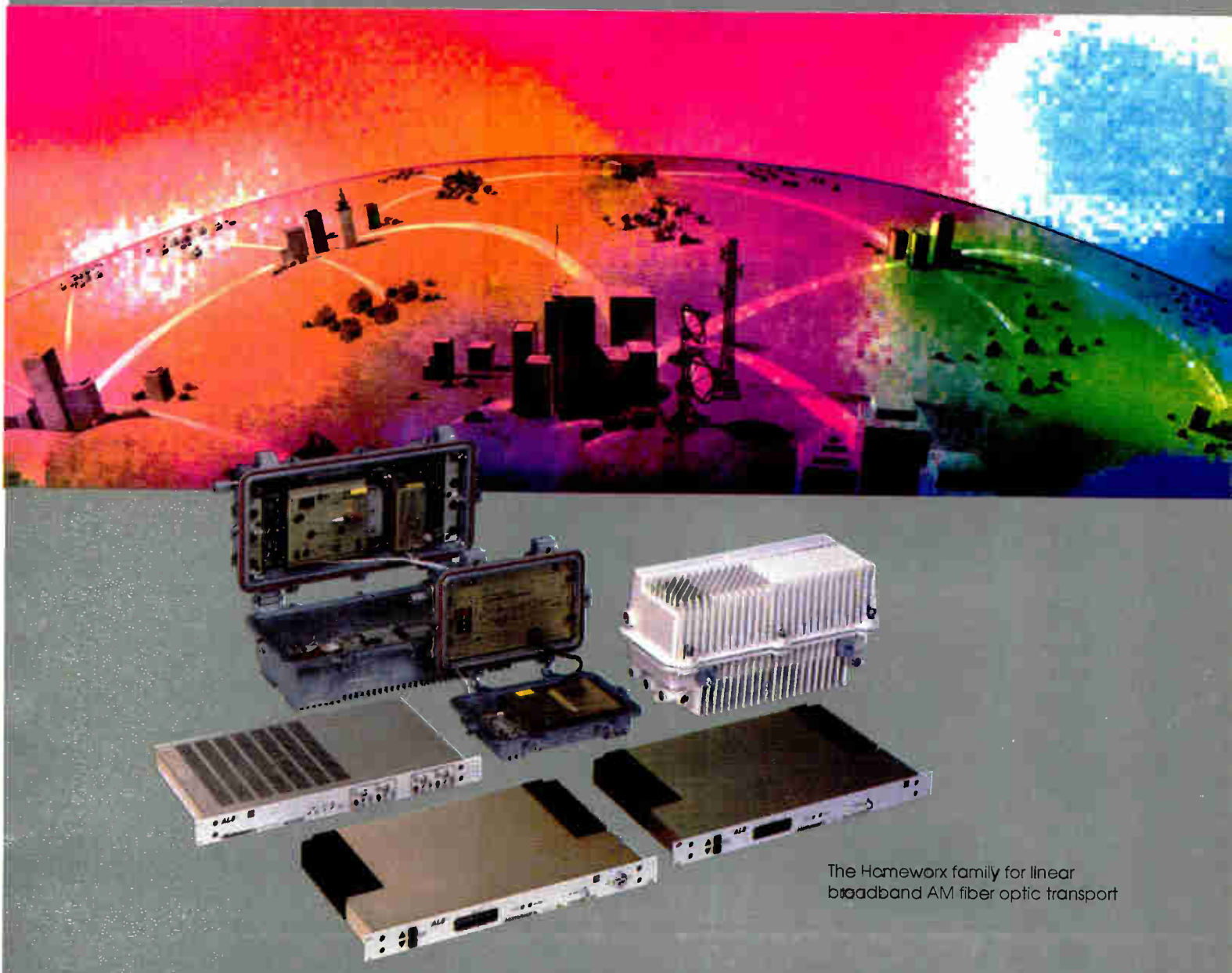

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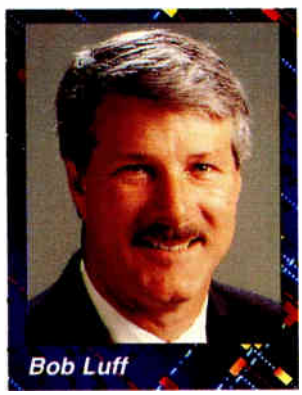
system. As we get to more transactional services, the bandwidth requirements are no longer going to be linear based on programming, but are going to be based on the amount of digital traffic that goes in and out of each home or business.

There'll be areas of the country that won't necessarily be fully two-way on the cable plant; they might not be providing all of the products and services that we talked about. There might be smaller niche areas where that's going to be the case. Will we be "substantially" two-way? Yes.


Bob Luff

We will stick with sub-low return for as long as we possibly can. We'll try to find ways of making it work, of getting rid of the ingress that we currently see out there. And that, of course, is helped along substantially by the fiber optic serving area size.

**Fellows:** I think the network will be in the 200 to 600 homes passed per node range. We are about to enter a phase when services won't be paced by our technical ability to provide the service–they will be paced by the human social ability to absorb the service, to understand the service and use it. You will be able to play games across the network, talking to and seeing the person you are playing against. You will be able to quite easily have everything that is in your office switched to a home office, so when you are in your office, your calls will go there, your Ethernet outlet will be from your computer there. When you go home, you'll flick a few buttons, press a few codes or just speak to a voice recognition terminal, so that when I call you at the office, your home phone rings with a distinctive ring so you know it's a business call.

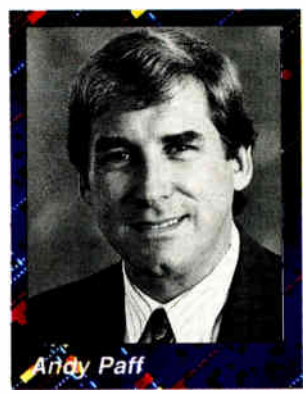
Combinations of wireless and wired offerings, with the wireless guys reselling wired access, or the wired guys reselling wireless access, will be in place...The growth will be in combinations of services.

The world never needs more than 750 MHz of bandwidth! I think the further channel needs in the year 2000 can be taken care of by compression and advancements in compression, rather than squeezing more megahertz out of a system.

**Luff:** It's very clear that hybrid fiber/coax will continue to be the backbone well past 2000. That the basic architecture of fiber to a service area, and then coax being used in the last portion of the span between the service providers and the home will also be there well past the year 2000, because coax's economics are very favorable.... Changes in modulation, in compression algorithms, protocols and such are totally transparent to the core architecture and design of the network itself. It is so versatile, and is the lowest cost of the other alternatives....

**Paff:** We'll see passive coax networks. We'll see node sizes reduced to their logical size, which is a logical extension of where we've been–from 10,000 to 500, down to anywhere from 100 to 150. This is based on having no actives in the coax portion of the plant. That will be driven by the fact that it will be two-way. The interactive services will create the need to shrink nodes sizes.

It won't be a zero sum game–it won't be cable eating telephone, or telephone eating cable. It will be a lot of new services that will require broadband in and out of the home which will create this evolutionary trend, which HFC is ideally suited to....


Andy Paff

**Van Loan:** The network will presumably not be that distant from where we are now: hybrid fiber/coax with 400-500 home nodes; two-way; 750 MHz, maybe 1 GHz. We are going to load the networks with everything we can get our hands on and hope some of it sticks. Some people are trying movies; there may be some of that. We will probably end up with all kinds of channels. You see it in the pipeline now: The Golf Channel, The History Channel, The Newly-Rich Channel, The Traffic Channel....

***CED:*** **What new technology do you need that's currently missing? What hidden technology will grow in importance to the degree that we'll all be talking about it five years from now?**

**Bauer:** A high-speed data modem. That is the one piece of equipment I'll need in a matter of several months. Modems are designed for twisted pair. The whole world is geared toward twisted pair. They don't understand what an RF modem is.

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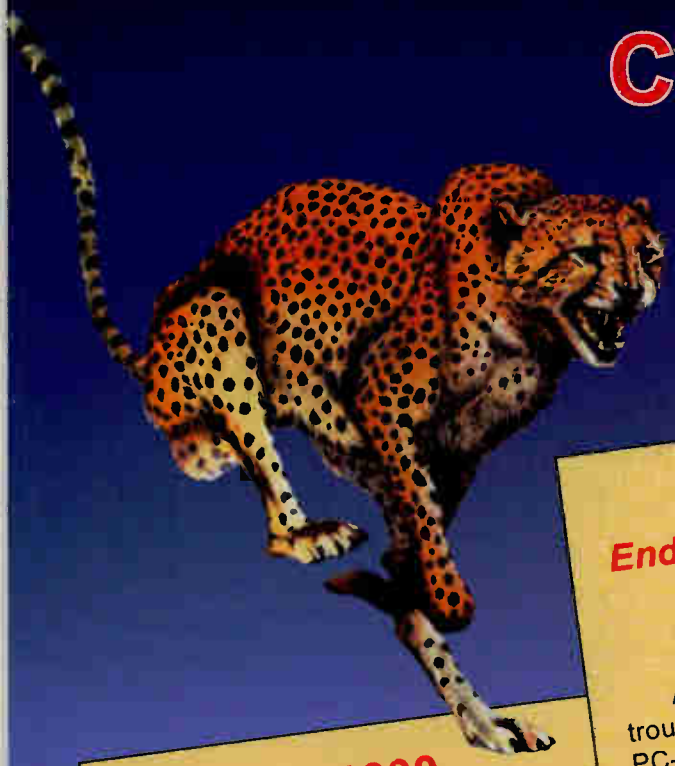

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**Bowick:** The list is huge. It is amazing what is not here. And it's not just the cable industry, by the way, it's the cable and telecommunications industries.

The transactional billing requirement is absolutely huge. And there is no solution on either side at this point. Cablephone–not yet fully developed. The issue of network vs. customer powering needs to be finalized. The prices for server technologies that we are looking at today for on-demands kinds of services are just absolutely out of this world.... The customer-friendly navigational platforms that are currently in development, but not yet finalized.... Operational Support Systems that support not just cable applications, but telecommunications applications as well.

**Chiddix:** Let's start off with technology that can turn lead into gold. I think there are a variety of refinements to come; but we have all of the technologies in their basic form that we need to provide the services that are ahead.

There's no gaping hole. That's not to say that better ways to do things won't emerge, they will. But I don't think there are gaping holes that have to be filled for us to go forward.

**Fellows:** We need reasonable Operational Support Systems, or OSS. It's part billing, part status monitoring, part technician dispatch, part measuring traffic on the network, knowing where the bottlenecks are. If, for example, on a Saturday night there are too many people requesting video dialtone in this particular neighborhood, let me divide the network up. Or for status monitoring: wait a minute; this amplifer's out, I'm going to route around it.

Right now, Bellcore spends about $800 million per year maintaining the OSS software that is used by the regional Bell companies. But we need something that the little operator can grow into, and the big operator can use.

**Paff:** The good news is, a lot of the technologies are out there. The major thing will be to define how we are going to do it and get back to that standards issue, and then get cost reduction into the products that we build. There's a lot of headroom for cost reduction in the hybrid fiber/coax platform, and that's good news for cable. And good news for the telephone guys who are using HFC.

**Van Loan:** Low-cost terminal equipment for telephone over hybrid/fiber coax. The other technology that's missing is the one our customers use to print money to pay for all of this. They won't want to use money they earned.

*CED:* **Predict how the cable TV/computer/telco convergence will occur. Who rules the home: PCs or TVs?**

**Bauer:** Will cable and telcos ever merge? Absolutely not. Never, ever, ever. The philosophies of the two industries are at opposite poles. The telcos have spent 50 years creating costs to raise their expenses so they can ask for a new rate base. And the cable industry has had to function very efficiently.

As for cable and the long distance carriers, it's very likely that they will (merge). I think it's a good marriage, and the public will be well served by the partnering. A lot of things can happen. We have things that the IXC does not; they have things that we do not.


Jim Chiddix


Chris Bowick

To some extent, (the utility companies) are a good match. They bring a lot of money to the table, but for that, they want control. They don't understand competition. They are a public utility; they are no different than the telcos....

Who rules the home? TVs. I see them as totally different worlds. People sit down at a TV to be entertained. They sit down at a computer to accomplish something. The PC will turn into the information provider–that's where you'll go to get your news.

**Bowick:** We have an absolutely outstanding relationship with our partner in Bell Canada. That relationship works extremely well. And I think that relationships similar to that, you could see ongoing with other parties.

Will CATV operators and local exchange carriers pair up long-term? There will be some mergers, but there will be competition as well. And in fact, what you might see are some local exchange carriers and CATV operators partnering in some areas, but competing in other areas, and it will be very confusing to know whether or not you're enemies or friends. The problem is both LECs and CATV operators have local loop access; they have access to the home.

The long distance carriers seem to be pretty ideal partners. The CATV operators have the local loop access; they also have content. And those are two things that the interexchange carriers really want and need. The interexchange carriers, on the other hand, have a national infrastructure, and an advanced intelligent networking solution. That seems to be a pretty interesting possiblity for partnership, and I'm surprised I haven't seen more of that happening.

The utility companies, those are sleepers. They are potentially very good partners. They have substantially more fiber deployed than most people realize...and can it be used to a great degee to help out in regional interconnects, for example, or interconnecting regional interconnects together, into more of a national infrastructure. They also have 100 percent penetration. Plus, they have a reasonably good relationship with their customers.

**Paff:** A year ago, you would have gotten a different answer. I'm not sure the answer is that much different now, but it was pretty clear that the telcos had a strategy for defending their territory, and a strategy for beating up on the other guy, the other RBOC. Beating up on the other RBOC seemed to involve a cable television partner in those areas outside their own service areas. Now, a lot of that has changed. The equity model got tempered through re-regulation, but the inherent principle still remains: that there are going to be at least two wires, and there seems to be enough stuff that will ultimately support both of those.

That brings in the interexchange carriers, who probably have as much or more compatibility with the cable operators as the RBOCs do....

**Van Loan:** There will be alliances between cable and long distance carriers soon, if not by the time you print this.

Power utility companies as good partners? No, I don't think they are.... Generally, they are loners. What do they offer? Poles and trouble. They want too much for the poles. They want to dominate. They are used to dominating. It's like getting hugged to death. If they like you, they can kill you.

Entertainment will be the TV; information will be the PC. Walt Ciciora said it: Remember how much channel surfing (annoys) everyone in the room? Who is going to bring up the stock portfolio in the living room in front of all the kids? All it will do is make them mad. They'll leave the room. Any kind of transactional service short of ordering pizza, which is a family affair, will probably be done on a PC. Have you ever tried to read a catalog with someone else? CED

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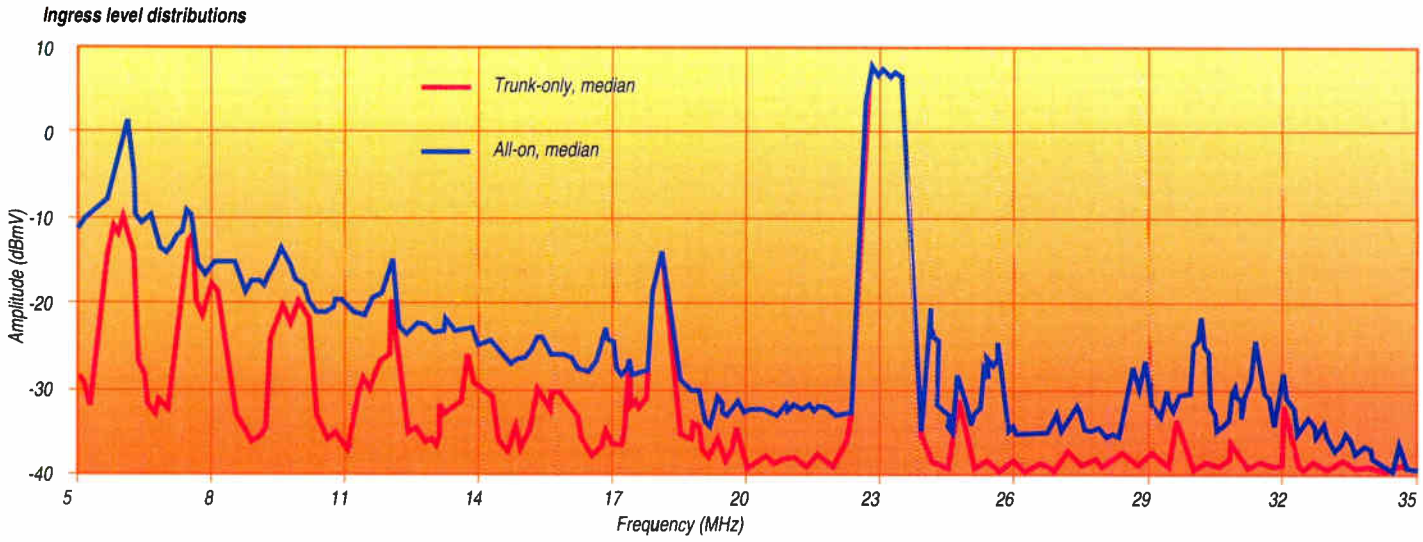


# The return band: Making two-way work Open for business?

*By Roger Brown*

If it's a given that cable operators will pursue new, transaction-oriented business like telecommunications and interactive video, engineers and technicians have a whole lot of work to do technically to make it feasible.

While cable systems have always been advertised as "two-way ready," in fact, they're not. Cable plants have been optimized to function in the forward direction only, and few systems have experience running a two-way plant. In fact, up until recently, no one even knew how to test the reliability of a return path.

Something less than five percent of the million miles of cable plant in existence is today two-way active, and most of that is used for status monitoring of electronics. No one anywhere is transmitting digital information from the home back to the headend.

"Clearly, we see implemented two-way as critical to our future," says Jim Chiddix, senior VP of engineering and technology at Time Warner Cable. "And it must be in real-time, not store-and-forward, not telephone return and not broadcast one-way. But," he cautions, "the sub-low return band is challenging spectrum, full of leaks and ingress from CB and Ham radios."

That complaint is a common one among cable engineers, who have noted that regular maintenance of the reverse plant is critical to its integrity. Most note that because of FCC leakage rules, however, operators have already made strides in "cleaning up" their plants, ridding themselves of many ingress problems. But is that enough? Will digital signals adequately pass through a cable system between 5 MHz and 30 MHz?

That's exactly the question the CableLabs Network Integrity Working Group intends to answer. Sometime in January 1995, the group (part of the Telecommunication Subcommittee) is scheduled to publish a report that will give operators a method for testing the reliability of the return plant.

Over the past year, this working group has developed a method for testing QPSK modulated video sent at T-1 speeds (1.544 megabits per second) over the return band to measure the number of bit errors occuring over time. Six systems were chosen to run month-long transmission tests to determine how various known RF impairments affect digital return signals.

"The issue of network integrity was really gnawing at us," says Paul Schauer, a Jones Intercable engineer who's been a member of the Telecom Subcommittee since 1991, when it began as the PCS Subcommittee. "There was always the question of how well our plant would perform."

The test systems chosen included: Rogers Cablesystems in Peel, Ontario; Jones Intercable in Broward County, Fla.; Greater Media in Ludlow, Mass.; Continental in Reverse, Mass.; and Crown Media in St. Louis. (More recently, Times Mirror's system in Phoenix was added.) These sites were selected because they represented a variety of cable plant, with varying amounts of fiber and differences in home densities, says Schauer.

While the test results varied widely, by correlating high bit-error rates with events that were ongoing in those cable plants, the group was able to make some intuitive, yet important, recommendations to the industry. While a more detailed explanation of those recommendations will be included in the report, this is the crux of the message:

✔ It's important to segment a large cable system into fiber serving areas and reduce the amount of coaxial cable plant. That may come as no revelation, but it was shown that cable networks with lots of coaxial trunk suffered more than their fiber counterparts. It appears that the number of homes passed per node should be 1,000 or less.

✔ Alignment of the RF reverse amplifiers is critical. This may also come as no surprise, but Schauer says that alignment is tricky.

✔ Other "intentional" carriers that occupy the return band, such as data carriers for pay-per-view authorization, must be considered. These data bursts are often high-level, slow speed signals that completely wipe out the entire return spectrum because of signal "splashing." Manufacturers may have to improve their

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*Continued from page 48, column 1*

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***Figure 3:*** *Unequalized 256-QAM constellation*

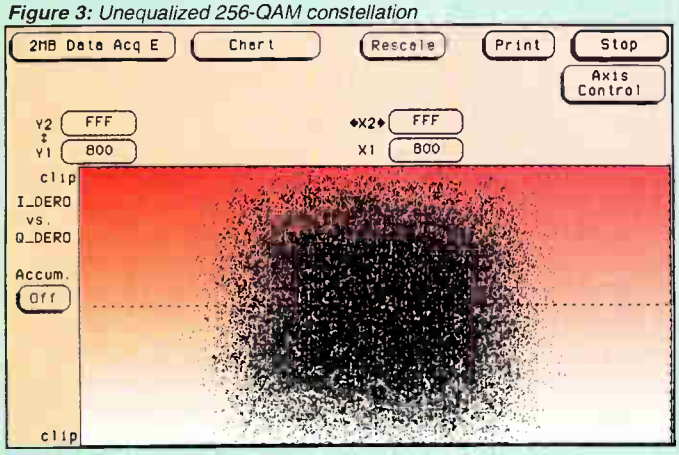
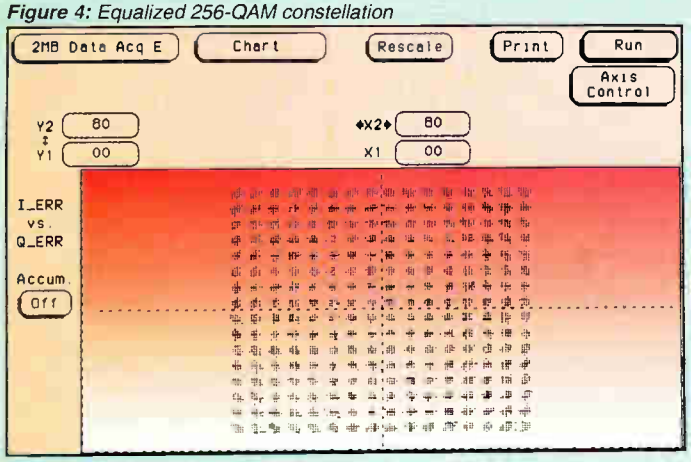



***Figure 4:*** *Equalized 256-QAM constellation*




of its all-digital implementation, the QAMLink receiver requires no tuning or production trimming and its performance is insensitive to temperature and aging effects.

## QAM convertor test results

Extensive laboratory and field measurements have been taken with the Scientific-Atlanta 8600XDI-2 production digital set-top boxes that incorporate the Broadcom three-chip set QAMLink receiver. QAMLink incorporates powerful decision-feedback equalization and robust clock and carrier recovery algorithms which acquire synchronization without any pilot tones or training sequences. QAMLink also includes a wide-band all-digital phase tracking loop for enhanced immunity to tuner phase noise and microphonics.

Tests were conducted in both 64-QAM and 256-QAM mode with and without forward error correction (FEC) at a symbol rate of 5 MBaud (30 Mbps for 64-QAM and 40 Mbps for 256-QAM). The transmitted signal was generated using the Scientific-Atlanta D9470 64/256-QAM modulator. The modulator output was upconverted to a 749-MHz RF carrier frequency using production local oscillators and mixers (not laboratory-grade test equipment).

The 8600XDI-2 incorporates a low-cost production-grade tuner. The

*Continued on page 52*

*Continued from page 48, column 2*

pointing system faults. The robust 16-VSB acquisition also results in faster recovery of momentary disturbances that knock a QAM receiver totally out of lock.

***Figure 2:*** *CSO & white noise threshold*

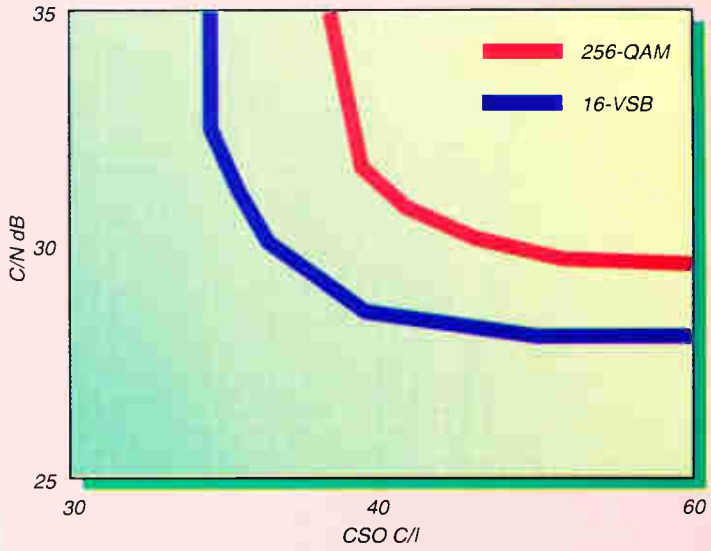
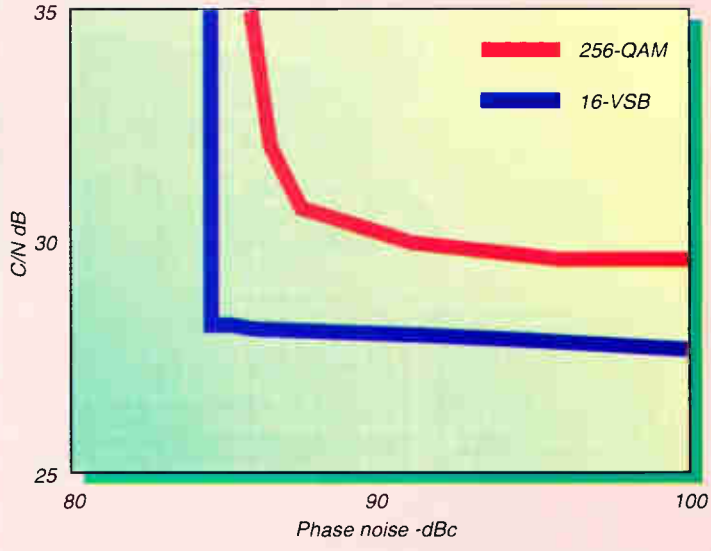



***Figure 3:*** *Phase noise & white noise threshold*



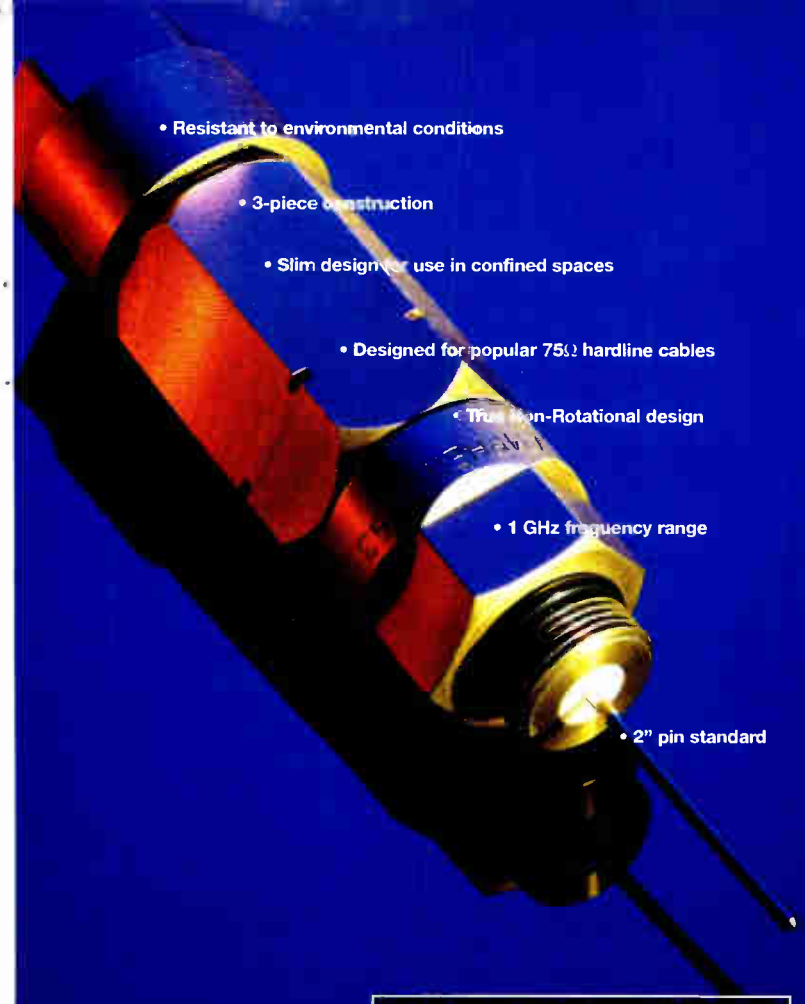

## Complexity comparison

Since cost is related to complexity, comparing relative complexities of 256-QAM and 16-VSB receivers reveals VSB cost-efficiency as well as design superiority.

✔ Tuner. The dominant characteristic of a tuner is its phase-noise contribution. Based on ACATS test results, tighter phase noise specs are required for 256-QAM than for 16-VSB. ACATS multiple impairment testing also showed that 256-QAM loses considerable CNR performance in the presence of phase noise. The superior 16-VSB performance is due to phase tracking by both the pilot PLL and a unique phase-tracking loop used in the 16-VSB receiver.

✔ Adaptive equalizer. The 16-VSB modem uses a symbol-spaced equalizer running at 10.7 MHz. All VSB testing has been conducted

*Continued on page 53*

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*Continued from page 50, Column 1*

FEC consists of a (204,188) Reed-Solomon code. The measured BER vs. CNR curves (with FEC) for 256-QAM are shown in Figure 1 (page 44). Performance is within 1 dB of theory at a $10^{-5}$ BER. Robust acquisition is achieved with multipath echoes as large as -2 dB relative to the desired signal. A sample spectrum is shown in Figure 2 (page 46). The corresponding 256-QAM constellations before and after equalization are shown in Figures 3 and 4 (page 50).

The robust performance of QAM in this test is significant when compared to VSB, because a notch such as the one shown in Figure 2 would severely impair or prevent VSB carrier acquisition if it were coincident with the pilot tone. Up to 17 dB of passband slope distortion can also be introduced without affecting acquisition performance. Modem synchronization occurs within 100 msec upon channel change even in severely distorted channels (-2 dB echo and 21 dB CNR). Carrier and clock loops can acquire synchronization with CNRs as low as 7 dB.

The QAMLink equalizer performs coefficient updating at the symbol rate (5 MHz), not at the line rate (60 Hz) as has been demonstrated in VSB prototypes. Thus, the equalizer can easily track rapid changes in the channel characteristics which could be caused by impedance mismatches from channel changes or on/off switches on secondary VCRs or TVs. Test data with the QAMLink receiver in 256-QAM mode have demonstrated its ability to dynamically track a 6 dB spectral notch (from a -10 dB echo introduced by a 50-foot cable stub) that is sweeping through the signal band at a rate of 240 MHz/sec.

Laboratory tests were also conducted using the Broadcom BCM93022 QAMLink demodulator in 64-QAM mode in conjunction with the General Instrument Commander VI 64-QAM modulator, transcoder and DigiCipher decoder. The DigiCipher FEC consists of a rate 14/15 trellis code concatenated with a (128,122) Reed-Solomon code. A General Instrument tuner was used as the receiver front-end with its output tapped off and fed into the QAMLink demodulator. The measured BER vs. CNR curves (with FEC) are shown in Figure 5. Performance is within 1 dB of theory at a $10^{-5}$ BER. General Instrument has adopted 64-QAM as the cable transmission format for the DigiCipher system.

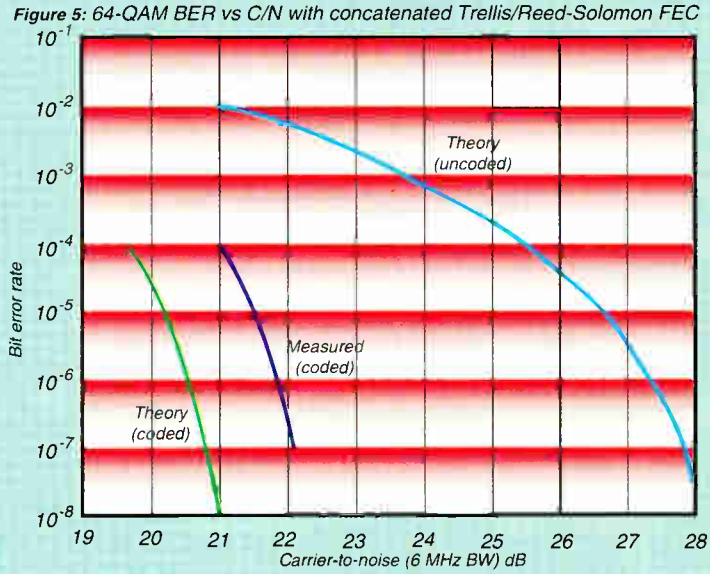
## HDTV compatibility issues

One of the advantages cited for using VSB for cable TV is its compatibility with HDTV. It has been claimed that a VSB receiver could be developed to work in both applications, thereby providing "cable ready HDTV." This claim is simply not true. VSB systems for HDTV and cable TV are inherently incompatible. VSB modems for terrestrial HDTV incorporate numerous design compromises to deal with the harsh broadcast transmission environment. Completely different coding schemes and equalizer complexities are required which are not compatible with the cable environment. Terrestrial VSB HDTV systems will require very long equalizers to combat multipath reflections and powerful forward error correction to combat co-channel interference.

Chip-level compatibility between terrestrial HDTV modems and cable-TV modems will never be cost effective no matter what modulation format is used. The multipath reflections in a cable network have delay spreads which are typically less than 1 microsecond, whereas the multipath reflections in a terrestrial broadcast environment have delay spreads of tens of microseconds. Thus, the equalization requirements for terrestrial HDTV are more than an order of magnitude more complex than for cable TV, and modem chip costs will be directly proportional to equalizer complexity.

Terrestrial HDTV systems also use powerful and complex concatenated trellis and Reed-Solomon codes to combat co-channel interference. In contrast, cable TV systems require much simpler forward error correction to combat short burst errors caused by impedance mismatches due to channel surfing or VCR/TV switches. As a result, a QAM modem for cable TV will be significantly lower cost than a VSB modem for terrestrial HDTV. This explains why five of the six members of the HDTV "Grand Alliance" presently have QAM cable TV transmission systems under development.

*Figure 5: 64-QAM BER vs C/N with concatenated Trellis/Reed-Solomon FEC*




## QAM cost and VLSI availability

QAM is a public-domain modulation technique requiring no license fees or royalty payments. QAM is a mature modem technology with a broad base of support. Numerous equipment vendors (AT&T, General Instrument, Hewlett-Packard and Scientific-Atlanta) have adopted QAM for their set-top boxes and numerous silicon manufacturers are developing QAM silicon solutions.

The Broadcom QAMLink 3-chip receiver has been available since 1993 and is beginning volume deployment in digital video field trials. A 256-QAM system based upon this solution was demonstrated by Scientific-Atlanta at the 1994 National Cable Television Association (NCTA) show last May. Production quantities of this low-cost QAMLink modem chip set are commercially available and shipping today.

Significant quantities of Scientific-Atlanta production digital set-top boxes incorporating QAMLink technology have been deployed in the field for both Time-Warner and US West in 1994, with several thousand more set-top boxes presently being manufactured for early 1995 deployment. The BCM3100 single-chip version of the QAMLink receiver was announced in November 1994 by Broadcom. Volume production will begin in January 1995. Purchase commitments for several hundred thousand BCM3100 QAMLink receiver chips have been made by the leading set-top box vendors for deployment beginning in early 1995. The BCM3023 single-chip QAM modulator for cable headends will also be in production by the end of 1994.

## Conclusion

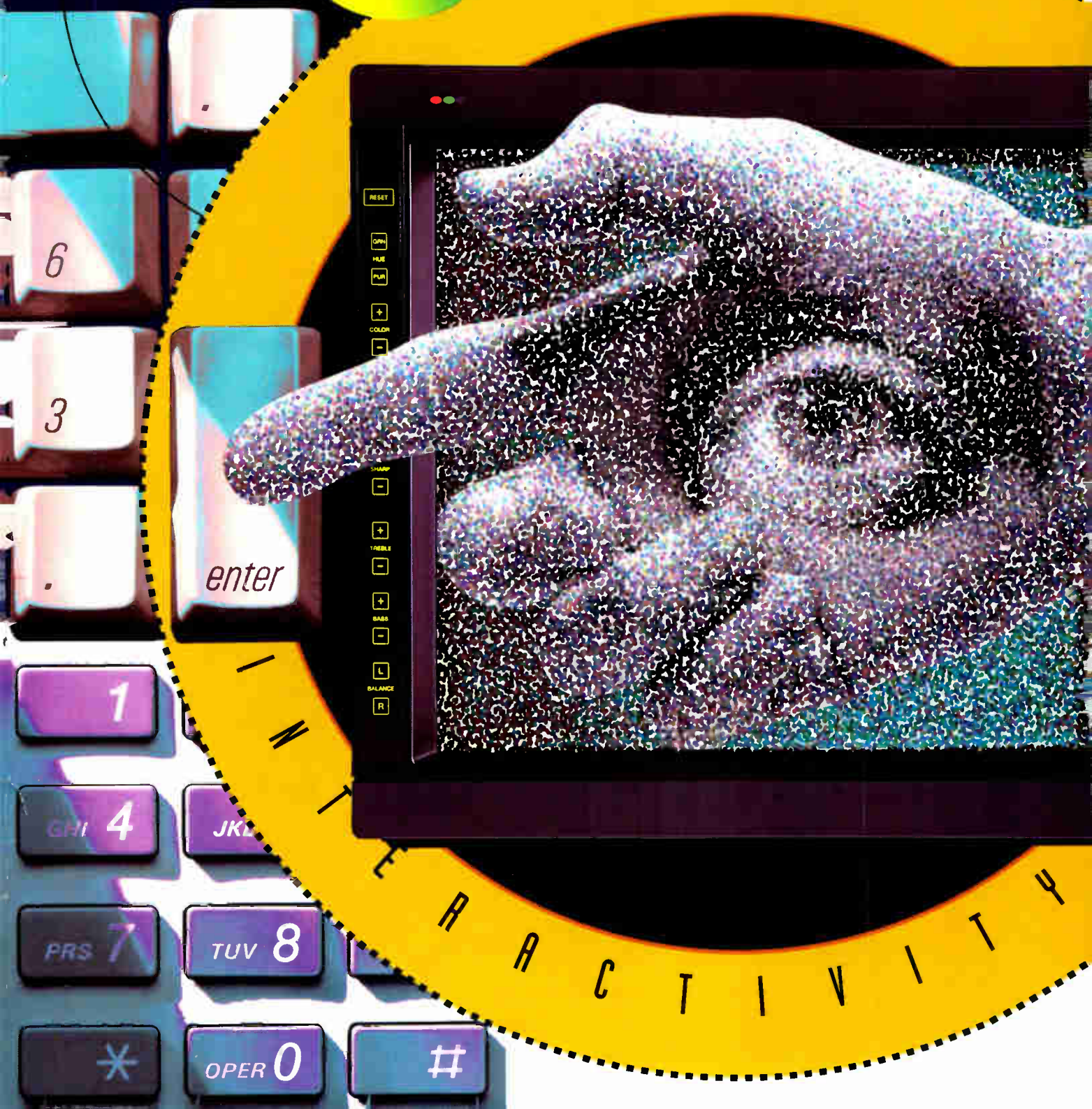
QAM is an open public domain modulation technique. Its performance has been demonstrated in production deployments, and it has been selected by virtually all major convertor box manufacturers. Low-cost silicon is available today. Based upon the technical performance, production readiness, and overwhelming industry support, QAM is the logical choice for digital cable TV transmission. CED

Broadband Connectivity Solutions from ADC Telecommunications.

Vol. #2 Fall 1994

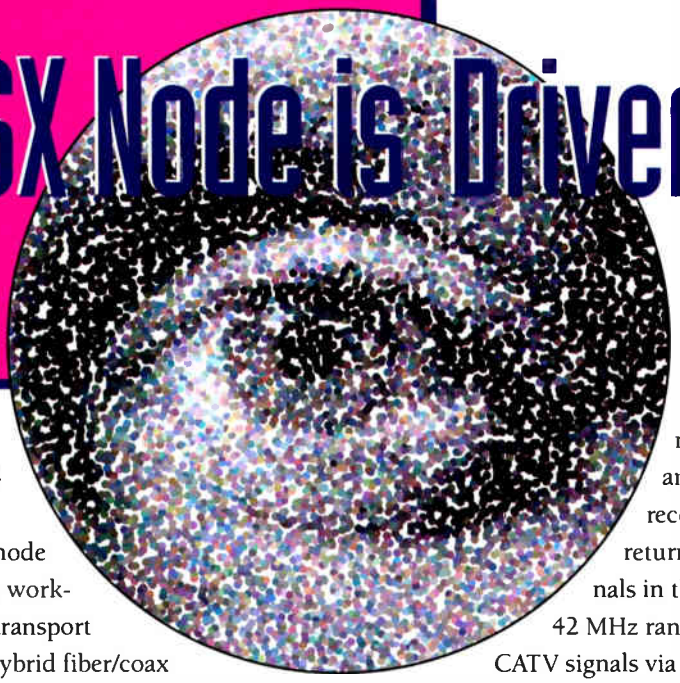
# The ADC Channel

## The new ISX node




INTERACTIVITY

# ISX Node is Driver in HFC System



An optical distribution node (ODN) is the workhorse of the transport system in a hybrid fiber/coax (HFC) architecture. The confluence of fiber-optic and coaxial distribution cables occurs in the ODN, which resides within the HFC distribution system at the point where optical trunk cables are terminated and traffic is converted into electrical signals carried over coaxial distribution cables.

ADC and its ALS subsidiary, proven suppliers of video/telephony HFC solutions, have developed an ODN known as the ISX node. It is an active device that functions as a bi-directional optical/RF signal converter and as an RF amplifier, and supports from 50 to 2,000 or more subscribers. The ISX node receives separate downstream optical video and optical telephony signals and converts them into a 50 to 750 MHz RF signal, which is passed to a preamplifier and then to a splitter that directs the signal into four ports. At each port, the RF signal is distributed to subscribers over a coaxial leg of the HFC system, with each leg carrying a particular set of DS0 telephony circuits.

The ISX node has a capacity of 672 non-concentrated DS0s, or 2,688 DS0s with the use of frequency shifting to decrease round-trip latency, support real-time video and provide the greater upstream bandwidth necessary for telephony. In the upstream direction, the ISX node's RF amplifier receives four return RF signals in the five to 42 MHz range, and CATV signals via coaxial distribution cables from set-top controls or other video equipment. The RF signals are frequency shifted (a feature not available in other ODNs), then passed to the upstream telephony transceiver and converted to an optical signal for output over a fiber-optic cable. If return path capacity is exhausted, the RF return signal can be frequency-shifted and stacked into the five to 200 MHz frequency range.

ADC has packaged the basic ISX node into a Video Services Node (VSN) cabinet that includes a complete fiber management system. The VSN cabinet is an aluminum enclosure housing the RF amplifier and power supply, as well as a variety of transmitters, receivers and status monitoring modules. Since the distribution architecture can vary significantly among HFC systems, the components used in different systems will also vary, and the coaxial distribution system may consist of either active or passive coax components.

The ISX node can support as much video capability as is required, from analog or broadcast CATV to digital video-on-demand or interactive channels, and is fully upgradable to telephony, supporting video-first, telephony-first or both. One coaxial cable can contain both CATV signals and power, and has the capacity to run telephony on the same line and in the same housing. The existing network is upgradable on a per-subscriber basis to support telephony services by adding a host digital terminal (HDT) at the service distribution hub and an integrated services unit (ISU) at the home. Telephony is fully protected, and the fiber-in-the-loop powering problem is eliminated by providing AC (60 VAC/60 Hz) power to the ISU over the coax service drop, as well as by battery backup.

Thanks to the ISX node's modularity and ability to handle upstream signaling to the headend, cable companies can easily diversify their offerings, adding services such as pay-per-view. Basic or interactive cable television or telephony can be deployed today while continuing to build a network infrastructure that supports tomorrow's broadband services.

Cable providers such as Cox Cable have already implemented an HFC architecture using the ISX node, and others are jumping on board every day. Even for those with no aspirations of eventually upgrading to telephony, the ISX node allows video to be provided that is clearer, crisper and faster than before, with the capacity to handle real-time video along with all of tomorrow's interactive video innovations that can't be planned for today.

# FAST Relief For Network Discomfort

Technicians can test any fiber in the network from any location. Since they don't have to be at the site of the problem, they can spend their time testing, not traveling.

As more messages traverse fiber-optic networks, the integrity of the network becomes critical. What was once the telephone network is now the phone-fax-email-video-data-what-have-you network, and even with redundancy and alternate routing, a fiber link failure can cause widespread pain, not to mention loss of revenue for the service provider. Fortunately, some of the same technology that makes the network possible allows technicians to diagnose its ills.

## A Brief History

Like many new technologies, fiber maintenance quickly became very demanding, requiring extensive (and expensive) training. The optical time domain reflectometer, or OTDR, is a good example. This device shoots pulsed laser light along a fiber and produces a reflected profile that a trained expert can usually interpret to identify the type and nature of damage to the line. Besides being difficult to use, OTDRs were bulky and expensive, which meant that there were never enough of them to go around. Each damaged fiber segment had to wait its turn for diagnosis, leaving service in limbo. Preventive service was more or less out of the question.

## Technology to the Rescue

The good news is that, once a technology has become sophisticated, you can turn your attention to making it easy to use, and that's exactly what ADC is doing for fiber maintenance. ADC's Frameworx™ Administration Software Tools (FAST) is a modular system of hardware and software that integrates with your growing network. One of the key components of FAST is the FiberWatch™ system, designed to simplify day-to-day maintenance.

Expensive OTDRs are replaced with Fiber Test Units (FTUs), which are permanently placed throughout the network and can be accessed remotely. Optical Test Access Units (OTAUs), also controlled from a remote location, allow each FTU to access up to 5,000 fiber cables.

## Software Makes the Expert

The biggest change is in the software driving the testing equipment. It is designed in easy-to-use modules with a graphical user interface. Instead of requiring a highly trained specialist, it allows technical generalists to test fibers and accurately interpret the results.

Once FTU and OTAU equipment is in place, technicians can test any fiber in the network from any location. Since they don't have to be at the site of the problem, they can spend their time testing, not traveling. The first people actually at the site will be a repair crew armed with the information and parts needed to restore service. Meanwhile, testing resources can then be turned to proactive testing, with scheduled preventive scans of the entire network and a special

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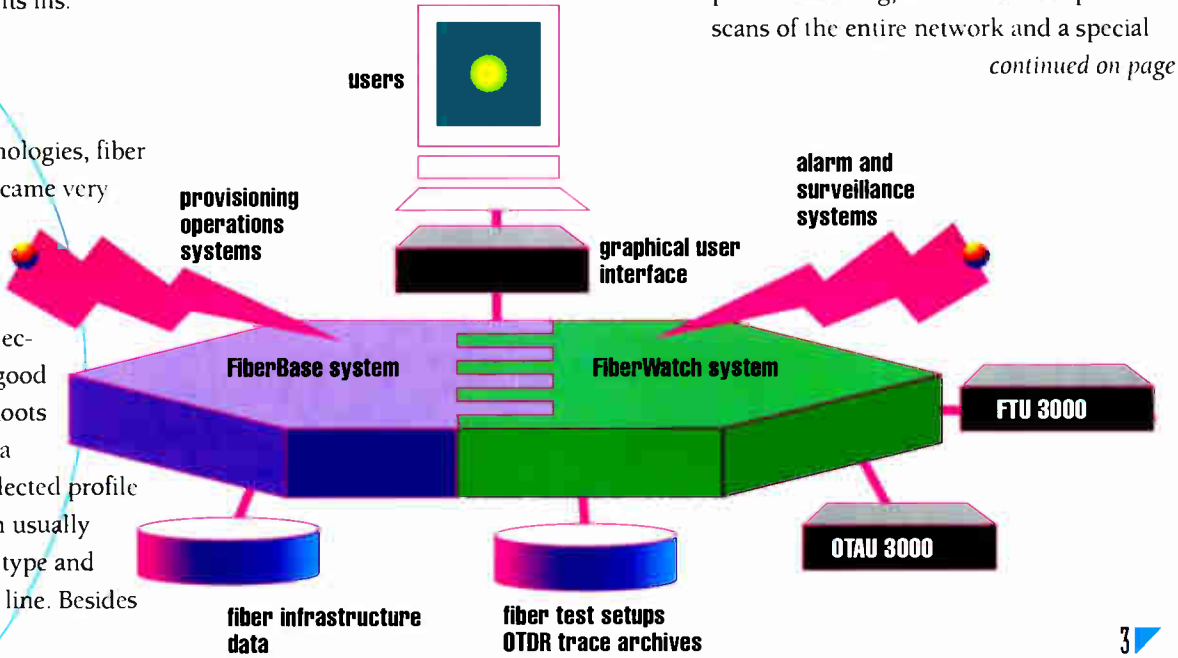


# Video Signal Management Adds to Network Flexibility

Developing breakthrough products that provide superior performance and deliver high quality video circuit management is part of ADC's commitment to offering a complete end-to-end transport system. Now available from ADC are several key products that will enable CATV providers to realize maximum video circuit flexibility and better manage video signals.

## AVIS Panels

Analog Video Interface System (AVIS) panels provide test and access points for transmission system outputs in hybrid fiber/coax (HFC) transport systems. Operating from the DC rate to up to 50 MHz of bandwidth, AVIS panels provide test capabilities on demand, giving you the option to test only when necessary, a practice that will ensure a quality signal and not deplete your budget. AVIS panels feature multiples of 16-circuit rear interface units and modular jack access cards for monitoring or patching video signals. AVIS panels also create a central interface point for testing and accessing video signals. Insertion loss, return loss and isolation are all compliant to the requirements of video transmission for video signal distribution.

## Splitter and Combiner Assemblies

ADC's high-performance splitter and combiner assemblies — which include the SC1016 and SC2008 — are equipped with 16 or 8 inputs respectively, and split and combine video signals from a range of 50 MHz up to 860 MHz of bandwidth.

## VJ2000 Video Jack

ADC's VJ2000 (patent pending) is the only jack test/access product designed to easily handle 50 to 1,000 MHz applications. The VJ2000 provides the capability to monitor video signals, as well as enables in-service cutovers for equipment upgrades and diverse routing such as patching around a single point of failure, which can occur in networks where equipment such as amplifiers are installed.

## ADC Splitter and Combiner Assemblies

| FEATURES | SC2008 | SC1016 |
|---|---|---|
| Splits/ Combines | 1 RF input to 8 RF outputs | 16 RF inputs to 1 RF output |
| Insertion Loss | <12dB with ±1 dB flatness | <16 dB with ± 1 dB flatness |
| Return Loss | >15 dB | >15 dB |
| Isolation | Nominal 22 dB | Nominal 22 dB |
| Characteristic Impedance | 75 Ohms | 75 Ohms |

## The End-to-End Video Transport Network

The DV6000™ transmission system, developed by ADC's subsidiary American Lightwave Systems (ALS), supports multiple video formats, performs drop-and-insert functions and carries as many as 16 channels of digitized, uncompressed video over fiber at up to 2.4 Gbps. At the remote headend, the output from the DV6000 system is fed through an AVIS panel, then through a modulator and into the Homeworx video subsystem, where the SC series of splitter/combiners and the VJ2000 video jacks are located.

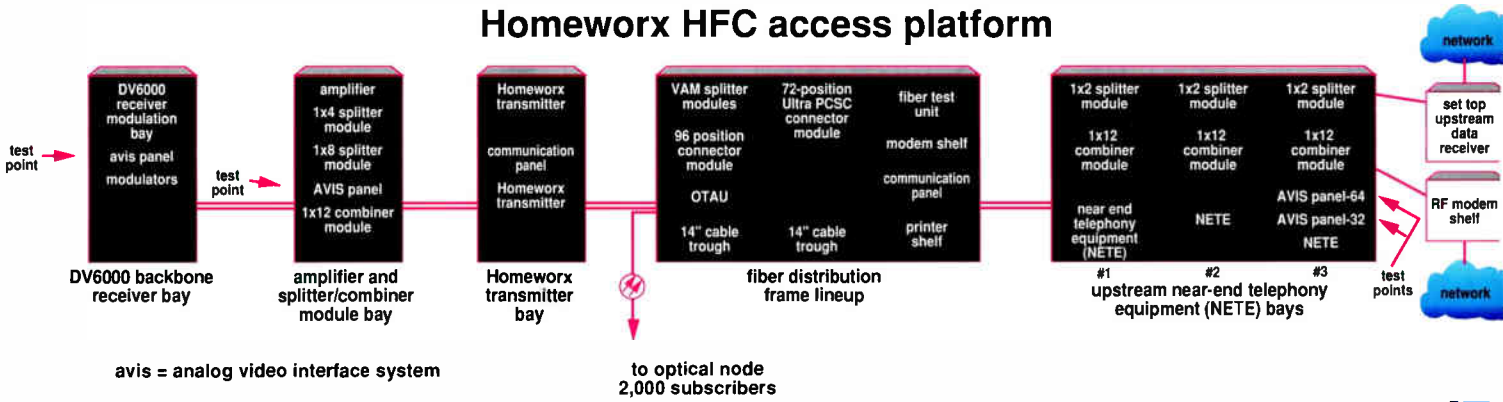
## Homeworx™ Access Platform

ADC's Homeworx access platform is a fully integrated access transport system with modular broadband video and telephony subsystems. Supporting both analog and digital services at variable rates, it can deliver broadcast, basic cable, premium and interactive video programming. It also allows CATV providers to add telephony services incrementally. Because the Homeworx platform was designed to balance costs with revenues, it enables CATV providers to generate revenues and invest in their network at the same time, rather than having to make a huge investment up front.

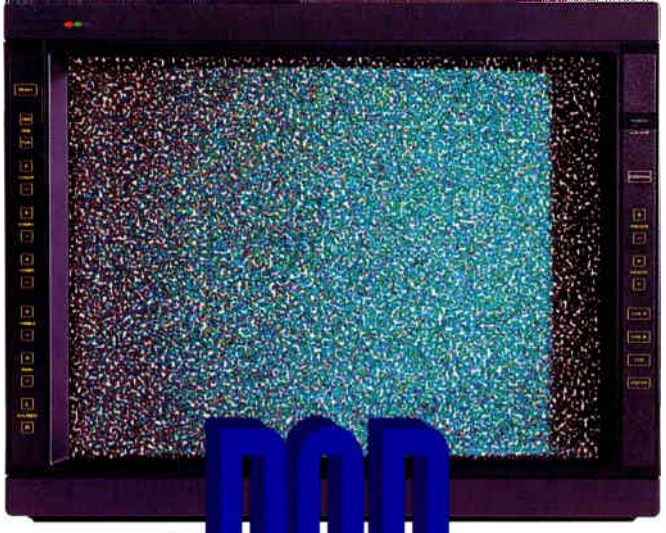
## Complete End-to-End Solution

By integrating the video transport capabilities of t e DV6000 system and the Homeworx : ccess platform with high quality, broadband connectivity solutions, ADC can be counted on as a dependable supplier for end-to-end video networking.

### Homeworx HFC access platform



Over the last several decades, the right to build cable networks and provide CATV services proved to be a very valuable franchise. Today, faced with competition ranging from direct broadcast technologies to the local video rental outlet, many cable providers are searching for new sources of revenue. Some are finding it in their existing networks.



# CABLE NETWORK GOES POP

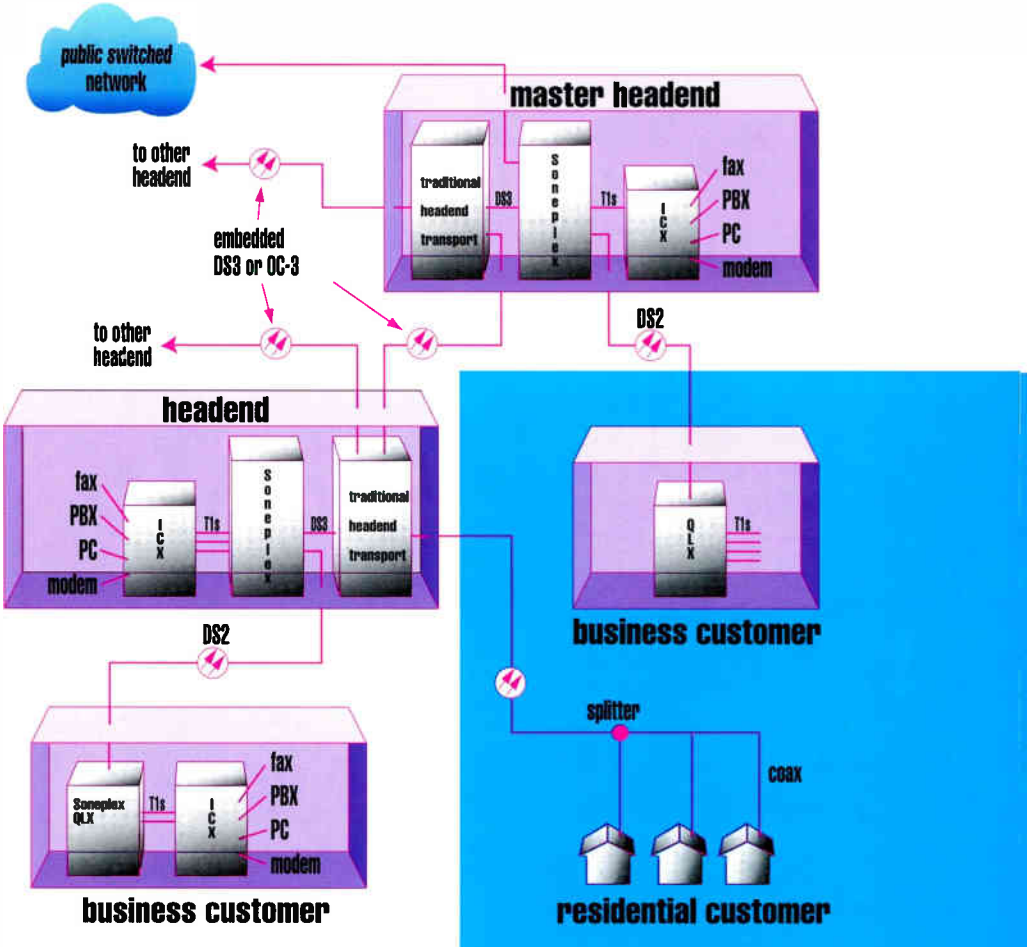
As data — anything from a half-page fax to a gigabyte upload — becomes more mobile, someone has to carry it. Interexchange carriers like Sprint, MCI, AT&T and Wiltel wage price wars over the long-haul portion of the transmission, but the local loop market is wide open. As cable operators build up their networks in anticipation of interactive services and video-on-demand, some are discovering that — contrary to conventional wisdom — the local telephone company does not have a monopoly in the local loop. It only seems that way because no one else has the entire area wired. In retrospect, however, it seems like somebody wired this whole area not too long ago...now, who was that?

## Competitive Access

When you dial a "1" to place a long distance call, you are directing that call to the local point-of-presence or POP, where it is transferred to the long distance facility of your choice. As data rates climb, local telcos often find their facilities strained, since large parts of their local network are still geared to relatively low-speed voice transmission. For business data, cable operators, with their broadband networks designed for the high data rates of video, actually have an advantage over the telcos. To business communications managers that's exciting news.

## The Access Market

If you've got the network, becoming a competitive access provider can be easy and lucrative. Best of all, the need to build an entire network just to play in the local access arena is a substantial barrier to *additional* competition.



## Access Made Easy

The biggest hurdle to be overcome by a competitive access provider is the jumble of data rates and protocols that must be merged for transport. Business users generate data with PCs, low speed terminals, modems, ISDN BRI, graphics and multimedia workstations, host computers, image processors, group III and IV fax machines, PBXs, video compression devices, LAN bridges and more. Traditionally, transmitting the resulting stew requires T1/E1 converters, DSUs, CSUs, channel banks, voice compression devices, subrate data multiplexers, frame relay switches, SMDS and ISDN multiplexers, synchronizers, and adapters. If that weren't daunting enough, the resulting transmissions are extremely inefficient, leaving lots of unused bandwidth between the rigidly formatted data streams.

ADC has a simple, effective solution: the ICX™ integrated communications access server. The ICX server is, essentially, a single box that handles the entire range of data formats performing the necessary conversions and packaging them neatly and efficiently for transport to the POP. Internally, it uses a client-server architecture, which places functions like inverse multiplexing, signal conversion, and frame relay switching on server cards. The "clients" are interface cards that can be internally switched to whichever server card offers the service needed for the traffic being handled at the moment. A non-blocking architecture keeps the process efficient, avoiding duplication of functions and achieving significant economies. The system is scalable from quite small to very large, allowing cost effective installation and easy growth. Redundancy is optional and sophisticated diagnostics are standard.

Once the traffic has been aggregated at the ICX server, it can be carried to the POP using ADC's Soneplex® access/transport platform. The Soneplex system interfaces with DS3, STS-1 and OC-3 facilities to provide safe, reliable and cost-effective transport. The ICX server and Soneplex platform provide the "missing link" between users' varied sub-T1 applications and the fiber network. Considering the expanding demand for data transport and limited competition in the marketplace, competitive access looks like the easy way to finance network expansion that otherwise might not start paying for itself for years.

FAST *continued from page 3*

focus on vulnerable areas. Many problems will be repaired before they impact customers or revenues.

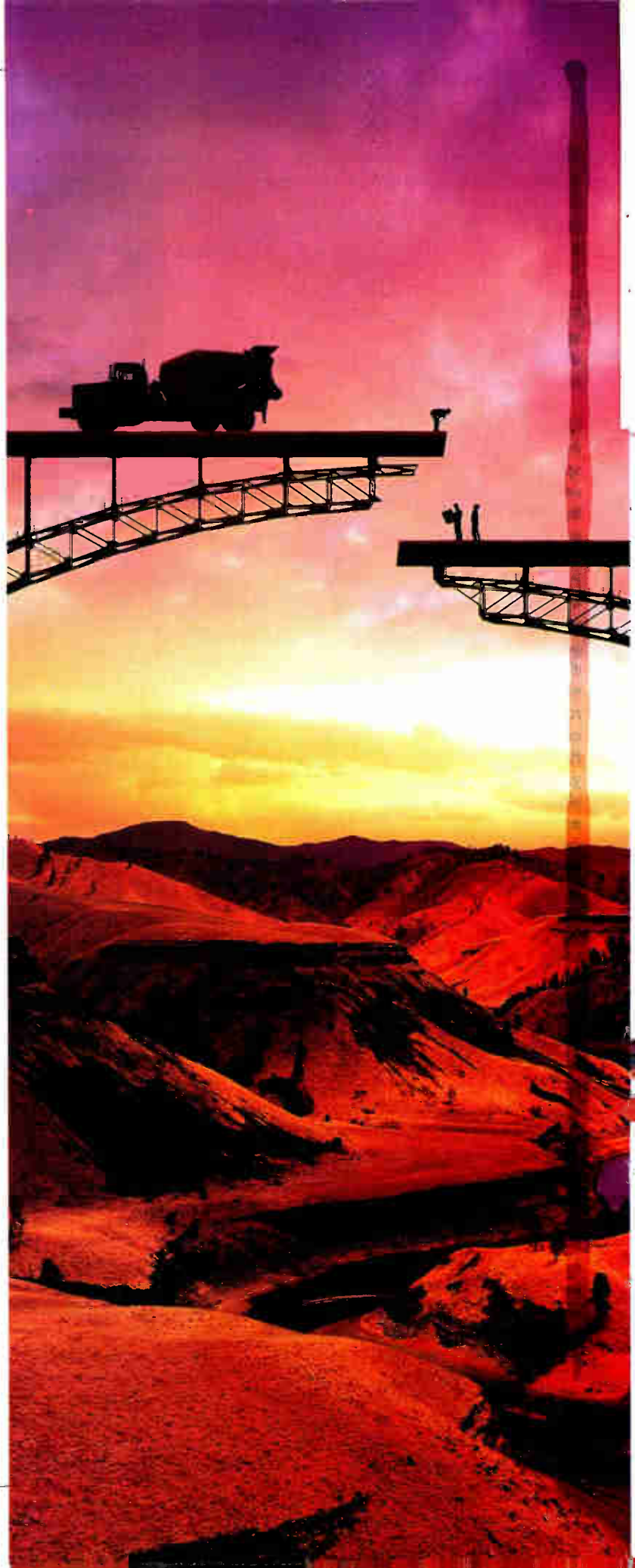
## Database Makes a Solid Foundation

The other critical component of fiber management is simply knowing what you have and where. Logically, this should precede testing, but in the real world, many existing networks have outstripped the provider's mapping and database capability. The first step is to install a system capable of keeping up.

The FiberBase™ system is ADC's database package, and the other major component of FAST. It is a sophisticated, relational database using a graphical user interface for easy access to enormous amounts of information. A client-server architecture keeps the entire system accessible, affordable, and able to sustain growth. The architecture of FAST is designed in compliance with industry standards, and for open interface to other systems.

The FiberBase system inventories fiber, connections, in-line equipment, frame layouts, and external landmarks. It is useful in planning, provisioning and repair, and can be started with newly installed equipment, with previously existing equipment entered as time allows. Like all of the components of FAST, FiberBase can stand alone or work with other systems. Every network has its own unique maintenance needs. FAST, with its powerful, modular design, can be tailored for a perfect fit.

# WOULD YOU BUILD A BRIDGE FROM SEPARATE ENDS WITHOUT PLANNING AHEAD?



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# Looking back on what was to be

## A few lessons learned

*By Roger Brown*

If there's anything we learned in 1994, it's that the interactive age won't come as fast as all the hype would have you believe, and that not all marriages are made in heaven.

The surprise merger between Bell Atlantic and TCI shook up the industry like no other announcement could. But when the Federal Communications Commission messed up the economics, the two sides split apart, to again become rivals. While that deal set the tone for 1994, it wasn't the only relationship that split apart. There was Southwestern Bell and Cox Cable, Bob Luff and Bell Atlantic, Hal Krisbergh and General Instrument, to name a few.

Other partnerships that got a lot of play in the press when they were announced have either quietly faded away or have so far failed to make any observable contribution to either new products or services. Whatever happened to the DSC Communications/GI alliance? What about Scientific-Atlanta and Kaleida Labs? Oracle has "allied" with everyone, but what does that mean?

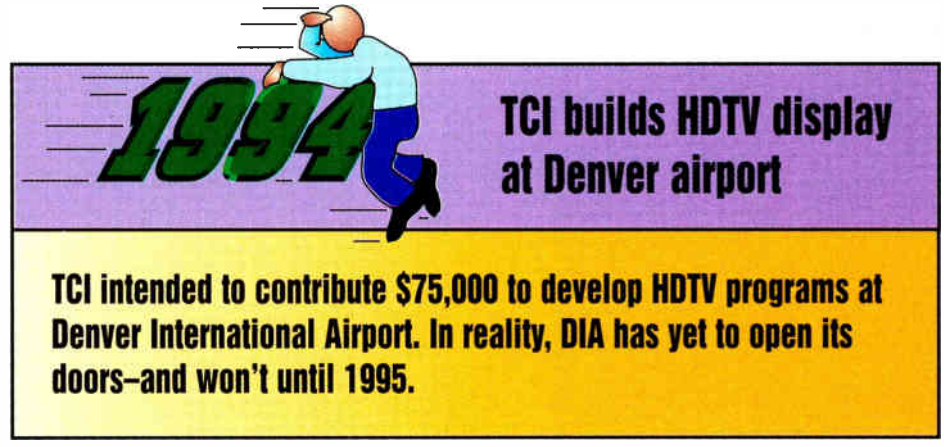
Still other alliances were rumored to occur and then never did. Remember the rumblings about S-A being sold to AT&T–or Northern Telecom–or one of several other manufacturing companies? At one point, Cablevision Systems was supposed to merge with GTE.

And yet there were some success stories. The US West/Time Warner deal (which actually occurred in 1993) is still holding, and both sides profess their satisfaction with the current arrangements. Jones Intercable and BCE, the parent company of Bell Canada, which also has its tentacles in Bell Northern Research and Northern Telecom, seem to be happy together. And Antec grew by buying up Electronic Systems Products, Power Guard, Keptel and Engineering Technologies Group.

After it became clear to the telephone companies that an outright purchase of the MSOs didn't make sense, they immediately went on the offensive. Pacific Bell announced it would spend zillions to overbuild the state of California; US West appears ready to take on TCI in its hometown (Denver) and some other big cities; Bell Atlantic will fight with Jones in Alexandria (the home of plenty of powerful politicians); and Ameritech plans to wire millions of homes in the Midwest for broadband capability.

Competition in the form of direct broadcast satellite service also finally came to fruition, and appears to have had an impact. Electronics stores can't keep the Thomson DSS system in stock, and DirecTv reached the 100,000 subscriber plateau in nothing flat. In response, Primestar Partners, the MSO-owned DBS provider, installed digital set-tops in an outrageously expensive upgrade that offers subscribers DigiCipher compression and lots of channels. Many more channels are promised in 1996, when Primestar goes to high-power satellites.

With that as a preamble, let's try to figure out what happened to some of the issues that have made news in the past year or so.




**Addressability.** Just a few years ago, it was starting to look like set-tops would disappear. Interdiction was touted by some as a way to become consumer-friendly. TVs were adding more and more features. Operators didn't want to buy all those expensive devices. Then along comes digital compression, re-regulation, competition and interactive services, and the set-top is back, smarter and more expensive than ever.

**ADSL.** This "interim" technology allows telephone companies to send video over copper twisted pairs. Actually, the quality isn't that bad; the only problem is, it's expensive, and few RBOCs appear willing to spend the money to buy it. Northern Telecom shut down its ADSL development program. But the rumblings continue about its possible use in some markets.

**ATS/Bull.** Touting an integrated solution to field service management and dispatch, the huge French company stormed after the cable industry. It apparently found that competition was fierce, because the company withdrew itself from the industry in the late summer.

**Compatibility.** After 10 years of squabbling between the NCTA and the EIA, both sides got down to work on settling their differences (because the FCC told them to). After some initial breakthroughs that warmed up the relationship, lately tempers have flared. Insiders say at least one consumer electronics company wants to undo all that's been done and start all over. FCC "deadlines" have come and gone, and still the issue drags on. "This thing will go on forever," says one who's close to the action.

**Digital technologies.** It seems like an eternity since John Malone said TCI would buy a million set-tops (it's been two years). Operators are getting antsy because of repeated delays (DigiCipher set-tops are now due sometime in late 1995) and they fear they're giving away any lead they had over the telcos. Some criticize General Instrument for not being fully compatible with MPEG-2, saying that's causing the delay. GI says that's not true, that set-tops are so complex that it's taking longer to design them than planned.

**EBS.** The FCC wants to upgrade the ancient emergency broadcast system and wants cable systems to take a more active role in notifying the public about impending life-

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threatening situations. The cable industry says it wants to be a good citizen, but doesn't want to foot the bill for a lot of bells and whistles. So far, the EBS ruling has been delayed at the FCC six times. A ruling was scheduled to happen the week this story was written.

**Eon.** The former TV Answer tried chumming up to cable operators as a method to get into interactivity quickly, but hasn't found any takers. The owner of patented broadcast technology also forged a relationship with Hewlett- Packard for set-tops, but H-P later withdrew. Then the company fired almost everyone and ousted its founder, who went off to form another rival company.

**Fiber optics.** The industry remains the fastest growing market for fiber optics, according to research done by Corning. Operators are often breaking networks down into 500-home nodes and serving them with 1310-nm fiber electronics. Now that MSOs are interested in shuttling signals long distances and even across traditional franchise area boundaries, 1550 nm equipment is experiencing new interest.

**Fiber patent suit.** Last winter, a few of the largest MSOs were contacted by a Florida law firm that asserted it held patent rights to delivering video over hybrid fiber/coax networks. Needless to say, a few people were up in arms. The NCTA got on the case, hired a patent attorney and advised MSOs not to capitulate. Since then, no one has heard from the group again.

**Galaxy I.** Without fanfare, Hughes Communications last March retired the first satellite that was dedicated to beaming cable programming to thousands of North American headends. Launched in June 1983, the bird was modeled after the "shopping center" marketing concept where cable systems could get all the programming they needed in one place. All 24 transponders were sold for the lifetime of the satellite–an unprecedented occurrence. The satellite is still drifting some 50 miles above the Earth, but it's out of fuel.

**HDTV.** Years ago, someone said, "HDTV is the next great revolution–and always will be." It's now the end of 1994 and the standards-making process is still grinding along. Field tests over broadcast stations and on a cable system took place in Charlotte, N.C., but evaluations continue. It'll probably be Christmas 1996 when it's a real product.

But now, the same broadcasters who saw HDTV as their savior just a few years ago want authorization to use the new spectrum they've been granted "flexibly." That means they want to hang on to their present spectrum and use digital compression to simulcast video, send one-way data or even get into PCS-like services.

The real question is: will consumers buy HDTV sets to get better quality pictures and the wide-screen look? Can broadcasters afford to switch to HDTV broadcasting?

A side note: TCI said last spring it would build an HDTV display at the new Denver International Airport to show how cable can offer that service. DIA still isn't open; TCI hasn't said when the display will be up and running.

**Intel.** The processor company has by no means disappeared, but it appears its view of the world is at loggerheads with General Instrument, its partner. Intel sees a future where the PC is the gateway to interactivity, while GI sees the TV filling that role. This must make for some interesting board-room discussions.

**Interactivity trials.** From Orlando to Omaha, network operators are finding it a real challenge to write software that can control an interactive broadband network. Even getting the piece parts from manufacturers isn't easy because their backlogs are getting lengthy. The software guys are all scratching their heads, wondering what the hullaballoo is all about–they say software releases are always later than advertised.

**Kaleida Labs.** The joint partnership between Apple and IBM started as a way to resolve the computer platform debate. Then S-A started working with them to build a set-top for the future. Then Kaleida lost its CEO and announced it was reducing its workforce. But insiders say the company isn't dead; it was supposed to make a major announcement with S-A at this year's Western Cable Show.

**MCI.** After making several public announcements that it was actively seeking cable partners to attack the local telephone market, the company gets shut out of the deal made by TCI, Comcast and Cox. Instead, Sprint is chosen. Insiders say MCI wanted too much in the deal, that it's brand name was worth more than the MSOs were willing to pay. But don't count the company out just yet–remember, it's doing a trial with Jones and S-A.

**Telephony over coax.** Like every other major trial announced this year, companies are finding it difficult to bring a suitable product to market in the timeframes they originally announced. GI and S-A both say they'll have product in mid-'95. ADC Telecommunications says the same thing. Tellabs and Motorola are trying to beat that date.

**Texscan.** After emerging from bankruptcy and after selling off many of its assets, some wondered what Texscan had left to offer. TCI discovered a lot of talent as well as another source of product. Consequently, TCI invested millions to keep the company going. Since then, TCI has renewed its effort to fund companies in which it sees potential.

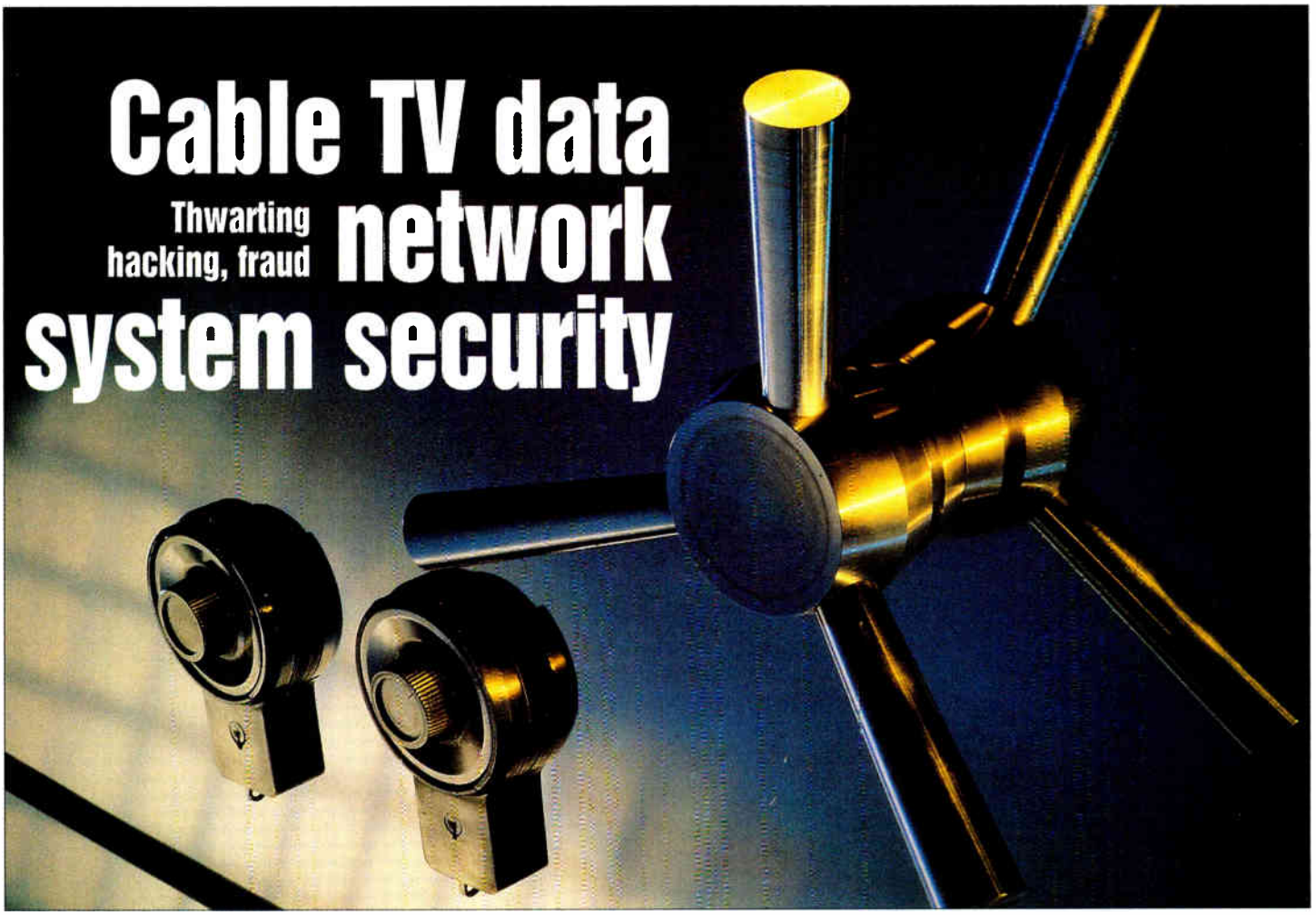
**Zenith.** Another company that rose from the ashes. After hiring Dean DeBiase and integrating its cable products division into the rest of the company, Zenith found renewed interest in its products. Since then, the company has re-invented itself through new products, including an RF modem and the "Media Access" digital set-top developed in conjunction with Philips Consumer Electronics and Compression Labs. The company also seems poised to reap the benefits of its multi-million dollar effort to develop an HDTV transmission system after its VSB modulation system was chosen as the North American standard. CED


**S-A plans to test video/phone solution**

**In fact, S-A may have run that test, but actual roll-out of telephony-over-coax systems won't occur until next year.**

# Cable TV data network system security

## Thwarting hacking, fraud



*By Stephen Holmes, Director of Sales, Network Systems, Zenith Electronics Corp.*

It has been demonstrated that the architecture of a cable TV system lends itself ideally to the transmission of digitized data. This is because, like a Local Area Network (LAN), the typical cable TV system can be configured as an immense data bus. As such, the cable TV data communications system can be designed to function identically to the LAN in an office, with all of the benefits of speed and no dial-up overhead (hence its appeal to work-at-home advocates). A concern with a cable TV-based data communications system is the security issue that must be addressed.

Absolute security on any communications system is an elusive goal. No real-world communications system can be expected to be 100 percent secure, given today's technology. Attesting to this are the recurrent breaches of the Internet, the most sophisticated network on the planet. The only absolutely secure communications system is one that no one can access! The purpose of this article is to explore the security issues on cable TV-based data communications systems and describe the methods to protect against system abuse.

To analyze the issues, a model of the Zenith Metropolitan Community Network (MCN) system was used. This is because the system is based on industry standard Ethernet, so the analysis parallels that of the typical office-based LAN. Also, the procedures and products used to provide security and detect security breaches on Ethernet LANs are based on standard techniques borrowed from the LAN data communications industry.

## Security issues

The security issues on any data communications system can be summarized as consisting of three distinct risks:

**Hacking:** The unauthorized access to network resources, usually mainframes or servers. Often, the intent is to steal information or cause mayhem.

**Eavesdropping:** To passively extract information from the cable as it is transmitted. The eavesdropper is usually after sensitive information such as trade secrets or incriminating information.

**Theft of service:** By attaching the appropriate modems to the system, it is possible that users could communicate with each other without permission.

Each of these risks can be analyzed, and once understood, the appropriate measures can be taken to minimize them.

## Hacking

Hacking is as prevalent a risk in telco and wireless systems as it can be on cable TV systems. One advantage cable TV enjoys, however, is that the system is not universally accessible. The access points to the system are geographically confined and relatively limited, compared to the telco system. Cable TV system access points are the coaxial taps installed and enabled by the cable TV company at each subscriber location. The access points are limited and known (there are no cable TV booths on the sidewalks).

A second advantage of a cable TV-based network, if it is based on the Ethernet LAN protocol, is that maintaining anonymity as a hacker becomes difficult. Each transmission on the network includes an Ethernet source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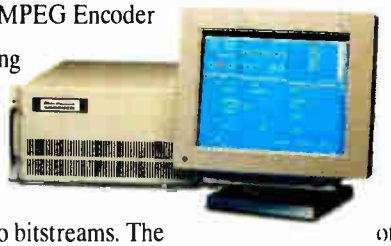

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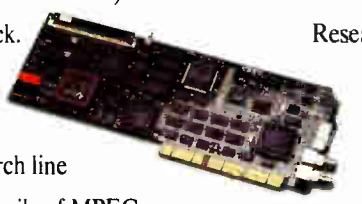

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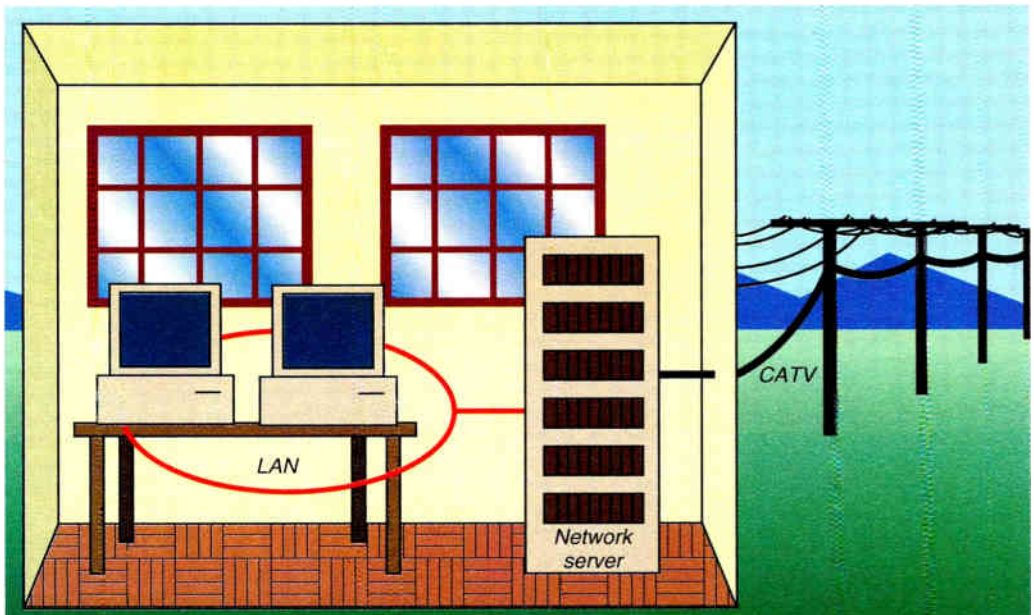


*Figure 2: At the point of ingress to a facility, a network server or some similar gateway device can block access by unauthorized CATV data users.*

address (SA), destination address (DA) and data payload (see Figure 1). The source address is unique to each user and can be used as a mechanism to indicate an unauthorized user on the network. Transmissions using this SA can be trapped, blocked or possibly traced.

Regardless of these mitigating circumstances, it should be anticipated that a person with ill intentions can and may wreak mayhem on any unprotected network, and appropriate precautionary measures should be taken.

## Eavesdropping

While eavesdropping is possible on telco systems, it's much easier to accomplish on cable TV and wireless systems because of the shared transmission medium (i.e., air or a coax bus). Unlike the telco system, the cable TV system has multiple points of shared access. These access points are the coaxial taps along any cable TV system trunk (i.e., all active cable subscribers). At each of these taps all transmission activity on the system can be detected.

**Unlike the telco system, the cable TV data network is a shared access bus, not a switched access network.**

This bus architecture poses a potential risk to secure communications. The practicality of eavesdropping needs to be considered, however. The expense and effort necessary to extract the RF carrier signal from the cable, demodulate the digital content and interpret the contents is significant. The only compelling reason to incur such an expense is the value of the communications on the system. It is doubtful that anyone would go to such an effort to listen to casual E-mail, distance learning transactions or consumer information services.

On the other hand, for sensitive transmissions involving passwords, business secrets or financial information, the desire to eavesdrop may be compelling, and the damage from eavesdropping can be significant to the user. Again, there are measures that can be taken to protect the network.

## Theft of service

Unlike the telco system, the cable TV data network is a shared access bus, not a switched access network. The advantages of speed, simplicity and cost as a shared data bus undermine the ability to totally control access. It is possible that users who acquire unauthorized modems could use these devices to communicate on the system. The damages associated with theft of service are that the network bandwidth is being used without compensation to the cable operator. Besides this loss of potential revenue, other users could see a degradation in the service response because of network congestion generated by the thief. This could lead to customer complaints.

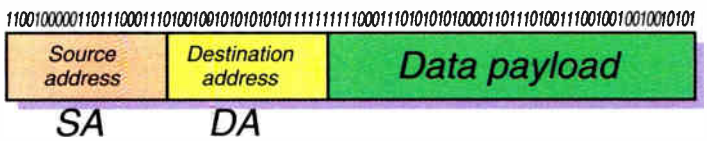


*Figure 1: The Ethernet data packet. The Source Address (SA) of the Ethernet packet can be used to make decisions on access to the network and can be used to indicate an unauthorized transmission.*

## Preventive methods

The above security issues need not prevent the implementation of a data communications system in any given franchise area. Once understood, these risks can be managed. Implementation today requires precautions if security breaches are to be kept to a minimum. Many of these precautionary measures rely on the attributes of the Ethernet LAN protocol, or else utilize methods established in the LAN environment by the Ethernet user community.

The incidence of hacking is of particular concern to institutions that wish to implement a work-at-home solution or as a multi-site backbone (i.e., schools, businesses or medical facilities).

Unauthorized access could be damaging. Actually, the potential for hacking over a cable network should be of less concern than on a telco-based system, because of the complexity of acquiring access to the cable TV network and the detection risk which would be taken by a hacker generating Ethernet packets on a closed cable TV system.

In any case, the same precautions should be taken as with a telco-based solution. At the point of ingress to each access site, a security gateway should be employed (see Figure 2). The only way through the gateway is through a series of passwords and security codes. These passwords and security codes should be unique to the cable TV data network. They should not be the same as passwords that the telco gateway would use.

Most network operating system vendors offer products to protect the LAN from unauthorized use. These same packages can be used on the cable TV LAN, as long as it adheres to a common LAN protocol such as Ethernet. For example, one system queries the user randomly from a database of personal data in order to verify the identity of the user so that access can be granted. At the same time, a user monitors activity under his password and is alarmed

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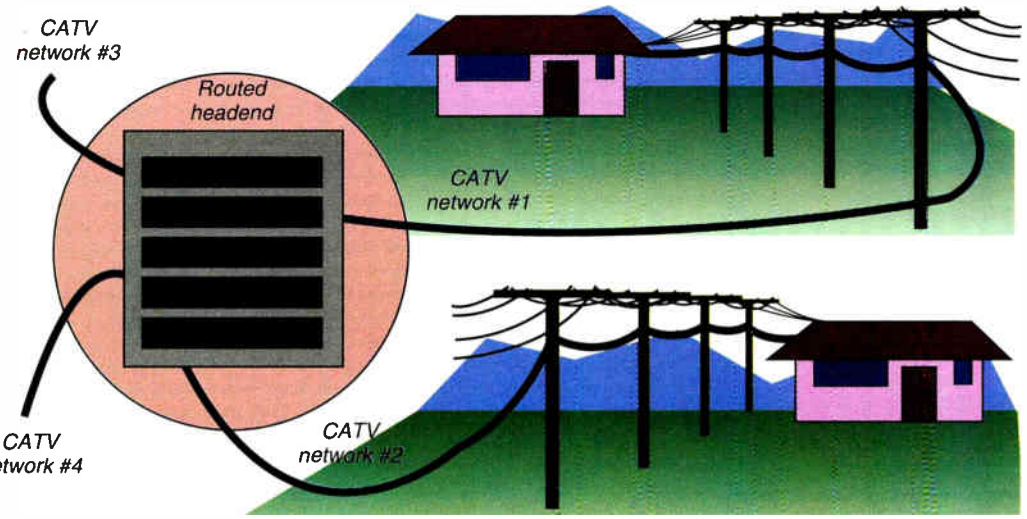



***Figure 3:*** *Treating each CATV trunk as a segmented network allows traffic to be controlled at the headend router. In this way, eavesdropping and theft of service exposure can be limited to a specific trunk, and hackers can be detected and blocked.*

if duplicate activity is present during his communications session.

## Eavesdropping prevention and control

In this system, each coaxial tap provides access to the network signal, and therefore, the traffic on the network could be passively extracted and interpreted. Actually doing so requires specialized knowledge of networking and relatively expensive equipment. The presence of a listener on the network would be difficult to detect.

Therefore, the cable TV system should take the following precautionary measures in order to limit the incidence of eavesdropping:

✔ All users should be made aware that this potential exists. In this way, the liability of the cable TV system is limited.

✔ All password-protected services should develop a secondary password scheme so that the passwords used on the cable TV system cannot be portable to some other access method like telco or a local LAN. For those users who wish to have secure communications, several encryption methods are available to scramble the data and reassemble it at its destination. Any commercial software or hardware encryption product which is compatible with Ethernet LANs is compatible with this network.

✔ It is recommended that cable TV subscribers be notified they will lose cable TV service connections if it is determined they are eavesdropping on the network.

✔ Finally, it's possible to limit the extent to which an eavesdropper can listen by configuring the cable system as several routed trunks rather than as one contiguous Ethernet bus (see Figure 3). By segmenting the trunks of the cable system in this way, an eavesdropper can only have access to communications on the trunk which he is physically connected to. Traffic would then be routed from trunk to trunk in the headend by standard Ethernet routing techniques.

## Theft of service prevention and control

The risk of theft of service cannot be totally eliminated. However, several precautionary considerations mitigate this risk.

First, the theft of service is made difficult by the complexity of acquiring a "rogue" modem and configuring it to the parameters of any given cable TV system (i.e., channel assignment tuning, power level adjustment and driver configuration). It is expected that the cable operator will maintain control over the distribution of these devices.

Second, assuming that a rogue modem is attached to the network, theft detection is a relatively simple procedure because of the nature of the Ethernet network protocol. Every Ethernet packet generated on the network has a Source Address (SA) associated with it. Any source address which has not been assigned specifically by the cable operator can be detected, trapped and decoded using standard LAN technology in the headend. In most cases, the content of the illegal messages will lead to the identity of the offender and will serve as evidence for prosecution. In the simplest situation, however, the operator needs only to use the remote management capacity of the standard SNMP control system to shut off the offending modem. This should be a standard capability of any cable TV-based interface device.

The potential effects from theft of service are further mitigated by configuring the cable system as several routed trunks rather than as one contiguous Ethernet bus. In this way, the communications from a rogue modem can be blocked from transmitting beyond the specific trunk on which it resides. The headend router will only route approved source addresses which have been programmed into its memory. This limits inter-trunk access, but does not limit intra-trunk access.

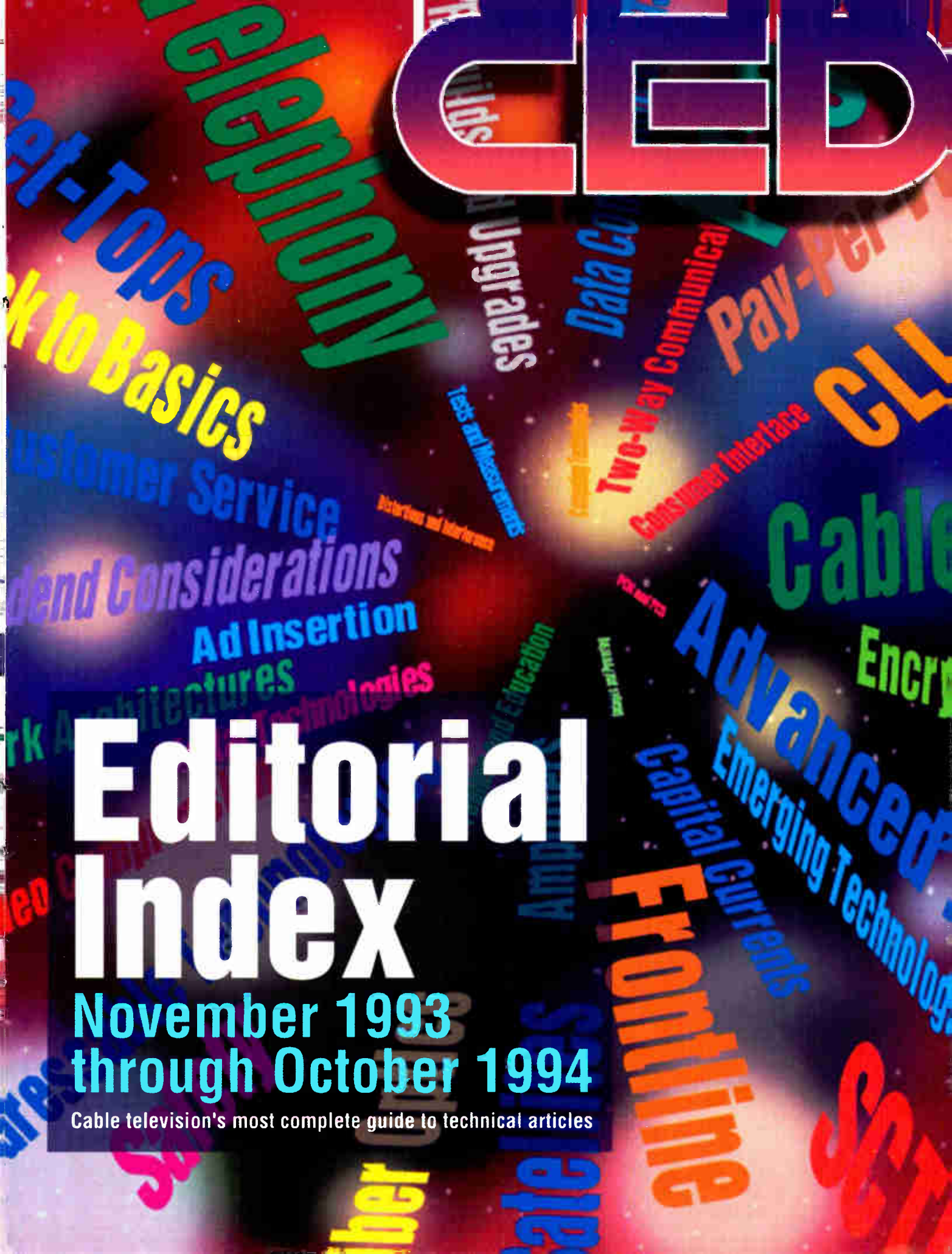
Theft of service is a crime. Most computer aficionados sophisticated enough to configure Ethernet modems understand that the transmissions they generate can be trapped, decoded and traced. This is not the situation on telco systems, where a criminal can anonymously communicate from anywhere to anywhere. This fact alone leads to the belief that theft of service incidents will be rare.

## Summary

There have been many proposals concerning the method for data communications on cable TV systems. This analysis of the security issues addresses only those systems where a standard protocol such as Ethernet is used. The common body of knowledge available in the standard LAN environment enables the cable TV industry to easily mitigate the security risks inherent in data communications systems.

Borrowing from the Ethernet LAN environment, password protection, security breach detection and access control can be implemented easily and cheaply using proven compatible third-party products. For those cable TV data communications systems that do not adhere to a common standard, it's incumbent on those suppliers to develop products and procedures to accomplish the same level of protection and control. This will most likely lead to costly, inflexible, non-standard solutions.

Regardless, it is becoming more common to see cable TV data communications systems in the mainstream of the communications industry as a competitive solution. Security need not be an issue in this situation, any more than it is in any other data communications system, as long as the risks are known and appropriate precautions are taken. The operator should, however, take the precaution of considering which strategy to implement before he embraces any specific cable TV-based data communications technology. CED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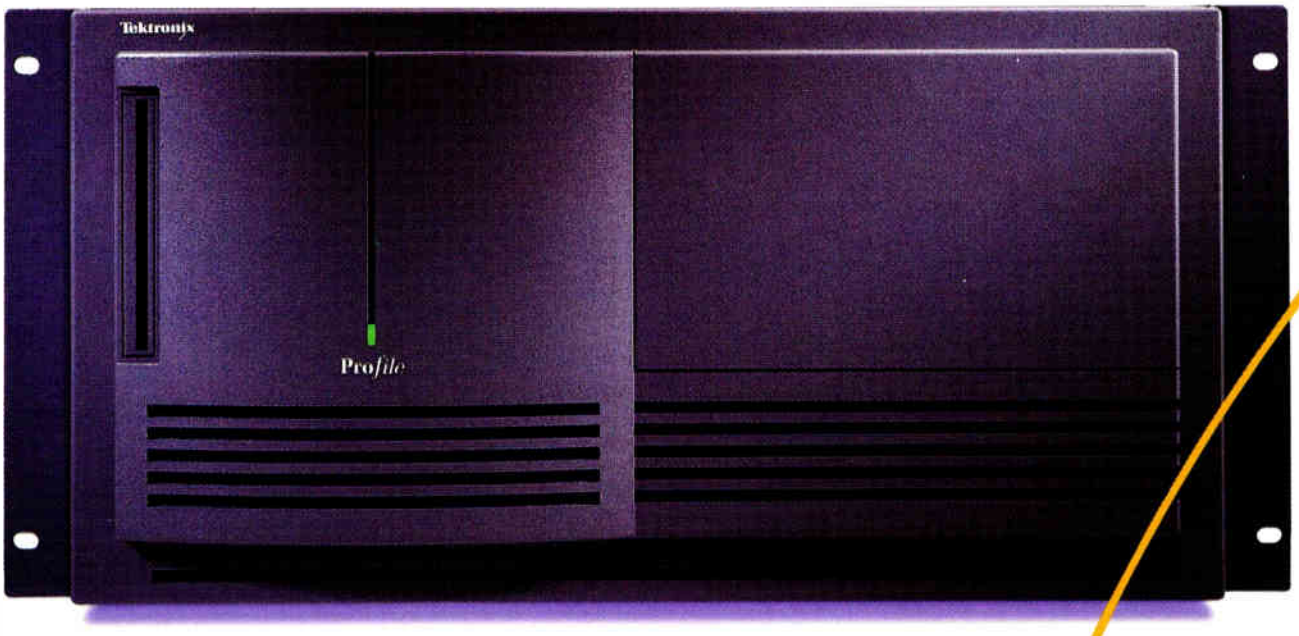


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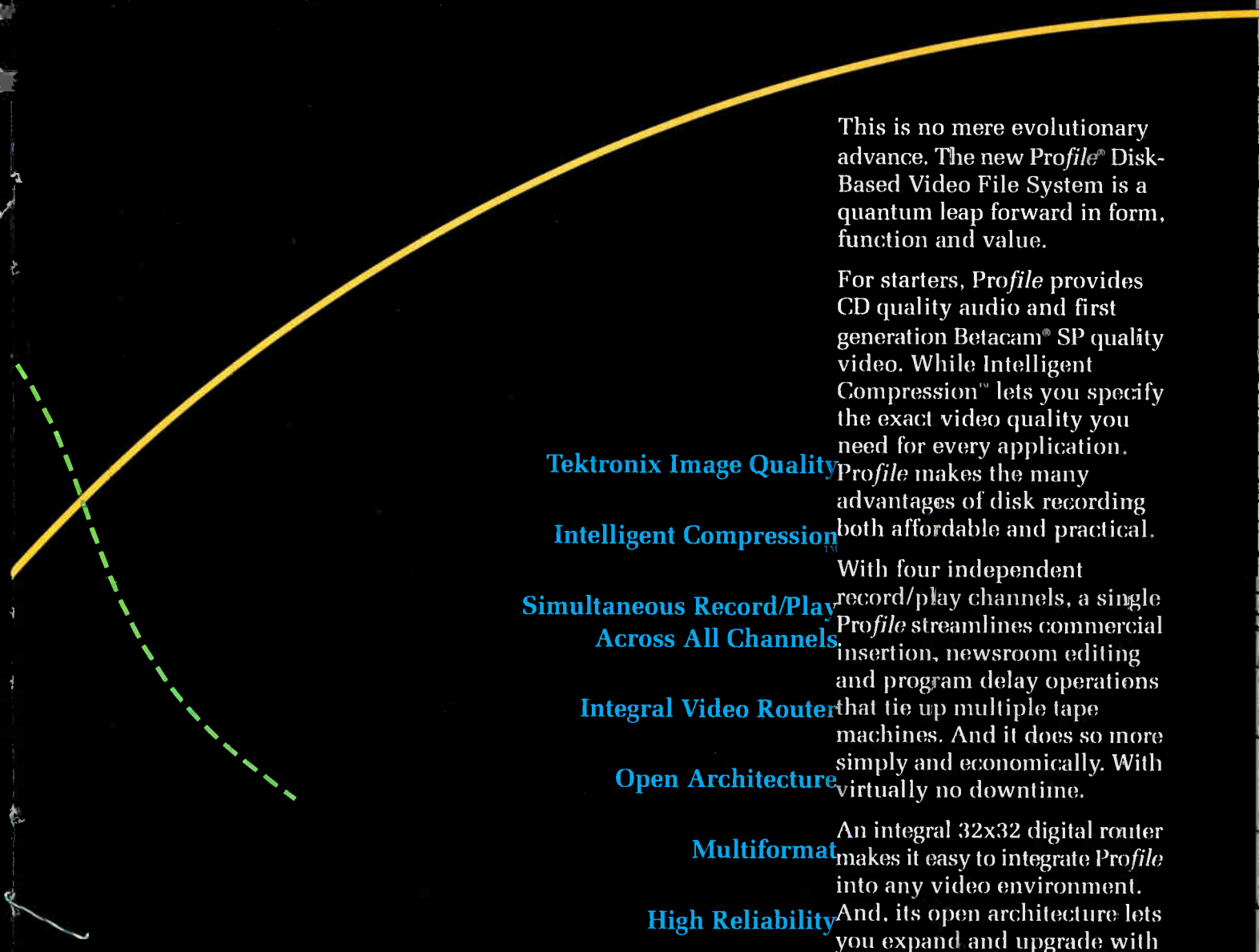

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## How to use this editorial index

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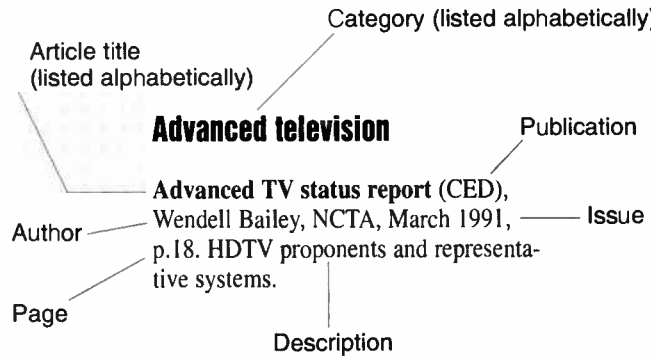
The index is divided into broad areas of interest, with articles that pertain to various subjects listed alphabetically below the heading. As shown in the diagram, the article title is printed in bold type, followed by the publication in which it appeared, the author of the article, the issue date and page number on which it starts. That is followed by a short description of the article's contents or theme.

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## Ad insertion

**Cox picks StarNet's digital ad gear in New Orleans** (MCN), by Linda Moss, 11/1/93, p.10. Cox wants to zone the New Orleans market.
**DEC adopts S-A MPEG for advertising insertion** (MCN), by Peter Lambert, 11/8/93, p.14. DEC will use S-A's MPEG compression technology in its SPOT System.
**SkyConnect expanding its digital offering** (MCN), by Peter Lambert and Linda Moss, 6/6/94, p.34. Media servers and satellite delivery are the backbone to this service.
**Vendors, operators attack advertising data issues** (MCN), by Leslie Ellis, 11/15/93, p.64. Review of an effort to establish a common protocol for transfer of advertising data.
**Video disks in cable television** (CED), by Jon Hazell, Paragon Cable, Dec. 1993, p.66. Tutorial in how to use and maintain video disk players for ad insertion and pay-per-view.
**Whither 3/4-inch tapes and players?** (CED), by Leslie Ellis, Dec. 1993, p.74. The growth of digital ad insertion systems and the need for a common protocol.

## Addressable technologies

**Addressability: Going up** (CV), by Chris Nolan, 6/20/94, p.42. The universe of addressable set-tops is expanding.
**Boxed in?** (CV), by Chris Nolan, 6/20/94, p.48. MSOs should be patient when it comes to those new digital set-tops.
**Building the compatibility elephant** (CED), by Wendell Bailey, NCTA, Nov. 1993, p.14. Review of the FCC Report on cable/consumer electronics compatibility.
**Can you top this?** (Conv), by Roger Brown, Sept. 1994, p.20. There's a new group of vendors interested in making set-tops.
**Compatibility compromise holding** (CED), Nov. 1993, p.10. News item on the EIA/NCTA compromise agreement on the consumer interface and the FCC Report.
**Full-featured set-top to debut in interactive trial** (CED), Nov. 1993, p.10. News item about Interaxx set-top trial in Coral Springs, Fla.
**A new way to interdict** (CV), by Chris Nolan, 6/20/94, p.49. Taking a look at providing two-way communication without expensive set-tops.
**Re-regulation and DBS fuel addressable surge** (MCN), by Peter Lambert, 1/10/94, p.3. Addressability grows in popularity.
**Simmons will make small town addressable with GI** (MCN), by Peter Lambert, 2/7/94, p.24. Simmons decides to make Madison, Ind. addressable and 750 MHz.
**Time Warner plans to buy 1M S-A boxes** (CED), April 1994, p.10. News item about Time Warner Cable purchasing up to 1 million analog set-tops over the next three years.

## Advanced television

**Breaking ATV out of the CRT bottleneck** (CED), by Fred Dawson, May 1994, p.49. What's happening with flat-panel displays for HDTV?
**Digital modulation tech showdowns near** (MCN), by Peter Lambert, 2/14/94, p.26. The HDTV tests begin comparing digital modulation schemes.
**Going digital** (CV), by Chris Nolan, 12/6/93, p.94. Stories about HDTV, ATM and compression.
**Grand Alliance makes key technology choices** (CED), Dec. 1993, p.12. News item on formal adoption of key components of HDTV standard.
**The Great Train Robbery of 1994** (CED), by Jeffrey Krauss, consultant, May 1994, p.22. The broadcasters want free spectrum, while others are expected to pay for it.
**HDTV fallout** (CV), by Chris Nolan, 8/22/94, p.14. Broadcasters don't want to send HDTV over the new spectrum they've been granted, but cable wants them to.
**HDTV standard could be here by end of '95** (MCN), by Leslie Ellis, 10/3/94, p.79. Field testing of HDTV over cable goes well, even in poor conditions.
**Pigs get fed; hogs get slaughtered** (CED), by Wendell Bailey, NCTA, May 1994, p.18. First, broadcasters say they have to have HDTV to survive. Now, they won't touch it.
**TCI builds HDTV display at Denver airport** (CED), May 1994, p.14. TCI promises to build an HDTV display at Denver's new airport (but the airport hasn't opened yet).
**Zenith's technology chosen for HDTV** (CED), April 1994, p.8. News item that Grand Alliance has chosen VSB digital transmission technology for advanced TV.

## Back to Basics

**Aural carrier center frequency measurement** (CED), by Steve Johnson, Time Warner Cable, June 1994, p.68. Explanation of how to perform the aural carrier test and why it should be performed.
**Back to basics: color distortions** (CED), by Chris Bowick, Jones Intercable, June 1994, p.24. Detailed discussion of the color tests that will be required by the FCC in 1995.
**History of the vestigial sideband** (CED), by Archer Taylor, Malarkey-Taylor Assoc., Dec. 1993, p.38. A basic tutorial on the vestigial sideband and group delay errors.
**In-band frequency response measurements** (CED), by David Large, Media Connections Group, August 1994, p.54. How and why to do these tests.
**Measuring cable system distortion** (CED), by Bill Morgan, CaLan, October 1994, p.72. Details on how to measure distortions.
**Preparing for in-service video measurements** (CED), by Francis Edgington, Hewlett-Packard, June 1994, p.94. Things to think about to prepare for the color tests that have to be performed next year.
**A quick look at hum** (CED), by Leslie Read, Sammons Communications, July 1994, p.78. How and why to test for hum.
**Tutorial on signal leakage and calibration** (CED), by Gregg Rodgers, Trilithic Inc., May 1994, p.60. How to test for signal leakage and why it's important.

## CableLabs

**ATM and MPEG protocol issues concern CableLabs officials** (CED), Sept. 1994, p.26. The importance of interoperability between ATM and MPEG standard protocols.
**ATM's cost, missing features worry designers of full service network** (CED), by CableLabs, Jan. 1994, p.22. There are some unresolved problems with the ATM standard.
**Cable likes ATM, but isn't ready to tie the knot** (MCN), 12/13/93, p.56. Courtship with ATM is going well, but there's not a marriage yet because there's a big leap that has to be made.
**CableLabs heartened by telecom RFI responses** (CED), May 1994, p.24. More than 50 responses came in to the RFI on cable getting into telephony.
**CableLabs issues $2 billion RFP; MSOs proclaim industry unification** (CED), Sept. 1994, p.10. The industry stands ready to spend money on technology for telephony.
**CableLabs issues RFI; plans to test QAM** (CED), July 1994, p.16. News item noting that CableLabs has issued an RFI on digital video servers and plans to work with vendors to test digital modulation schemes.
**CableLabs issues telecommunications RFI** (MCN), by Peter Lambert, 1/31/94, p.29. Operators seek info on how to enter the telecom market.
**CableLabs leads industry into NII initiative via XIWT** (CED), Feb. 1994, p.12. News item on CableLabs joining the Cross-Industry Working Team laboring to define the architecture and requirements of the National

Information Infrastructure.

**CableLabs plans compression test lab** (CED), April 1994, p.8. News item that CableLabs will open a test facility to verify interoperability of MPEG-2 compression systems.

**CableLabs plans to add 9 new key personnel** (CED), Feb. 1994, p.12. CableLabs grows in importance and size. News item.

**CableLabs undertakes MPEG rights project** (CED), June 1994, p.16. To help spur adoption of MPEG standards, CableLabs attempts to provide access to intellectual property rights issues.

**CableLabs will build MPEG-2 test facility** (MCN), by Peter Lambert, 2/28/94, p.6. CableLabs wants to speed the MPEG process and will test systems.

**CableNet '93: CableLabs' pieces of a dream** (MCN), by Peter Lambert, 11/29/93, p.116. An explanation of what CableNet is and why it's important.

**MSOs may commit $2B to telephony** (MCN), by Leslie Ellis, 8/1/94, p.1. The CableLabs RFP on telecom promises a $2 billion expenditure.

**The standard quest** (CV), by Chris Nolan, 8/8/94, p.20. CableLabs asks patent holders to think about licensing their technology.

## Capital Currents

*(Capital Currents is a monthly CED column written by Jeffrey Krauss, consultant.)*

**AT&T declares war on cable TV**, March 1994, p.20. AT&T's Bob Kavner blasts the cable industry for "gatekeeping."

**The channel 19 problem**, Dec. 1993, p.20. The issue of signal leakage and interference on channel 19.

**It's decision time for PCS**, Nov. 1993, p.18. Explanation of how the spectrum is being carved up for PCS use.

**FCC controls remote controls**, August 1994, p.18. Regulation prohibiting changes to IR remotes will stifle technological change.

**The future of scrambling**, Jan. 1994, p.18. Expect a major battle between cable TV and consumer electronics industries.

**The Great Train Robbery of 1994**, May 1994, p.22. The broadcasters want free spectrum, while others are expected to pay for it.

**The radio spectrum: what's up there?** June 1994, p.146. A look at the frequency allocation table and who occupies what space.

**Security and the NII**, Sept. 1994, p.24. Tutorial on the types of security that exist.

**Telephone service on a cable system**, Feb. 1994, p.20. How to share cable's bandwidth over a multitude of users.

**What is privacy anyway?** April 1994, p.18. Are private communications really private? Maybe, maybe not.

## Competing technologies

**A $16.4 million "Cadillac"** (CV), by Chris Nolan, 8/8/94, p.46. Bell Atlantic peioneers its first video dialtone project in New Jersey.

**ADSL put on shelf by Northern Telecom** (CED), July 1994, p.16. News item that NT has abandoned work on ADSL products–at least until someone is ready to buy some product.

**Alliance formed to foster wireless digital technology** (CED), August 1994, p.8. News item about the formation of the Wireless Cable Digital Alliance, an R&D group consisting of Zenith, Microwave Filter, Emcee, California Amplifier and Andrew.

**Ameritech ready to rock 'n' roll** (MCN), by Fred Dawson, 12/20/93, p.1. The RBOC prepares to announce its plans to roll out video in its territory.

**Battle of the broadbands** (CV), by Tom Kerver, 2/7/94, p.22. Comparison of how US West and Cox will attack the Omaha market head-to-head.

**Bell Atlantic chooses set-top box vendors** (CED), March 1994, p.12. News item that Bell Atlantic has chosen IBM, Philips/Compression Labs and DiviCom/Microware/Eurodec to supply set-tops for the interactive TV trials.

**Bell Atlantic, SWBell select vendors** (CED), July 1994, p.14. News item detailing the vendors each RBOC has chosen to use for their full service network trials.

**BellSouth spells out Atlanta-area technical tests** (MCN), by Leslie Ellis, 7/25/94, p.89. How this RBOC will deliver interactive multimedia.

**Competition brings new challenges, growth** (CED), by Wendell Bailey, NCTA, March 1994, p.16. What impact will the RBOC investments in cable TV have on the business?

**Compression, financing strengthen MMDS industry** (CED), by Leslie Ellis, March 1994, p.38. How the "wireless cable" operators are posturing to get more subscribers and be bigger players.

**Connecticut telco plans a $4.5B deployment of broadband nets** (MCN), by Fred Dawson, 1/17/94, p.2. Southern New England Telephone announces its upgrade plans.

**Direct Broadcast Satellite: Cable's worst nightmare?** (CED), by Leslie Ellis, March 1994, p.28. Detailed article on DirecTv service and how it works.

**DirecTv opens $100M DBS center; TCI, Bell Atlantic cut ribbons too.** (CED), May 1994, p.12. News coverage of three separate facilities related to digital compression and distribution of programming.

**FiberVision gets nod on Hartford overbuild** (CED), March 1994, p.12. News item that FiberVision was given permission to build a 750-MHz system in six Connecticut towns around Hartford.

**FiberVision seeks permission to overbuild Connecticut operators** (CED), Nov. 1993, p.8. News item showing FiberVision's network architecture and plans to build in Bridgeport, New Haven and New Britain.

**GTE selects ADC; ADC adopts VSB** (CED), March 1994, p.10. News item about GTE offering an integrated voice, video and data service. Also mentions that ADC will integrate Zenith VSB digital modulation into its products.

**Hughes officially opens DirecTv center in Castle Rock** (MCN), by Peter Lambert, 4/11/94, p.30. The ribbon is cut on the DBS operations center.

**Innovative technology tests running side-by-side** (CED), by Roger Brown, March 1994, p.33. A look at Omaha and the networks being built there by Cox Cable and US West.

**Integrated cablephone network given official sanction** (CED), by Fred Dawson, Jan. 1994, p.56. Pacific Bell believes the cable TV "hybrid fiber/coax" network is the platform it needs for future services.

**Lillis: The US West, Time Warner plan** (MCN), 2/21/94, p.1. Q&A with Chuck Lillis, chief planning officer of US West.

**Marching to a different drummer** (CV), by Chris Nolan, 9/5/94, p.18. Rochester Telephone opens its network to anyone who wants a slice.

**MCI plans to compete with LECs, will seek help from cable MSOs** (CED), Feb. 1994, p.10. News item on MCI's strategy for entering the local access market through MCI Metro.

**The narrowband alternative** (CED), by Alan Stewart, consultant, April 1994, p.38. How the telcos plan to deliver video over their networks.

**Nynex, PacTel prepare major broadband roll-out** (MCN), by Fred Dawson, 11/15/93, p.1. The two companies announce plans to support voice, video and data to 11 million homes by 2000.

**PacBell plans broadband upgrade; interactive TV tests next on agenda** (CED), March 1994, p.10. News item about PacBell's $16 million upgrade to broadband via the hybrid fiber/coax architecture.

**Ringing the Bell in Texas** (CV), by Tom

Kerver, 4/25/94, p.18. Southwestern Bell plans to roll out video service in Richardson.
**Telco vs CATV battles: A review** (CED), by Archer Taylor, Malarkey-Taylor Assoc., Feb. 1994, p.90. The telephone companies and cable have a long history of confrontation.
**Telcos rush headlong into video** (CED), by Roger Brown and Leslie Ellis, April 1994, p.24. Details of the video deployment strategy by all the RBOCs and GTE.
**"Total solutions" approach important for MSOs, LECs** (CED), by Kent Takeda, AT&T Network Systems, May 1994, p.28. Things to keep in mind as interactive networks are being built.
**US West to file additional dial tone applications** (MCN), by Peter Lambert, 1/3/94, p.25. US West plans filing to launch video services in 14 states.
**Utility power** (CV), by Mitch Shapiro, 6/20/94, p.32. Do utilities want to get into voice and video delivery? What benefits would they bring? Will they be cable's friend or foe?
**Windstar testing wireless transmission at 38 GHz** (MCN), by Fred Dawson, 10/3/94, p.88. Several companies test the new technology.
**Wireless plugs into interactivity** (CV), by Tom Kerver, 1/10/94, p.33. Wireless industry begins to assert itself, led by Videotron in Canada.

## Construction issues

**Component shortage may stall many rebuilds** (MCN), by Leslie Ellis, 2/21/94, p.47. Operators may be forced to hurry up and wait as equipment suppliers ramp up.
**Market forces squeeze broadband equipment suppliers** (CED), by Leslie Ellis and Roger Brown, March 1994, p.50. The cable equipment manufacturers are enjoying good times. How can an operator get his gear when he needs it?
**MSO spending heavy despite unsavory environment** (CED), by Leslie Ellis, May 1994, p.37. Cable operators will spend $4.5 billion in rebuilds and upgrades in 1994, according to a CED survey of MSOs.
**Operators prepare for the face-off** (CED), by Roger Brown, October 1994, p.30. An examination of what cable operators are building and how fast they're doing it.
**Prime plans fast-track digital project in Houston** (MCN), by Peter Lambert, 2/21/94, p.47. Prime Cable in Houston decides on 550 MHz, with compressed video.
**Toward a more perfect union** (CED), by Dana Cervenka, October 1994, p.34. How to forge a good relationship with contractors.

## Consumer interface

**Apple integrates computer with TV, CD audio systems** (CED), Dec. 1993, p.12. News item on the new Apple computer that doubles as a TV set and a CD-ROM stereo system.
**Building the compatibility elephant** (CED), by Wendell Bailey, NCTA, Nov. 1993, p.14. Review of the FCC Report on cable/consumer electronics compatibility.
**Cable, EIA race to meet compatibility deadline** (MCN), by Leslie Ellis, 1/17/94, p.25. Comments about the progress made on compatibility issues.
**Compatibility compromise holding** (CED), Nov. 1993, p.10. News item on the EIA/NCTA compromise agreement on the consumer interface and the FCC Report.
**Compatibility effort winds down, decoder interface still iffy** (CED), Sept. 1994, p.10. News item about input on the proposed decoder interface.
**The consumer electronics bus, part 2** (CED), by Jud Hofmann, Panasonic Technologies, Nov. 1993, p.38. Explanation of the cable and business applications of CEBus and how to adapt products to work with the coaxial bus.
**Current standards activity affecting cable** (CED), by Joseph Glaab, General Instrument, May 1994, p.42. A rundown of EIA standards that will have an effect on cable systems.
**Digitally incompatible** (CV), by Chris Nolan, 4/25/94, p.16. There are worries that the incompatibilities from the analog world will spill into the digital world.
**FCC controls remote controls** (CED), by Jeffrey Krauss, consultant, August 1994, p.18. Regulation prohibiting changes to IR remotes will stifle technological change.
**FCC issues NPRM on electronics compatibility** (CED), Jan. 1994, p.10. The NPRM on consumer compatibility contained few surprises for cable operators.
**FCC issues rules on compatibility** (MCN), by Jeannine Aversa, 11/15/93, p.3. First step toward crafting new interface regulations.
**The future of scrambling** (CED), by Jeffrey Krauss, consultant, Jan. 1994, p.18. Expect a major battle between cable TV and consumer electronics industries.
**Interface comes down to the wire** (CED), by Wendell Bailey, NCTA, August 1994, p.14. There's a tentative agreement between the cable and consumer electronics industries on a decoder interface.
**Striving for harmony** (CV), by Chris Nolan, 1/10/94, p.20. TV manufacturers and cable engineers are still agreeing to agree.
**Technically, it's politics** (CV), by Chris Nolan, 2/28/94, p.18. Compatibility issues have the attention of the U.S. Congress.
**What is a demarc box?** (CED), by Frank Priebe and Tony Nieves, Keptel Inc., May 1994, p.46. Issues related to the box that sits on the side of the house.

## Data communications

**Adding voice and data to cable** (CED), by Ronald Foster, Scientific-Atlanta, Feb. 1994, p.52. Adding fiber to the network allows voice and data to be added more easily.
**Cabling computers** (CV), by Chris Nolan, 3/14/94, p.52. How cable networks can improve on-line PC services.
**Contention and other Ethernet issues** (CED), by Chris Bowick, Jones Intercable, May 1994, p.20. How Ethernet networks avoid contention issues.
**Datacom becomes latest cable/telco battleground** (CED), by Fred Dawson, March 1994, p.43. Data communications is another reason everyone is rebuilding their networks.
**Encryption fundamentals and the DES** (CED), by Chris Bowick, Jones Intercable, August 1994, p.16. Defining data encryption methods and discussing the data encryption standard.
**Intel Corp. details three-prong plan for cable modems** (MCN), by Leslie Ellis, 10/17/94, p.44. How Intel intends to attack the broadband market.
**The Internet** (Conv), by Mary McFall, Winter 1993, p.40. Things to do on the Internet and how to get access.
**Internet protocol and standards** (CED), by Chris Bowick, Jones Intercable, March 1994, p.18. The characteristics and history of TCP/IP.
**The Internet: What it is** (CED), by Chris Bowick, Jones Intercable, Jan. 1994, p.16. Background and detail of what the Internet is, and why it's important.
**Introduction to Local Area Networks, part 2** (CED), by Ed Zylka, Zenith Communications, Nov. 1993, p.34. Case study of how operators and a school district are using cable plant and RF modems to make a LAN.
**Jones to offer Internet in Alexandria system** (CED), Nov. 1993, p.10. News item noting that Jones intends to offer Internet access to its subscribers.
**LANs, the OSI model and layering** (CED), by Chris Bowick, Jones Intercable, Feb. 1994, p.18. Understanding the layers of the OSI model.
**MSOs chart aggressive course on PC connections** (MCN), by Fred Dawson, 5/16/94,

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p.21. The industry's flirt with datacom is turning into a heated romance.

**PC linkage key to multimedia future** (CED), by Fred Dawson, July 1994, p.74. The tools needed to revolutionize the way services are created are in place. Are cable operators ready?

**TCI, Rogers join Intel-led cable-PC consortium** (MCN), by Peter Lambert, 5/23/94, p.8. Several companies work together to to develop technical requirements.

**Team develops software for PC-over-cable apps** (CED), October 1994, p.14. News item about Team Software's Community Channels software for PC on cable applications.

**Zenith starts shipping second modem to operators** (MCN), by Leslie Ellis, 7/18/94, p.44. A "second generation" modem promises faster speeds, better reliability.

## Digital technologies

**Alliance formed to foster wireless digital technology** (CED), August 1994, p.8. News item about the formation of the Wireless Cable Digital Alliance, an R&D group consisting of Zenith, Microwave Filter, Emcee, California Amplifier and Andrew.

**ATM causes MSOs to rethink digital** (CED), by Fred Dawson, August 1994, p.64. Progress is accelerating in the development of ATM, which has operators rethinking their plans.

**Boxed in?** (CV), by Chris Nolan, 6/20/94, p.48. MSOs should be patient when it comes to those new digital set-tops.

**CableLabs issues RFI; plans to test QAM** (CED), July 1994, p.16. News item noting that CableLabs has issued an RFI on digital video servers and plans to work with vendors to test digital modulation schemes.

**CableLabs plans compression test lab** (CED), April 1994, p.8. News item that CableLabs will open a test facility to verify interoperability of MPEG-2 compression systems.

**CableLabs will build MPEG-2 test facility** (MCN), by Peter Lambert, 2/28/94, p.6. CableLabs wants to speed the MPEG process and will test systems.

**Century plans digital compression blitz in L.A.** (MCN), by Peter Lambert, 11/15/93, p.60. Century intends to buy 300,000 GI set-tops for deployment in Los Angeles.

**Cox Cable links schools with fiber digital network** (CED), Jan. 1994, p.12. News item on Cox Cable San Diego's two-way digital network that links schools.

**Cox picks StarNet's digital ad gear in New Orleans** (MCN), by Linda Moss, 11/1/93, p.10. Cox wants to zone the New Orleans market.

**Defining a North American digital television system** (CED), by Graham Stubbs, consultant to TV/COM International, October 1994, p.44. Why it's so important to develop a digital standard for networks.

**Digital modulation tech showdowns near** (MCN), by Peter Lambert, 2/14/94, p.26. The HDTV tests begin comparing digital modulation schemes.

**Digital standards: looking beyond MPEG** (CED), by Leslie Ellis, July 1994, p.36. Now it seems everyone wants to get into the act of developing digital standards for cable TV.

**Digitally incompatible** (CV), by Chris Nolan, 4/25/94, p.16. There are worries that the incompatibilities from the analog world will spill into the digital world.

**DirecTv opens $100M DBS center; TCI, Bell Atlantic cut ribbons too.** (CED), May 1994, p.12. News coverage of three separate facilities related to digital compression and distribution of programming.

**Elcom Technologies hooks cable into AC, overcomes household noise** (CED), October 1994, p.14. New technology sends voice, data and video signals over the existing electrical wiring.

**Going digital** (CV), by Chris Nolan, 12/6/93, p.94. Stories about HDTV, ATM and compression.

**How digital carriers affect analog plant** (CED), by Jeff Hamilton and Dean Stoneback, General Instrument Corp., June 1994, p.80. Results of an experiment where digital signals were placed on a system with analog signals.

**Is it MPEG2?** (CV), by Chris Nolan, 1/10/94, p.38. Coverage of the debate between MPEG and DigiCipher standards.

**Let's put the cart behind the horse** (CED), by Wendell Bailey, NCTA, Sept. 1994, p.18. Too many standards groups want to have a say in digital standards-setting.

**MPEG-2 disputes delay delivery of digital set-tops** (MCN), by Peter Lambert, 4/25/94, p.40. A delay in the standards process leads to differing views about when set-tops will be ready.

**Peeking inside the future digital set-top** (CED), by Roger Brown, May 1994, p.30. Now it seems everyone wants to build set-tops: the RBOCs, computer companies, you name it.

**Prevue to deploy digital server network** (CED), October 1994, p.16. Beginning in early 1995, Prevue intends to roll out a network of digital file servers.

**Primestar debuts first "digital town" in N.Y.** (CED), October 1994, p.16. Primestar brings multiple channels of video to Arietta, N.Y. for the first time.

**Primestar gets $565M infusion to go digital** (MCN), 3/21/94, p.3. The DBS provider will use the money to offer more channels, replace analog boxes.

**Primestar to spend millions for MPEG-2 upgrade** (MCN), by Rachel Thompson, 12/6/93, p.10. Primestar may spend more than $50 million to upgrade 70,000 boxes to be MPEG-2 compatible.

**Reaching digital detente** (MCN International), by Martin Levine, 4/18/94, p.12A. A look at how Europe standardized its digital approach.

**Rebuilding for the digital future** (CED), by Ron Goodrich and Tom Williams, Ventura County Cable, Feb. 1994, p.58. Case study of the design choices made by one cable operator to position himself for the future.

**Riding on the "Headend in the sky"** (CV), by Tom Kerver, 3/14/94, p.38. The details of how TCI wants to offer other MSOs a chance to receive digital video.

**S-A unveils digital video file server for NVOD, enhanced PPV applications** (CED), June 1994, p.14. News item about new product from Scientific-Atlanta that can offer compressed movies.

**Satellite failure may accelerate digital in Canada** (MCN), by Peter Lambert, 1/31/94, p.20. The failure of Anik 2 may result in a quick move to digitally compressed programs.

**Servers for all occasions** (CV), by Chris Nolan, 11/8/93, p.20. Digital servers are viewed as the way to take the network intelligence out of the home.

**Test: Transfer time not an issue in digital era** (CED), August 1994, p.10. Antec/Power Guard test shows that power transfer time won't affect digital bit streams.

**Time Warner delays Orlando FSN launch** (CED), April 1994, p.10. News item finds Time Warner perhaps underestimated the complexity of its task in Florida.

**TV/COM proposes new group to develop digital standards** (CED), Sept. 1994, p.12. Proposal to form the North American Digital Group to develop standards.

**What is Silicon Graphics Inc.?** (CV), by Mitch Shapiro, 1/10/94, p.28. Profile of the company and its strategy to bring digital technology to the industry.

**Which is better for cable: QAM or VSB?** July 1994, p.22. Overview of the differences between QAM and VSB technologies.

**Zenith advanced modulation tests get thumbs up** (MCN), by Fred Dawson, 11/15/93, p.62. Videoway tests VSB technology, and it passes with flying colors.

**Zenith's technology chosen for HDTV**

(CED), April 1994, p.8. News item that Grand Alliance has chosen VSB digital transmission technology for advanced TV.
**Zenith's 16-VSB scheme gets nod from ADC Telecom** (MCN), by Peter Lambert, 2/14/94, p.28. ADC endorses the Zenith technology after testing it.

## Distortions and interference

**Back to basics: color distortions** (CED), by Chris Bowick, Jones Intercable, June 1994, p.24. Detailed discussion of the color tests that will be required by the FCC in 1995.
**The channel 19 problem** (CED), by Jeffrey Krauss, consultant, Dec. 1993, p.20. The issue of signal leakage and interference on channel 19.
**History of the vestigial sideband** (CED), by Archer Taylor, Malarkey-Taylor Assoc., Dec. 1993, p.38. A basic tutorial on the vestigial sideband and group delay errors.
**Measuring cable system distortion** (CED), by Bill Morgan, CaLan, October 1994, p.72. Details on how to measure distortions.
**A quick look at hum** (CED), by Leslie Read, Sammons Communications, July 1994, p.78. How and why to test for hum.

## Emerging technology

**ATM and MPEG protocol issues concern CableLabs officials** (CED), Sept. 1994, p.26. The importance of interoperability between ATM and MPEG standard protocols.
**ATM causes MSOs to rethink digital** (CED), by Fred Dawson, August 1994, p.64. Progress is accelerating in the development of ATM, which has operators rethinking their plans.
**ATM's cost, missing features worry designers of full service network** (CED), by CableLabs, Jan. 1994, p.22. There are some unresolved problems with the ATM standard.
**ATM deployment: Waiting could be costly** (CED), by Todd Schieffert, ADC Telecommunications, August 1994, p.36. Definition of ATM, how it works, and how it can be used by cable operators.
**Cable networks and energy management** (CED), by Fred Dawson, Jan. 1994, p.56. Pilot project by TCI and Pacific Gas and Electric to use the cable network to monitor residential energy usage.
**Cablevision launches ATM-switched net** (MCN), by Fred Dawson, 2/21/94, p.53. Cablevision Systems ties medical facilities together on Long Island.
**Can networks deliver the multimedia promise?** (CED), by Fred Dawson, April 1994, p.62. Who will own the multimedia consumer market: retail stores and machine makers, or network operators?
**Elcom Technologies hooks cable into AC, overcomes household noise** (CED), October 1994, p.14. New technology sends voice, data and video signals over the existing electrical wiring.
**GTE launches multimedia service via imitation ATM** (MCN), by Peter Lambert, 2/7/94, p.25. A new tariffed service launches that uses integrated voice, video and data.
**Integrated cablephone network given official sanction** (CED), by Fred Dawson, Jan. 1994, p.56. Pacific Bell believes the cable TV "hybrid fiber/coax" network is the platform it needs for future services.
**Interconnecting the networks** (Conv), by Paul Demerly, Winter 1993, p.42. Three elements are necessary for the highway: Fiber cable, Sonet transport and ATM switches.
**Northern Telecom shelves ADSL for fiber/coax hybrid** (MCN), by Leslie Ellis, 6/13/94, p.3. ADSL is too expensive and no one's buying, so NT shelves it.
**The only constant is change...** (CED), by Leslie Ellis, Feb. 1994, p.64. Key messages from the SCTE Conference on Emerging Technology.
**When is the future?** (MCN supplement), 6/13/94, p.16A. Roundtable discussion with the industry's engineers about emerging technologies.

## Engineering management

**After a municipal inspection of your system** (CED), by Jonathan Kramer, Communications Corp., August 1994, p.60. What to do before, during and after someone comes to test your cable system.
**Cable struggles to build an OSS** (CED), by Roger Brown, July 1994, p.30. The issues that surround a good operational support system and the work some people are doing to build one.
**Cable telephony: operational considerations** (CED), by Chris Bowick, Jones Intercable, April 1994, p.16. Things to think about if there are plans to offer telephony over cable plant.
**Complexity slows Time Warner in Orlando** (MCN), by Roger Brown, 10/3/94, p.80. Full service networks still need a good operational support system.
**Current standards activity affecting cable** (CED), by Joseph Glaab, General Instrument, May 1994, p.42. A rundown of EIA standards that will have an effect on cable systems.
**Delegation: How to do it and why it's important** (CED), by Leslie Ellis, Dec. 1993, p.50. How to train yourself to become a good delegator.
**Five systems take Fleetcon on-line tracking system** (MCN), by Peter Lambert, 5/9/94, p.34. Arrowsmith sells workforce management system.
**The fleet's in** (CV), by Simon Applebaum, 11/8/93, p.35. Several stories related to fleet management at the system level.
**How digital carriers affect analog plant** (CED), by Jeff Hamilton and Dean Stoneback, General Instrument Corp., June 1994, p.80. Results of an experiment where digital signals were placed on a system with analog signals.
**How to avoid thinking "it's a job,"** (CED), by Wendell Bailey, NCTA, April 1994, p.14. Getting the most out of where you are–and serving the customer, too.
**Laying the foundation for advanced services** (CED), by Dilpreet Jammu and Jim McEachern, Bell Northern Research, July 1994, p.42. Comparison of different architectures and their effectiveness at delivering advanced services.
**Managing stress at work: How to make it work for you** (CED), by Leslie Ellis, Dec. 1993, p.59. Too much stress in your life? Read this and learn how to use it to your advantage.
**Managing turbulent staffers in turbulent times** (CED), by Leslie Ellis, Dec. 1993, p.46. How to manage difficult or disruptive employees.
**The MIS factor** (CV), by Simon Applebaum, 8/22/94, p.36. Testing to see if in-van equipment can expand the role of field personnel.
**Negotiation: How to get what you want** (CED), by Leslie Ellis, Dec. 1993, p.54. Looking for a raise or a promotion? This article may help you sell yourself.
**Network management for emerging broadband services** (CED), by Satish Desai and Mike DeMaio, AT&T Network Systems, May 1994, p.68. Smart network components allow personnel to monitor the entire network.
**The new EBS: What it means for cable operators** (CED), by Jack Bryant of Antec and Marty Callahan of HollyAnne Corp., May 1994, p.74. The Emergency Broadcast System is being revamped, and the FCC wants greater cable industry participation.
**New engineering title: technology futurist?** (CED), by Kathy Rauch and Douglas Wolfe, Corning Inc., April 1994, p.20. How much fiber should you put in your network today?
**Operations support systems quiet giant of future** (MCN), by Leslie Ellis, 7/25/94, p.90. The issue of OSS will be around for a long, long time.
**Ops say re-reg is taking heavy toll** (CED), by Roger Brown, August 1994, p.28. Annual survey finds guys in the trenches are worried

about the effects of re-regulation.
**Prime Cable bets it all in Vegas** (CED), by Roger Brown, June 1994, p.66. How one cable system keeps growing even in the face of new competition.
**The quest for open architecture** (CV), by Chris Nolan, 11/8/93, p.28. Debating the merits of complete interoperability vs. security.
**Staging a fiber restoration drill** (CED), by Art Yano, Antec, June 1994, p.32. How to be prepared for a fiber break before it actually happens.
**Still at the altar** (CV), by Simon Applebaum, 8/22/94, p.43. What's happening with Viacom's test of Ubiquinet and personal digital assistants?
**Strategic planning on the information highway** (CED), by Larry Yokell, Convergence Industry Assoc., October 1994, p.54. How to succeed and prosper in the chaotic environment of the info superhighway.
**Total Quality Management, reducing waste and rework** (CED), by Leslie Ellis, Dec. 1993, p.64. What is TQM, and how can it be integrated into your training program?
**What is privacy anyway?** (CED), by Jeffrey Krauss, consultant, April 1994, p.18. Are private communications really private? Maybe, maybe not.

## Fiber optics

**1550 gear quietly comes on line** (CED), by Fred Dawson, Sept. 1994, p.76. Interest is rising in 1550 nm technology, and some are looking toward wave division multiplexing.
**Are MSOs that use fiber violating someone's patent?** (CED), by Roger Brown, March 1994, p.22. Florida law firm contends MSOs are violating a patent that it holds that details delivery of video over fiber cable.
**The benefits of fiber in CATV networks** (CED), by Stuart Barr, AOFR, October 1994, p.24. The effect fiber is having on the industry.
**CATV fiber cable management** (CED), by Steve Day, CommDOC Services, Feb. 1994, p.34. As headends grow and add more fiber, the need for good cable management grows as well.
**C-COR PCM ring becoming interim step to Sonet** (MCN), by Peter Lambert, 2/7/94, p.24. Operators are pursuing a low-cost alternative to Sonet transport.
**Cablevision eyes small nodes for multiplexing** (MCN), by Fred Dawson, 10/17/94, p.43. The MSO looks at wave division multiplexing.
**Cablevision seeks to catch big fish in its high-speed Long Island net** (CED), April 1994, p.8. News item on Cablevision's "FISHNet" interconnect encompassing Long Island, N.Y.
**Canadian operator builds all-passive pocket** (MCN), by Leslie Ellis, 7/11/94, p.46. CF Cable intends to fire up an all-passive pocket of subscribers near Montreal.
**A cellular look at cable topologies** (CED), by Larry Richards, Philips Broadband Networks, Nov. 1993, p.42. Proposed new terms for fiber optic architectures used in cable TV.
**Continental, InterMedia install broadband equipment** (MCN), by Peter Lambert, 11/15/93, p.60. Continental in Chicago and InterMedia in Minnesota buy equipment for regional interconnects.
**Cost considerations for cable TV splicing** (CED), by Douglas Wolfe, Corning Inc., and J. Douglas Coleman, Siecor, Sept. 1994, p.66. An examination of the different types of fiber splices, their performance and their cost.
**Cox picks Homeworx fiber/coax platform for Omaha** (MCN), by Peter Lambert, 11/8/93, p.30. Cox selects product from ADC subsidiary American Lightwave Systems.
**Does Sonet play in cable's future?** (CED), by Roger Brown, Sept. 1994, p.34. A close look at the benefit/cost tradeoff of Sonet. Can cable operators afford it?
**Evolving from FSA to passive cable networks** (CED), by Gary Lyons, Scientific-Atlanta, Sept. 1994, p.60. How much fiber should operators put in their networks?
**Greater Media Cable added to fiber link** (CED), June 1994, p.14. News item about Greater Media and Continental plans to link more than 1 million cable subs in four New England states with an interconnect.
**Increasing flexibility and performance in optical networks** (CED), by Dr. Patrick Harshman, Harmonic Lightwaves, Sept. 1994, p.40. The results of integrating YAGs and DFBs: there is some performance gain.
**Integrated cablephone network given official sanction** (CED), by Fred Dawson, Jan. 1994, p.56. Pacific Bell believes the cable TV "hybrid fiber/coax" network is the platform it needs for future services.
**Interconnecting the networks** (Conv), by Paul Demerly, Winter 1993, p.42. Three elements are necessary for the highway: Fiber cable, Sonet transport and ATM switches.
**Interconnects: MSOs learn to work together** (CED), by Roger Brown, Dec. 1993, p.30. How some cities and states are planning to interconnect themselves with fiber optics.
**Jerrold/GI develops architecture to support interactivity** (CED), by Roger Brown, Dec. 1993, p.22. Details of GI's Broadband Telecommunications Architecture.
**Jones reaches 200-home nodes in Florida resort** (MCN), by Peter Lambert, 11/8/93, p.30. Jones plans to overlay 3,000 fiber miles on coax in its Panama Beach system.
**Making the perfect connection** (CED), by Markus Giebel, Siecor Corp., July 1994, p.24. An examination of the future connector requirements for nodes.
**Meeting the passive node challenge** (CED), by Patrick Kelley, Antec, August 1994, p.20. An architectural comparison finds the passive network has many attributes.
**The migration to passive networks** (CED), by Mike Sparkman, Antec, Feb. 1994, p.38. Do passive cable networks make sense? This article details how the evolution might take place.
**National cable interconnect activity heats up** (CED), by Leslie Ellis, Sept. 1994, p.28. An update on the status of some interconnects and the benefits they promise.
**Network flexibility will be key in future** (CED), by Roger Brown, April 1994, p.83. User-friendly networks without bottlenecks will be important, according to Ray Smith of Bell Atlantic. Coverage of the Optical Fiber Conference.
**NewChannels and NT link Alabama schools** (CED), October 1994, p.14. News item about agreement to link public buildings over a common fiber network.
**New engineering title: technology futurist?** (CED), by Kathy Rauch and Douglas Wolfe, Corning Inc., April 1994, p.20. How much fiber should you put in your network today?
**New fiber distribution cable** (CED), by Bruce Carlson, CommScope–General Instrument, Jan. 1994, p.25. A new fiber cable for the distribution plant lets new services flow all the way to the home.
**Ortel study finds passive coax design cost-effective** (CED), June 1994, p.18. Results of a comparison between architectures shows passive coax to be the lowest cost, when life-cycle costs are factored in.
**RBOCs? Who needs RBOCs?** (CV), by Ed Rosenthal, 12/6/93, p.77. New Jersey operators are banding together to build an interconnect.
**Rebuilding for the digital future** (CED), by Ron Goodrich and Tom Williams, Ventura County Cable, Feb. 1994, p.58. Case study of the design choices made by one cable operator to position himself for the future.
**S-A gets into 1550 arena as MSO demand rises** (MCN), by Fred Dawson, 7/25/94, p.93. The economics for 1550 nm gear make more sense.
**Sewing up a fiber-rich state** (CV), by Chris Nolan, 8/8/94, p.50. FiberSpan Pennsylvania will link the whole state.
**Staging a fiber restoration drill** (CED), by Art Yano, Antec, June 1994, p.32. How to be

prepared for a fiber break before it actually happens.
**Synchronous will demonstrate 1310-nm amp at Western Show: First working prototype for cable** (MCN), by Fred Dawson, 11/19/93, p.120. The first look at a fiber amp that works in the 1310-nm window.
**Telcos resume pursuit of fiber-to-home technology** (MCN), by Fred Dawson, 11/1/93, p.36. Some telcos say costs are coming down to where they can afford fiber to the home.
**Times Mirror's plans are as simple as X and Y** (MCN), by Peter Lambert, 1/10/94, p.26. The MSO plans to upgrade its systems to 750 MHz and 500-home fiber serving areas.
**Time Warner's Jim Ludington wins Polaris Award** (CED), by Leslie Ellis, Feb. 1994, p.62. Why Ludington won the award for fiber optic innovation, given during the SCTE Conference on Emerging Technology.
**What is a breathable fiber optic closure?** (CED), by George Steenton and David Stehlin, Keptel Inc., Sept. 1994, p.72. The importance of using a good closure in a fiber optic network.
**Where are we headed with node sizes?** (CED), by Larry Stak, Ortel, Feb. 1994, p.28. Analysis shows node sizes will get smaller as more electronics move out of the network.

## From the Headend

*(From the Headend is a monthly CED column written by Chris Bowick of Jones Intercable.)*

**Back to basics: color distortions**, June 1994, p.24. Detailed discussion of the color tests that will be required by the FCC in 1995.
**The basics of FDMA, TDMA and CDMA,** October 1994, p.22. Each technology is explained.
**Contention and other Ethernet issues**, May 1994, p.20. How Ethernet networks avoid contention issues.
**Encryption fundamentals and the DES**, August 1994, p.16. Defining data encryption methods and discussing the data encryption standard.
**Internet protocol and standards**, March 1994, p.18. The characteristics and history of TCP/IP.
**The Internet: What it is**, Jan. 1994, p.16. Background and detail of what the Internet is and why it's important.
**Is spread spectrum in our future?** Sept. 1994, p.20. How the technology works and if it's applicable in the return path.
**LANs, the OSI model and layering**, Feb. 1994, p.18. Understanding the layers of the OSI model.
**Networks: An integral part of the future**, Dec. 1993, p.18. How cable TV is becoming a major international telecommunications player.
**Resonant circuits, filters and traps, part 5**, Nov. 1993, p.16. Continuation of a tutorial series of what happens inside certain components.

## Frontline

*(Frontline is a monthly opinion column that appears in CED written by Wendell Bailey of NCTA.)*

**1993: The year in review**, Dec. 1993, p.16. How the world has changed over the course of a year.
**Building the compatibility elephant**, Nov. 1993, p.14. Review of the FCC Report on cable/consumer electronics compatibility.
**Competition brings new challenges, growth**, March 1994, p.16. What impact will the RBOC investments in cable TV have on the business?
**How to avoid thinking "it's a job,"** April 1994, p.14. Getting the most out of where you are–and serving the customer, too.
**In defense of Montreux**, Jan. 1994, p.14. Why the Montreux Television Symposium should be maintained as it is.
**Interface comes down to the wire**, August 1994, p.14. There's a tentative agreement between the cable and consumer electronics industries on a decoder interface.
**Issues surround the information superhighway,** Feb. 1994, p.16. Clearing up the myths surrounding the info highway.
**Let's put the cart behind the horse**, Sept. 1994, p.18. Too many standards groups want to have a say in digital standards-setting.
**NCTA's loss was SCTE's gain**, June 1994, p.22. Bill Riker leaves the NCTA and comes on to "save" the SCTE.
**NII will blur property lines**, October 1994, p.20. The issue of intellectual property.
**Pigs get fed; hogs get slaughtered**, May 1994, p.18. First, broadcasters say they have to have HDTV to survive. Now, they won't touch it.
**Shows prove cable ready to battle competitors**, July 1994, p.20. Even with the burden of new regulations, the industry remains ready to battle its competitors.

## Headend issues

**Resonant circuits, filters and traps, part 5** (CED), by Chris Bowick, Jones Intercable, Nov. 1993, p.16. Continuation of a tutorial series of what happens inside certain components.
**Riding on the "Headend in the sky"** (CV), by Tom Kerver, 3/14/94, p.38. The details of how TCI wants to offer other MSOs a chance to receive digital video.
**Sounds good** (CV), by Chris Nolan, 12/6/93, p.38. The issue of varying sound levels across different channels and what can be done to fix it.

## Interactive TV

**ATM causes MSOs to rethink digital** (CED), by Fred Dawson, August 1994, p.64. Progress is accelerating in the development of ATM, which has operators rethinking their plans.
**Bell Atlantic chooses set-top box vendors** (CED), March 1994, p.12. News item that Bell Atlantic has chosen IBM, Philips/Compression Labs and DiviCom/Microware/Eurodec to supply set-tops for the interactive TV trials.
**Bell Atlantic, Oracle unite to develop multimedia** (CED), Feb. 1994, p.12. News item detailing BA/Oracle agreement to develop and market interactive multimedia software.
**BellSouth spells out Atlanta-area technical tests** (MCN), by Leslie Ellis, 7/25/94, p.89. How this RBOC will deliver interactive multimedia.
**Building a smarter infrastructure** (Conv), by Mike DeMuro and Rob Agee, Vol.2, No. 1, p.14. The dilemma of interactive TV is where to put the intelligence.
**Cablevision seeks to catch big fish in its high-speed Long Island net** (CED), April 1994, p.8. News item on Cablevision's "FISHNet" interconnect encompassing Long Island, N.Y.
**Cabling computers** (CV), by Chris Nolan, 3/14/94, p.52. How cable networks can improve on-line PC services.
**Can you top this?** (Conv), by Roger Brown, Sept. 1994, p.20. There's a new group of vendors interested in making set-tops.
**Consortium formed to develop interactivity** (CED), June 1994, p.16. News item about a partnership between BroadBand Technologies, Compression Labs, Digital Equipment Corp., Microware Systems and Philips Consumer Electronics.
**GTE enters interactive VDT action** (MCN), by Peter Lambert, 1/24/94, p.3. GTE plans to test interactive TV in Manassas, Va. late in 1994.
**Innovative technology tests running side-by-side** (CED), by Roger Brown, March 1994, p.33. A look at Omaha and the networks being built there by Cox Cable and US West.
**Interactive distortion** (CV), by Chris Nolan, 7/25/94, p.22. The interactive future rests with the return band, where problems exist.
**InterMedia plans to test ICTV interactive**

**gear** (CED), Feb. 1994, p.10. InterMedia in the South Bay area of San Francisco will test ICTV equipment.
**Jerrold/GI develops architecture to support interactivity** (CED), by Roger Brown, Dec. 1993, p.22. Details of GI's Broadband Telecommunications Architecture.
**Mid-sized MSOs take two-way turn** (CV), by Chris Nolan, 2/7/94, p.18. InterMedia and KBLCOM decide to offer two-way service to their subs.
**Networks go on-line** (CV), by Chris Nolan, 2/7/94, p.19. C-SPAN and Court TV get interactive through on-line computer services.
**New company formed to develop IVDS system** (CED), June 1994, p.18. Founder of Eon (formerly TV Answer) spins out a new company, called Interactive Return Service Inc.
**Nynex unveils VOD plans** (MCN), by Tom Ustead and Peter Lambert, 5/9/94, p.3. How the telco plans to roll out video on demand.
**PacBell plans broadband upgrade; interactive TV tests next on agenda** (CED), March 1994, p.10. News item about PacBell's $16 million upgrade to broadband via the hybrid fiber/coax architecture.
**PacTel jumps on AT&T bandwagon** (MCN), by Peter Lambert, 1/24/94, p.1. The two companies plan to test interactive TV in Milpitas, Calif.
**PacTel will deploy H-P servers in California** (MCN), by Peter Lambert, 1/31/94, p.20. The telco plans to roll out video on demand in Los Angeles, Orange County, San Diego and the Silicon Valley.
**PC linkage key to multimedia future** (CED), by Fred Dawson, July 1994, p.74. The tools needed to revolutionize the way services are created are in place. Are cable operators ready?
**Protocol standards necessary for interactivity** (MCN), by Leslie Ellis, 11/22/93, p.52. Message from Convergence conference on the need to speak common languages.
**Providing two-way riddled with complexities** (MCN), by Leslie Ellis, 6/27/94, p.33. It won't be easy for cable operators to fire up and use the return band.
**Server race may not be to the swift** (MCN), by Peter Lambert, 5/16/94, p.3. A status check on where the server market is right now.
**Telcos and Cable TV must cooperate** (CED), by Alan Stewart, Networks Interface Corp., and Alan Pearce, Information Age Economics; Sept. 1994, p.50. There are opportunities for both industries in the interactive age, but there's work to do.
**Time Warner broadens 2-way transmission tests** (CED), Feb. 1994, p.10. Plans to test spread spectrum technology for the reverse band.
**Time Warner examines reverse-path solutions** (MCN), by Leslie Ellis, 1/17/94, p.25. The MSO plans to test spread spectrum with Unisys.
**"Total solutions" approach important for MSOs, LECs** (CED), by Kent Takeda, AT&T Network Systems, May 1994, p.28. Things to keep in mind as interactive networks are being built.
**Wireless plugs into interactivity** (CV), by Tom Kerver, 1/10/94, p.33. Wireless industry begins to assert itself, led by Videotron in Canada.

## My View

*(My View is a monthly opinion column appearing in CED magazine written by Archer Taylor of Malarkey-Taylor Associates.)*

**Breakthroughs: Past and present**, March 1994, p.66. This wasn't the first time the industry has faced a "swirling maelstrom of new developments."
**Cutting the Gordian Knot**, Nov. 1993, p.86. The issue of signal security and its impact on system design.
**Don't stop thinking about tomorrow!**, Jan. 1994, p.90. Is there life after convergence for cable operators left out of the telco mergers?
**The Gordian Knot revisited**, Dec. 1993, p.94. The impact of the proposed Bell Atlantic-TCI merger on cable TV.
**The information superhighway**, July 1994, p.100. Issues surrounding the highway and what it might offer.
**Learning from each other**, April 1994, p.90. Telcos and cable companies can still learn a lot from one another, whether they're married or not.
**Professor Crook: Inventor of CATV**, June 1994, p.26. History shows there may be a new, unknown "inventor" of cable television no one has ever talked about.
**Quality, price and reliability**, Sept. 1994, p.114. Competition in the future will focus on these three attributes.
**Recycling consumer electronics products** (CED), October 1994, p.100. What happens to old TVs, VCRs and radios? They should be recycled, but not everyone thinks so.
**Subscriber nightmare: believe it or not**, May 1994, p.106. The story of how one cable subscriber was treated by the cable company.
**Telco vs CATV battles: A review**, Feb. 1994, p.90. The telephone companies and cable have a long history of confrontation.
**Tips on grounding the service drop**, August 1994, p.90. Don't forget about grounding your plant!

## Network architecture

**A $16.4 million "Cadillac"** (CV), by Chris Nolan, 8/8/94, p.46. Bell Atlantic pioneers its first video dialtone project in New Jersey.
**ATM causes MSOs to rethink digital** (CED), by Fred Dawson, August 1994, p.64. Progress is accelerating in the development of ATM, which has operators rethinking their plans.
**ATM deployment: Waiting could be costly** (CED), by Todd Schieffert, ADC Telecommunications, August 1994, p.36. Definition of ATM, how it works, and how it can be used by cable operators.
**Bell Atlantic details initial video network plans** (MCN), by Kent Gibbons, 6/20/94, p.4. How the RBOC plans to configure its network.
**Bell Atlantic installs multimedia network software** (MCN), by Peter Lambert, 1/3/94, p.23. The RBOC takes delivery of a software package via a license from FutureVision.
**Cablevision seeks to catch big fish in its high-speed Long Island net** (CED), April 1994, p.8. News item on Cablevision's "FISHNet" interconnect encompassing Long Island, N.Y.
**Cable telephony: operational considerations** (CED), by Chris Bowick, Jones Intercable, April 1994, p.16. Things to think about if there are plans to offer telephony over cable plant.
**Can the telcos wait for HFC?** (CED), by Fred Dawson, June 1994, p.73. An examination of integrated hybrid fiber/coax designs and use of the alternative ADSL technology.
**C-COR PCM ring becoming interim step to Sonet** (MCN), by Peter Lambert, 2/7/94, p.24. Operators are pursuing a low-cost alternative to Sonet transport.
**A cellular look at cable topologies** (CED), by Larry Richards, Philips Broadband Networks, Nov. 1993, p.42. Proposed new terms for fiber optic architectures used in cable TV.
**Continental builds master headend** (CED), by Leslie Ellis, June 1994, p.110. The master headend concept and how one operator plans to use it in Pompano Beach, Fla.
**Continental, InterMedia install broadband equipment** (MCN), by Peter Lambert, 11/15/93, p.60. Continental in Chicago and InterMedia in Minnesota buy equipment for regional interconnects.
**Continental plans $25M upgrade in Los Angeles** (MCN), by Peter Lambert, 11/1/93, p.34. The start of a five-year upgrade that includes optical fiber and 750 MHz plant.
**Cox Cable Quad Cities deploys Antec design** (MCN), 2/28/94, p.28. The company agrees to go with Star-Star-Bus 500.
**Cox will build FSN in Omaha** (MCN), by

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Peter Lambert, 12/6/93, p.2. Cox will use technology from ICTV, IBM and Zenith to build a full service network.

**Cox: Optimistic but cautious** (CV), by Chris Nolan, 8/8/94, p.53. Plans in Omaha call for aggressive, but yet cautious, roll-outs.

**Cutting the Gordian Knot** (CED), by Archer Taylor, Malarkey-Taylor Assoc., Nov. 1993, p.86. The issue of signal security and its impact on system design.

**Datacom becomes latest cable/telco battleground** (CED), by Fred Dawson, March 1994, p.43. Data communications is another reason everyone is rebuilding their networks.

**Does Sonet play in cable's future?** (CED), by Roger Brown, Sept. 1994, p.34. A close look at the benefit/cost tradeoff of Sonet. Can cable operators afford it?

**Evolving from FSA to passive cable networks** (CED), by Gary Lyons, Scientific-Atlanta, Sept. 1994, p.60. How much fiber should operators put in their networks?

**Fellows: Interoperability a must for multimedia and interactive** (MCN), 11/29/93, p.116. Question-and-answer session with David Fellows of Continental Cable.

**FiberVision seeks permission to overbuild Connecticut operators** (CED), Nov. 1993, p.8. News item showing FiberVision's network architecture and plans to build in Bridgeport, New Haven and New Britain.

**GI, DSC close to telephone-over-cable venture** (MCN), by Fred Dawson, 11/15/93, p.8. General Instrument and DSC Communications prepare to announce an alliance.

**How digital carriers affect analog plant** (CED), by Jeff Hamilton and Dean Stoneback, General Instrument Corp., June 1994, p.80. Results of an experiment where digital signals were placed on a system with analog signals.

**How to manage random access video** (CED), by Bert McCoy, Prevue Networks, August 1994, p.44. Review of how Prevue develops and sends compressed video over satellite and how that info can help cable operators in the future.

**Increasing flexibility and performance in optical networks** (CED), by Dr. Patrick Harshman, Harmonic Lightwaves, Sept. 1994, p.40. The results of integrating YAGs and DFBs: there is some performance gain.

**Interconnecting the networks** (Conv), by Paul Demerly, Winter 1993, p.42. Three elements are necessary for the highway: Fiber cable, Sonet transport and ATM switches.

**Interconnects: MSOs learn to work together** (CED), by Roger Brown, Dec. 1993, p.30. How some cities and states are planning to interconnect themselves with fiber optics.

**Jones builds first all-passive network** (MCN), by Leslie Ellis, 6/27/94, p.1. Some insight into what Jones is building in Alexandria.

**Jones reaches 200-home nodes in Florida resort** (MCN), by Peter Lambert, 11/8/93, p.30. Jones plans to overlay 3,000 fiber miles on coax in its Panama Beach system.

**Jones steps up to 750 MHz** (CV), by Chris Nolan, 8/8/94, p.48. Upgrade strategy in Virginia–in competition with Bell Atlantic.

**Jerrold/GI develops architecture to support interactivity** (CED), by Roger Brown, Dec. 1993, p.22. Details of GI's Broadband Telecommunications Architecture.

**Laying the foundation for advanced services** (CED), by Dilpreet Jammu and Jim McEachern, Bell Northern Research, July 1994, p.42. Comparison of different architectures and their effectiveness at delivering advanced services.

**Meeting the passive node challenge** (CED), by Patrick Kelley, Antec, August 1994, p.20. An architectural comparison finds the passive network has many attributes.

**The narrowband alternative** (CED), by Alan Stewart, consultant, April 1994, p.38. How the telcos plan to deliver video over their networks.

**National cable interconnect activity heats up** (CED), by Leslie Ellis, Sept. 1994, p.28. An update on the status of some interconnects and the benefits they promise.

**NBTel plans network rebuild with ATM** (CED), August 1994, p.8. Cable system rebuild in Canada looks to be state of the art.

**Networks: An integral part of the future** (CED), by Chris Bowick, Jones Intercable, Dec. 1993, p.18. How cable TV is becoming a major international telecommunications player.

**New engineering title: technology futurist?** (CED), by Kathy Rauch and Douglas Wolfe, Corning Inc., April 1994, p.20. How much fiber should you put in your network today?

**Ortel study finds passive coax design cost-effective** (CED), June 1994, p.18. Results of a comparison between architectures shows passive coax to be the lowest cost, when life-cycle costs are factored in.

**Pawns, kings and the local loop** (Conv), by Fred Dawson, April 1994, p.13. Prospects for competition in the local loop are alive and well.

**Plain old cable? No way** (CV), by Chris Nolan, 8/8/94, p.52. Continental looks to be flexible in its Florida rebuild in Broward County.

**Prime plans fast-track digital project in Houston** (MCN), by Peter Lambert, 2/21/94, p.47. Prime Cable in Houston decides on 550 MHz, with compressed video.

**RBOCs? Who needs RBOCs?** (CV), by Ed Rosenthal, 12/6/93, p.77. New Jersey operators are banding together to build an interconnect.

**Rebuilding for the digital future** (CED), by Ron Goodrich and Tom Williams, Ventura County Cable, Feb. 1994, p.58. Case study of the design choices made by one cable operator to position himself for the future.

**Reliance debuts multimedia system** (CED), May 1994, p.14. Reliance Comm/Tec introduces its new interactive multimedia access system.

**Reliance launches Matrix all-purpose transport** (MCN), by Peter Lambert, 4/11/94, p.32. Details of Reliances' vision and new product line.

**Rochester Telephone expands its video dial tone design** (MCN), by Peter Lambert, 11/1/93, p.34. The company plans to test both hybrid fiber/coax and ADSL.

**Sewing up a fiber-rich state** (CV), by Chris Nolan, 8/8/94, p.50. FiberSpan Pennsylvania will link the whole state.

**The state of the network** (Conv), by Fred Dawson, Winter 1993, p.10. Industries are way ahead of the regulators when it comes to building new networks.

**Telcos and Cable TV must cooperate** (CED), by Alan Stewart, Networks Interface Corp., and Alan Pearce, Information Age Economics, Sept. 1994, p.50. There are opportunities for both industries in the interactive age, but there's work to do.

**Telcos rush headlong into video** (CED), by Roger Brown and Leslie Ellis, April 1994, p.24. Details of the video deployment strategy by all the RBOCs and GTE.

**Telephony via cable: Competing in a new business** (CED), April 1994, p.46. Details of Antec's Cable Loop Carrier product.

**Times Mirror's plans are as simple as X and Y** (MCN), by Peter Lambert, 1/10/94, p.26. The MSO plans to upgrade its systems to 750 MHz and 500-home fiber serving areas.

**Time Warner primes a dozen markets for 750 MHz** (MCN), by Leslie Ellis, 12/20/93, p.34. The MSO targets several cities in its aggressive upgrade plans.

**US West, Cox Cable battle it out in Omaha** (CED), Jan. 1994, p.10. News item about how two companies will compete with advanced services.

**US West sets ATM as format to home** (MCN), by Fred Dawson, 10/31/94, p.45. ATM goes to the home, so US West architecture changes.

**What is a demarc box?** (CED), by Frank Priebe and Tony Nieves, Keptel Inc., May 1994, p.46. Issues related to the box that sits on the side of the house.

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## Pay-per-view technology

**How to manage random access video** (CED), by Bert McCoy, Prevue Networks, August 1994, p.44. Review of how Prevue develops and sends compressed video over satellite and how that info can help cable operators in the future.
**Nynex unveils VOD plans** (MCN), by Tom Ustead and Peter Lambert, 5/9/94, p.3. How the telco plans to roll out video on demand.
**NVOD options** (CV), by Mitch Shapiro, 6/20/94, p.24. Operators prepare for an on-demand future by taking an interim step.
**S-A unveils digital video file server for NVOD, enhanced PPV applications** (CED), June 1994, p.14. News item about new product from Scientific-Atlanta that can offer compressed movies.
**Video disks in cable television** (CED), by Jon Hazell, Paragon Cable, Dec. 1993, p.66. Tutorial in how to use and maintain video disk players for ad insertion and pay-per-view.
**The wizards of VOD** (CV), by Chris Nolan, 10/24/94, p.54. You need massive computers to support video on demand, but the perfect one isn't out there yet.

## Personal communications

**Airwaves on the block** (CV), by Chris Nolan, 8/22/94, p.16. The first spectrum auction raised nearly $700 million; what does that mean for PCS?
**Cablevision sends PCS data via moving automobile** (CED), Nov. 1993, p.8. News item on Cablevision Systems' work with PCS and how they made hand-offs happen at vehicular speeds.
**Comcast, MCI, Nextel form national PCS alliance** (MCN), by Peter Lambert, 3/7/94, p.27. Comcast engineers an alliance to launch wireless service.
**Getting personal: The PCN market heats up** (Conv), by Roberta Bhasin, April 1994, p.18. The spectrum auction is expected to unleash a gold rush.
**It's decision time for PCS** (CED), by Jeffrey Krauss, consultant, Nov. 1993, p.18. Explanation of how the spectrum is being carved up for PCS use.
**Motorola unveils CableComm telephony at show** (MCN), by Leslie Ellis, 5/30/94, p.48. Another plan to help the cable industry offer telephony.
**New technology confuses PCS market** (CED), by Fred Dawson, October 1994, p.60. Confusion over air interface multiplexing schemes for PCS is worse than ever because of technology improvements.
**PCN service offered across three networks** (CED), Jan. 1994, p.10. News item about Cablevision, Continental and Time Warner jointly offering PCS service across franchise borders.
**Time Warner claims PCS works** (MCN), by Kent Gibbons, 6/6/94, p.2. Tests of CDMA technology show it can work over cable networks.
**Time Warner's PCS-over-cable test in Orlando pronounced a success** (CED), July 1994, p.14. News item about PCS test completion with graphic showing how test was conducted.

## Personality profiles

**Babcock: Technical training is his niche** (CED), by Leslie Ellis, p.20. Alan Babcock of TCI Central.
**Bauer: Cable's reality checker** (CED), by Leslie Ellis, August 1994, p.12. Spotlight on Bill Bauer of Windbreak Cable in Nebraska.
**Birthing a childhood dream** (CED), by Leslie Ellis, Dec. 1993, p.14. Profile of Leo Hoarty of ICTV.
**Dr. Walt Ciciora: 1993 Man of the Year** (CED), by Roger Brown, Jan. 1994, p.36. Profile of Ciciora, who worked to forge a compromise with the consumer electronics industry.
**Frame: Leading NT's broadband charge** (CED), by Leslie Ellis, July 1994, p.18. Feature on Mike Frame of Northern Telecom.
**Johnson: Cable TV's RF wizard** (CED), by Leslie Ellis, March 1994, p.14. Profile of Steve Johnson of Time Warner Cable.
**McDonough: The cable vagabond** (CED), by Leslie Ellis, Nov. 1993, p.12. Profile of Pat McDonough, vice president of engineering at United International Holdings.
**Bill Nash: TCI's quintessential communicator** (CED), by Leslie Ellis, Feb. 1994, p.14. Profile on TCI's project engineer of compression technology.
**Prodan: Rocking down the highway** (CED), by Leslie Ellis, May 1994, p.16. A look at Richard Prodan of CableLabs.
**Ken Pyle: Off to a running start** (CED), by Dana Cervenka, Sept. 1994, p.14. Profile of the Raynet video product manager.
**Skinner: Pioneering telecom change** (CED), by Leslie Ellis, April 1994, p.12. Profile of Russ Skinner of US West.
**Vecchi: The integration magician** (CED), by Dana Cervenka, October 1994, p.18. Story on Mario Vecchi of Time Warner Cable.

## Powering and outages

**Choosing the best battery backup for cable networks** (CED), by Chris Tallackson, Johnson Controls, and Larry Roper, Alpha Technologies, October 1994, p.40. An examination of the battery choices cable operators have and a comparison of their performance.
**Meeting the U.K.'s communication powering needs** (CED), by Jeff Geer and Greg Zediker, Alpha Technologies, Nov. 1993, p.30. Explanation of how an integrated cable TV/telephony plant can be powered.
**They've got the power** (CV), by Chris Nolan, 11/22/93, p.20. The issue of power backup when cable begins to offer telephony.

## Rebuilds and upgrades

**A $16.4 million "Cadillac"** (CV), by Chris Nolan, 8/8/94, p.46. Bell Atlantic peioneers its first video dialtone project in New Jersey.
**Build, we must** (CV), by Chris Nolan, 6/20/94, p.22. Operators' increased rebuild schedule has manufacturers increasing output.
**Continental builds master headend** (CED), by Leslie Ellis, June 1994, p.110. The master headend concept and how one operator plans to use it in Pompano Beach, Fla.
**Continental plans $25M upgrade in Los Angeles** (MCN), by Peter Lambert, 11/1/93, p.34. The start of a five-year upgrade that includes optical fiber and 750 MHz plant.
**Datacom becomes latest cable/telco battleground** (CED), by Fred Dawson, March 1994, p.43. Data communications is another reason everyone is rebuilding their networks.
**Jones reaches 200-home nodes in Florida resort** (MCN), by Peter Lambert, 11/8/93, p.30. Jones plans to overlay 3,000 fiber miles on coax in its Panama Beach system.
**Market forces squeeze broadband equipment suppliers** (CED), by Leslie Ellis and Roger Brown, March 1994, p.50. The cable equipment manufacturers are enjoying good times. How can an operator get his gear when he needs it?
**MSO spending heavy despite unsavory environment** (CED), by Leslie Ellis, May 1994, p.37. Cable operators will spend $4.5 billion in rebuilds and upgrades in 1994, according to a CED survey of MSOs.
**Plain old cable? No way** (CV), by Chris Nolan, 8/8/94, p.52. Continental looks to be

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## Regulatory issues

**Aural carrier center frequency measurement** (CED), by Steve Johnson, Time Warner Cable, June 1994, p.68. Explanation of how to perform the aural carrier test and why it should be performed.
**Back to basics: color distortions** (CED), by Chris Bowick, Jones Intercable, June 1994, p.24. Detailed discussion of the color tests that will be required by the FCC in 1995.
**FCC controls remote controls** (CED), by Jeffrey Krauss, consultant, August 1994, p.18. Regulation prohibiting changes to IR remotes will stifle technological change.
**FCC issues rules on compatibility** (MCN), by Jeannine Aversa, 11/15/93, p.3. First step toward crafting new interface regulations.
**In-band frequency response measurements** (CED), by David Large, Media Connections Group, August 1994, p.54. How and why to do these tests.
**Measuring cable system distortion** (CED), by Bill Morgan, CaLan, October 1994, p.72. Details on how to measure distortions.
**The new EBS: What it means for cable operators** (CED), by Jack Bryant of Antec and Marty Callahan of HollyAnne Corp., May 1994, p.74. The Emergency Broadcast System is being revamped, and the FCC wants greater cable industry participation.
**N.Y. PSC eases entrance for CAPs** (MCN), by Fred Dawson, 11/8/93, p.32. The state acts to make it easier for competitive access providers to get up and running.
**Ops say re-reg is taking heavy toll** (CED), by Roger Brown, August 1994, p.28. Annual survey finds guys in the trenches are worried about the effects of re-regulation.
**Preparing for in-service video measurements** (CED), by Francis Edgington, Hewlett-Packard, June 1994, p.94. Things to think about to prepare for the color tests that have to be performed next year.
**Proof testing** (CED), May 1994, p.94. Another survey about how operators are doing with the required FCC technical tests.
**A quick look at hum** (CED), by Leslie Read, Sammons Communications, July 1994, p.78. How and why to test for hum.
**Tutorial on signal leakage and calibration** (CED), by Gregg Rodgers, Trilithic Inc., May 1994, p.60. How to test for signal leakage and why it's important.

## Return Path

*(Return Path is a monthly fax-in poll published in CED magazine.)*

**1994 Construction plans**, April 1994, p.80. Looks like planned network upgrades are numerous.
**Convergence**, March 1994, p.58. Many in the industry think their systems will one day be owned by a telephone company.
**DBS competition**, June 1994, p.132. Operators' thoughts about the impending competition from DBS.
**Emergency alerting**, Dec. 1993, p.68. Results of poll asking operators about their role in the emergency broadcast system.
**In-home wiring**, October 1994, p.92. Survey says drop material has improved, making digital signals more viable.
**Interconnects**, Feb. 1994, p.76. Survey shows operators believe interconnecting with their neighboring systems will gain importance.
**Outages**, August 1994, p.74. Survey says outage problems have improved.
**Standards**, Nov. 1993, p.68. Results of the poll asking opinions about standards.
Status monitoring, Jan. 1994, p.84. Results of survey show growing interest in status monitoring systems for cable networks.
**Training and education**, Sept. 1994, p.86. Few operators have started an in-house digital training course yet.
**The workplace**, July 1994, p.90. Questions about working conditions at the local level.

## Safety

**Avoiding accidents on the info highway** (CED), by Andy Booz, May 1994, p.53. Case study of how RTK Corp. started a new training and safety program.
**OSHA compliance: tips for safety managers** (CED), by Michelle Dionne, Antec, October 1994, p.66. New developments related to safety issues that affect cable TV systems.

## Satellite communications

**Competing antenna requirements for dual-band satellites** (CED), by Dr. Ronald Posner, Antennas for Communications, March 1994, p.52. Satellites are on the move–how can a cable operator make sure his antenna "sees" the birds he needs?
**Direct Broadcast Satellite: Cable's worst nightmare?** (CED), by Leslie Ellis, March 1994, p.28. Detailed article on DirecTv service and how it works.
**DirecTv opens $100M DBS center; TCI, Bell Atlantic cut ribbons too.** (CED), May 1994, p.12. News coverage of three separate facilities related to digital compression and distribution of programming.
**EchoStar nails $335M in new DBS financing** (MCN), by John Higgins, 6/6/94, p.4. Another satellite DBS provider prepares to launch service.
**Gambling in space** (Conv), by Sue Marek, April 1994, p.42. A look at mobile satellite service and its potential.
**Hughes officially opens DirecTv center in Castle Rock** (MCN), by Peter Lambert, 4/11/94, p.30. The ribbon is cut on the DBS operations center.
**Hughes seeks to offer switched services via birds** (MCN), by Fred Dawson, 3/21/94, p.38. Plan is to use the Ka band for global coverage.
**Satellite failure may accelerate digital in Canada** (MCN), by Peter Lambert, 1/31/94, p.20. The failure of Anik 2 may result in a quick move to digitally compressed programs.

## SCTE

**Cable-Tec Expo draws 5,200 to St. Louis** (CED), July 1994, p.64. Coverage of the 1994 SCTE convention.
**NCTA's loss was SCTE's gain** (CED), by Wendell Bailey, NCTA, June 1994, p.22. Bill Riker leaves the NCTA and comes on to "save" the SCTE.
**The only constant is change...** (CED), by Leslie Ellis, Feb. 1994, p.64. Key messages from the SCTE Conference on Emerging Technology.
**Rocky Mountain Chapter learns telephony** (CED), by Leslie Ellis, April 1994, p.69. Coverage of a Rocky Mountain SCTE meeting that covered the basics of telephony.
**SCTE, Bellcore square off over drop specifications** (MCN), 2/28/94, p.28. Things get heated at an interface practices subcommittee meeting.
**SCTE celebrates 25th with little time to**

**look back** (CED), by Leslie Ellis, June 1994, p.38. Complete history of the SCTE's accomplishments and a look forward to future goals.
**SCTE welcomes new Board members** (CED), May 1994, p.14. News coverage of who won the national SCTE Board of Directors election.
**Time Warner's Jim Ludington wins Polaris Award** (CED), by Leslie Ellis, Feb. 1994, p.62. Why Ludington won the award for fiber optic innovation, given during the SCTE Conference on Emerging Technology.
**Woody named Member of Year; Antec given chairman's award** (CED), July 1994, p.68. Coverage of the major award winners during the SCTE Cable-Tec Expo.

## Set-tops

**Addressability: Going up** (CV), by Chris Nolan, 6/20/94, p.42. The universe of addressable set-tops is expanding.
**Are standards in the set-top's future?** (CED), by Roger Brown, May 1994, p.36. Current thinking about digital set-top standards.
**Boxed in?** (CV), by Chris Nolan, 6/20/94, p.48. MSOs should be patient when it comes to those new digital set-tops.
**Can you top this?** (Conv), by Roger Brown, Sept. 1994, p.20. There's a new group of vendors interested in making set-tops.
**Full-featured set-top to debut in interactive trial** (CED), Nov. 1993, p.10. News item about Interaxx set-top trial in Coral Springs, Fla.
**Digital standards: looking beyond MPEG** (CED), by Leslie Ellis, July 1994, p.36. Now it seems everyone wants to get into the act of developing digital standards for cable TV.
**Digitally incompatible** (CV), by Chris Nolan, 4/25/94, p.16. There are worries that the incompatibilities from the analog world will spill into the digital world.
**Experts see limited TV/PC/phone/set-top convergence** (MCN), by Peter Lambert, 11/29/93, p.125. Consumer electronics may continue to be very segmented, according to many.
**Future set-tops begin to take shape** (CED), July 1994, p.54. Coverage of the 1994 National Cable Show, where many new products and alliances were announced.
**Invisible software** (CV), by Chris Nolan, 10/24/94, p.24. Explanation of the layers of software that make those set-tops work.
**MPEG-2 disputes delay delivery of digital set-tops** (MCN), by Peter Lambert, 4/25/94, p.40. A delay in the standards process leads to differing views about when set-tops will be ready.
**Peeking inside the future digital set-top** (CED), by Roger Brown, May 1994, p.30. Now it seems everyone wants to build set-tops: the RBOCs, computer companies, you name it.
**Primestar DBS boxes to include multimedia software** (MCN), by Peter Lambert, 5/9/1994, p.32. A look inside the new Primestar units.
**Primestar to spend millions for MPEG-2 upgrade** (MCN), by Rachel Thompson, 12/6/93, p.10. Primestar may spend more than $50 million to upgrade 70,000 boxes to be MPEG-2 compatible.
**Re-regulation and DBS fuel addressable surge** (MCN), by Peter Lambert, 1/10/94, p.3. Addressability grows in popularity.
**Software solves set-top challenge** (MCN), by Peter Lambert, 2/14/94, p.26. Garden State Cable saves a bundle by "re-engineering" old set-tops to perform new functions.
**The standard question** (CV), by Chris Nolan, 7/11/94, p.22. There was a meeting to establish standards for set-tops, but none of the operators showed up.
**Time Warner plans to buy 1M S-A boxes** (CED), April 1994, p.10. News item about Time Warner Cable purchasing up to 1 million analog set-tops over the next three years.
**Who's inside that box?** (CV), by J.P. Mark, 10/3/94, p.26. The battle between the chip makers for real estate inside the new digital boxes.
**Zenith, Philips, CLI form alliance on set-tops** (MCN), by Fred Dawson, 5/23/94, p.29. The three will work together on new interactive boxes.

## Signal security

**3rd party set-top makers talk tough** (MCN), by Linda Haugsted, 1/31/94, p.14. Companies want to decriminalize possession of cable boxes bought from someone other than a cable operator.
**Cutting the Gordian Knot** (CED), by Archer Taylor, Malarkey-Taylor Assoc., Nov. 1993, p.86. The issue of signal security and its impact on system design.
**Encryption fundamentals and the DES** (CED), by Chris Bowick, Jones Intercable, August 1994, p.16. Defining data encryption methods and discussing the data encryption standard.
**How Continental of L.A. thwarted complex piracy ring** (CED), by Mike Bates of Continental and Robert Depweg, L.A.P.D., June 1994, p.58. Case study of one operator's battle to reduce piracy.
**Security and the NII** (CED), by Jeffrey Krauss, consultant, Sept. 1994, p.24. Tutorial on the types of security that exist.

## Tests and measurements

**After a municipal inspection of your system** (CED), by Jonathan Kramer, Communications Corp., August 1994, p.60. What to do before, during and after someone comes to test your cable system.
**Aural carrier center frequency measurement** (CED), by Steve Johnson, Time Warner Cable, June 1994, p.68. Explanation of how to perform the aural carrier test and why it should be performed.
**Back to basics: color distortions** (CED), by Chris Bowick, Jones Intercable, June 1994, p.24. Detailed discussion of the color tests that will be required by the FCC in 1995.
**CableLabs plans compression test lab** (CED), April 1994, p.8. News item that CableLabs will open a test facility to verify interoperability of MPEG 2 compression systems.
**In-band frequency response measurements** (CED), by David Large, Media Connections Group, August 1994, p.54. How and why to do these tests.
**Measuring cable system distortion** (CED), by Bill Morgan, CaLan, October 1994, p.72. Details on how to measure distortions.
**POP survey cites manpower as big eyeopener** (CED), by Leslie Ellis, Jan. 1994, p.72. Results of a national survey on proof-of-performance testing.
**Preparing for in-service video measurements** (CED), by Francis Edgington, Hewlett-Packard, June 1994, p.94. Things to think about to prepare for the color tests that have to be performed next year.
**Proof testing**, May 1994, p.94. Another survey about how operators are doing with the required FCC technical tests.
**A quick look at hum** (CED), by Leslie Read, Sammons Communications, July 1994, p.78. How and why to test for hum.
**Testing's only half the story** (CV), by Chris Nolan, 5/9/94, p.18. Sales of test equipment are up, but the tech standards are only half the reason.
**Tutorial on signal leakage and calibration** (CED), by Gregg Rodgers, Trilithic Inc., May

1994, p.60. How to test for signal leakage and why it's important.

## Trade show coverage

**Big money rushing into CAPs** (CED), by Fred Joyce, Jan. 1994, p.76. Coverage of Association for Local Telecommunications Services meeting reveals they have a lot of support on Wall Street.
**Broadband networks dominate show** (CED), by Roger Brown, Jan. 1994, p.64. Review of the 1993 Western Cable Show and how CableNet '93 was a huge hit. Plus other key announcements.
**Cable suppliers head south for the winter** (CED), by Roger Brown, Jan. 1994, p.78. North America has a lot of influence over how the networks in Argentina will be built, according to events at the Jornadas '93 show.
**Cable-Tec Expo draws 5,200 to St. Louis** (CED), July 1994, p.64. Coverage of the 1994 SCTE convention.
**Future set-tops begin to take shape** (CED), July 1994, p.54. Coverage of the 1994 National Cable Show, where many new products and alliances were announced.
**Integrated cable/phone platform comes into focus** (CED), by Fred Dawson, Feb. 1994, p.68. Review of the CableLabs CableNet '93 exhibit, how it worked and what that means to cable operators.
**Jerrold, S-A focus on telephony applications during Western Show** (CED), Dec. 1993, p.10. News item previewing the new products the two companies planned to unveil.
**Network flexibility will be key in future** (CED), by Roger Brown, April 1994, p.83. User-friendly networks without bottlenecks will be important, according to Ray Smith of Bell Atlantic. Coverage of the Optical Fiber Conference.
**New products debut at Western Show** (CED), Jan. 1994, p.68. A review of the new products announced during the 1993 Western Cable Show.
**SuperComm focuses on video systems** (CED), by Roger Brown and Leslie Ellis, June 1994, p.104. The SuperComm show has historically focused on telephony; this year the focus shifted to video provision.
**The only constant is change...** (CED), by Leslie Ellis, Feb. 1994, p.64. Key messages from the SCTE Conference on Emerging Technology.
**Time Warner's Jim Ludington wins Polaris Award** (CED), by Leslie Ellis, Feb. 1994, p.62. Why Ludington won the award for fiber optic innovation, given during the SCTE Conference on Emerging Technologies.
**Woody named Member of Year; Antec given chairman's award** (CED), July 1994, p.68. Coverage of the major award winners during the SCTE Cable-Tec Expo.

## Training and education

**Delegation: How to do it and why it's important** (CED), by Leslie Ellis, Dec. 1993, p.50. How to train yourself to become a good delegator.
**Engineering consortium expands training focus** (CED), by Patrick Etchart, Sept. 1994, p.81. International Engineering Consortium looks to get participation from the cable industry.
**Here come the specialists** (MCN supplement), by Leslie Ellis, 6/13/94, p.24A. Cable technical training is narrowing its focus.
**Managing stress at work: How to make it work for you** (CED), by Leslie Ellis, Dec. 1993, p.59. Too much stress in your life? Read this and learn how to use it to your advantage.
**Managing turbulent staffers in turbulent times** (CED), by Leslie Ellis, Dec. 1993, p.46. How to manage difficult or disruptive employees.
**Negotiation: How to get what you want** (CED), by Leslie Ellis, Dec. 1993, p.54. Looking for a raise or a promotion? This article may help you sell yourself.
**OSHA compliance: tips for safety managers** (CED), by Michelle Dionne, Antec, October 1994, p.66. New developments related to safety issues that affect cable TV systems.
**Total Quality Management, reducing waste and rework** (CED), by Leslie Ellis, Dec. 1993, p.64. What is TQM and how can it be integrated into your training program?
**Vendors don their training caps** (CED), by Roger Brown, June 1994, p.52. A look at how the training courses taught by vendors have changed over the years to become less commercial.

## Video compression

**CableLabs issues RFI; plans to test QAM** (CED), July 1994, p.16. News item noting that CableLabs has issued an RFI on digital video servers and plans to work with vendors to test digital modulation schemes.
**CableLabs plans compression test lab** (CED), April 1994, p.8. News item that CableLabs will open a test facility to verify interoperability of MPEG 2 compression systems.
**CableLabs undertakes MPEG rights project** (CED), June 1994, p.16. To help spur adoption of MPEG standards, CableLabs attempts to provide access to intellectual property rights issues.
**Century plans digital compression blitz in L.A.** (MCN), by Peter Lambert, 11/15/93, p.60. Century intends to buy 300,000 GI set-tops for deployment in Los Angeles.
**Defining a North American digital television system** (CED), by Graham Stubbs, consultant to TV/COM International, October 1994, p.44. Why it's so important to develop a digital standard for networks.
**Good news, bad news** (CV), by Chris Nolan, 9/19/94, p.20. The DBS services show that MPEG compression works pretty well.
**Going digital** (CV), by Chris Nolan, 12/6/93, p.94. Stories about HDTV, ATM and compression.
**Is it MPEG2?** (CV), by Chris Nolan, 1/10/94, p.38. Coverage of the debate between MPEG and DigiCipher standards.
**Riding on the "Headend in the sky"** (CV), by Tom Kerver, 3/14/94, p.38. The details of how TCI wants to offer other MSOs a chance to receive digital video.
**S-A unveils digital video file server for NVOD, enhanced PPV applications** (CED), June 1994, p.14. News item about new product from Scientific-Atlanta that can offer compressed movies.
**Which is better for cable: QAM or VSB?** July 1994, p.22. Overview of the differences between QAM and VSB technologies.
**Zenith advanced modulation tests get thumbs up** (MCN), by Fred Dawson, 11/15/93, p.62. Videoway tests VSB technology, and it passes with flying colors.
**Zenith's technology chosen for HDTV** (CED), April 1994, p.8. News item that Grand Alliance has chosen VSB digital transmission technology for advanced TV.

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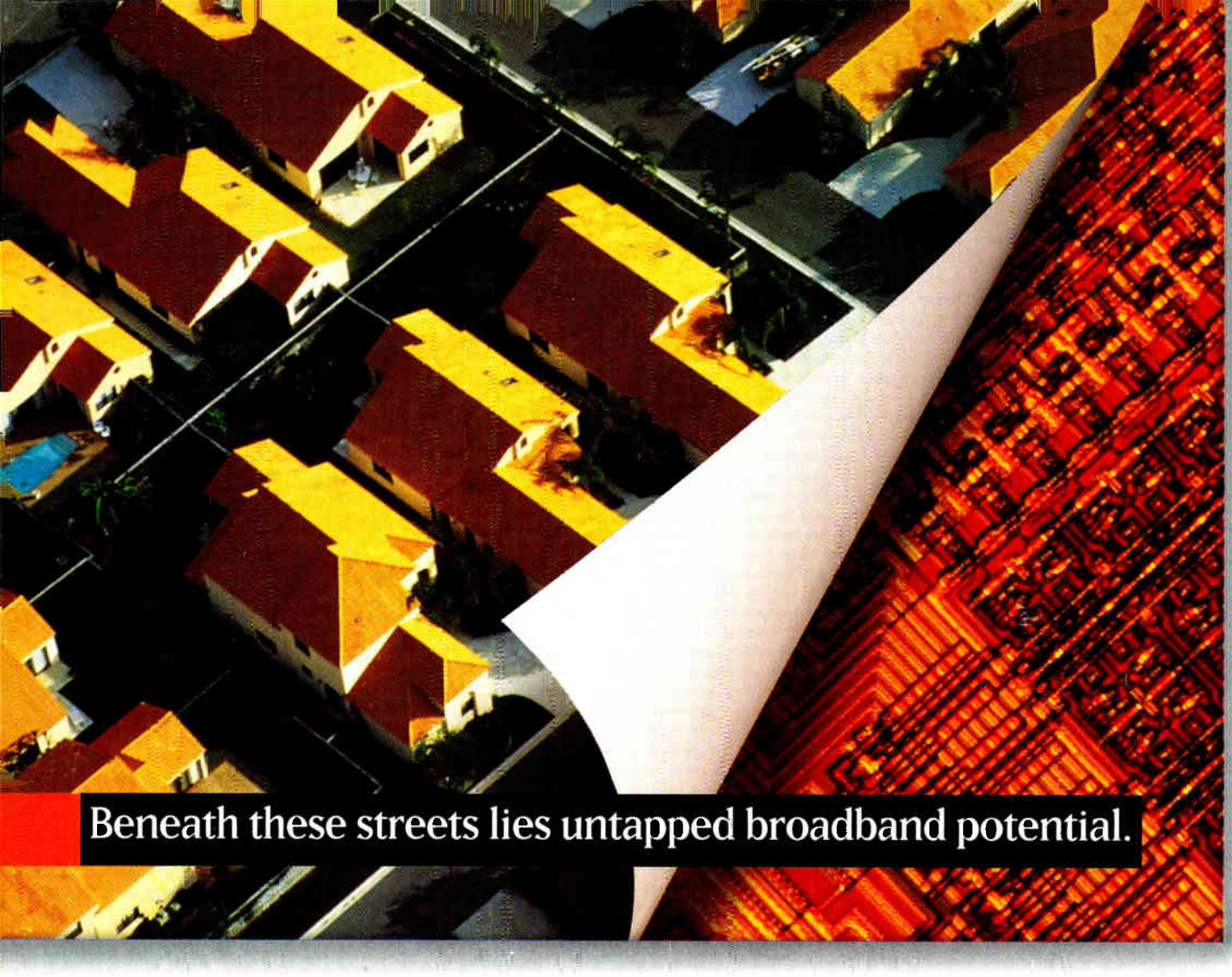


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*Polaris Award winner – 1993*

# The North American numbering plan

## Cracking the area code mystery

*By Neal McLain, Project Manager, Communication Technologies Inc.*

Area code 215, which serves Pennsylvania, was recently split, and the western part of 215 was assigned a new area code, 610. Consequently SCTE's national headquarters now has a new telephone number: 610-363-6888.

Another new area code, 710, also was introduced recently.

For those in the cable television industry, these assignments will have far more significance than the new number at SCTE headquarters might indicate. The reason: of the 144 area codes presently available in North America, 610 and 710 were the 143rd and 144th area codes to be assigned. As of the publication date of this article, North America has run out of area codes.

With the cable industry on the verge of launching telephone services, thousands of new telephone numbers will be needed. PCS services will need new numbers too. Where will these new numbers come from?

The answer to that question lies in a new numbering plan to be introduced in 1995. The new numbering plan will affect all telephone numbers in what's called "World Zone 1," which includes the United States, Canada, and parts of the Caribbean.

The new numbering plan is actually the fourth numbering plan North America has had: Previous plans were introduced in 1952, 1960 and 1975. Before describing the new numbering plan, the history of these earlier plans will be examined.

The first attempt to establish a uniform format for telephone numbers in the United States and Canada was introduced in 1952.[1] According to this plan, all telephone numbers were supposed to look like this:

215 LOcust 4-9232

The number was composed of three segments: the area code (215), the central office code (LOcust 4), and the individual subscriber line number (9232).

Insofar as possible, one area code was assigned to each state or province. However, there were exceptions: some states and provinces had more than one area code, and the Maritime Provinces (New Brunswick, Nova Scotia, and Prince Edward Island) shared one area code (902).

The second digit of the area code was always 0 or 1 so that area codes could be distinguished from central office codes. The second digit also specified the number of area codes within a state or province: 0 meant the state had only one area code, and 1 meant that it had more than one. Florida, for example, had one area code (305), but Ontario had two (416 and 613). (See Figure 1.)

Only the first two letters of the central office code were dialed; these letters were capitalized in directory listings. "LOcust 4" actually represented the digit combination 564.

It was a nice quaint numbering system. Telephone companies could pick prominent locally-significant names for central office codes (like LOcust in Philadelphia, NAtional in Washington, and UPtown in Chicago) so they'd be easy to remember. And long-distance operators could easily recognize states and provinces with multiple area codes.

But the system had problems.

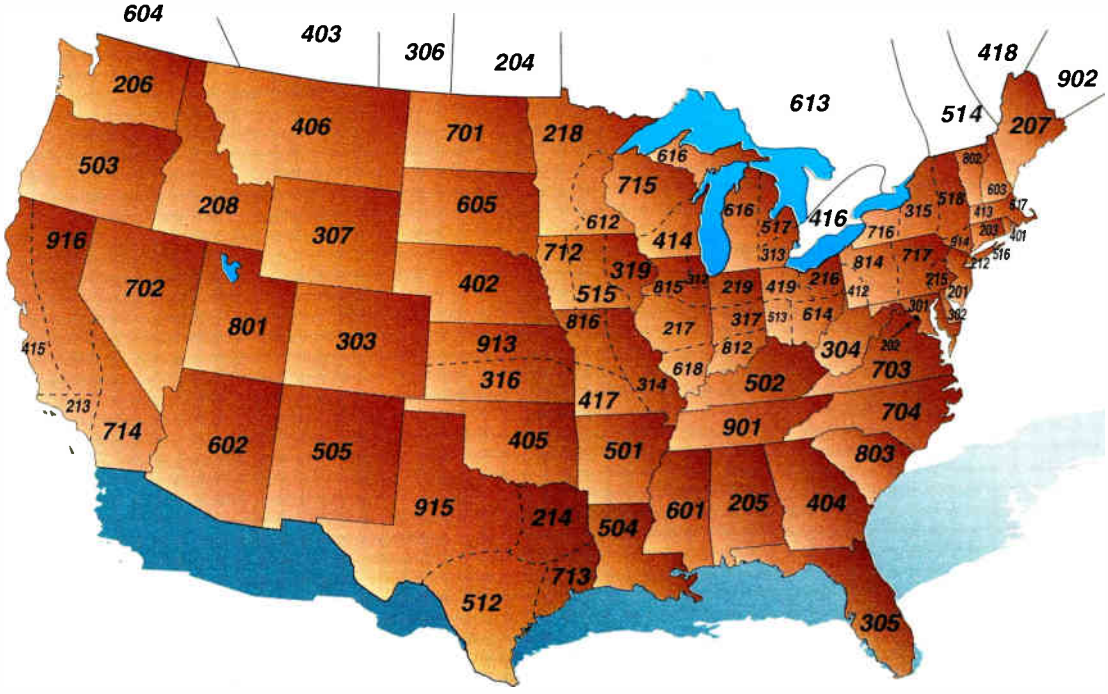
Much confusion arose over the "dial-only-the-first-two-letters" requirement. When confronted with LOcust, some callers would dial LOCUST.

Confusion arose over the distinction between the letter "O" and the number zero. LOcust 4 would be dialed as 504 instead of 564. Similar confusion arose over the distinction between the letter "I" and the number one: LIncoln 9 would be dialed as 519 rather than 549.

The choice of central office code names sometimes added to the confusion. Arlington Heights, Ill. was home to ORange 0, which directory assistance operators cheerfully pronounced, "oh are oh."

Some central office names had unintended cultural significance, particularly to outsiders. To someone unfamiliar with Philadelphia

**Figure 1:** *1952 National Numbering Plan*



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street names, what does "LOcust" mean? An insect? A tree? The Ninth Plague?

Some combinations were just about impossible to use because of the lack of suitable English words: 55 and 57 were never used (apparently, KLondike and KRemlin weren't considered "local").

The second-digit-0 designation for single-area code states didn't work either, because many of the original single-code states outgrew number capacity. By 1958, 10 single-code states had already acquired a second: Florida, Georgia, Kentucky, Louisiana, Nebraska, New Jersey, North Carolina, Oklahoma, Tennessee and Washington.

By the late 1950s, it was obvious that the system needed to be changed. The second-digit-0 designation for single-area code states had already been abandoned, and it was time to abandon the two-letter central office designations as well. In a flurry of publicity, ANC, or All Number Calling, was born. LOcust 4 became 564; ORange 0 became 670; NAtional 8 became 628; UPtown 8 became 878.

There was much opposition to this change. City officials railed against the plan as though the telephone companies were trying to steal their very cultural identities. Newspaper editors fretted that the public would never be able to remember seven-digit numbers. But in the end, ANC happened anyway. By the time the dust settled, telephone numbers looked like this:

215 564-9232.

The telephone number was still composed of three segments: the area code (215), the central office code (564), and the individual subscriber number (9232). The second digit of the area code was still restricted to 0 or 1 so that the telephone switching equipment could distinguish area codes from central office codes.

This change produced two immediate results: dialing errors were reduced, and formerly unusable central office codes could be used. One formerly unusable combination (55) was put to immediate use as the uniform nationwide code for directory assistance: 555.

## The 1975 numbering plan

By the mid-'70s, the demand for numbers was again outgrowing the capacity of the numbering plan. But it was evident that just assigning more area codes wasn't necessarily the best solution if number assignments within existing area codes could be used more efficiently.

In attempt to do this, some telephone companies began assigning area-code-like combinations (with 0 or 1 as the second digit) as central office codes. We started seeing telephone numbers like these:

201-200-2000
214-907-2297
215-619-9232
301-713-2825
708-803-3608

And, of course, the cable industry's all-time favorite:

202-416-0856 (the FCC Cable Bureau).

Within area codes where these central office codes were used, the switching equipment couldn't tell the difference between another area code and a central office code. This posed a problem for intra-area long-distance calls. To illustrate this problem, compare the following numbers:

313-913-2639 in Ann Arbor, Mich.
913-263-9232 in Abilene, Kan.

If a caller from Detroit (also in area code

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***Table 1:** The original 144 area codes*

*Listed below are the 144 area codes presently available in World Zone 1, and the assignments which existed on December 1, 1994. This list includes all area codes which can possibly exist under the current (1975) numbering plan.*

| | | |
|---|---|---|
| 201 | New Jersey (northern) | Orig. Assign. 1952; two splits (609, 908). |
| 202 | District of Columbia | Orig. Assign. 1952; never split. |
| 203 | Connecticut | Orig. Assign. 1952; never split. |
| 204 | Manitoba | Orig. Assign. 1952; never split. |
| 205 | Alabama | Orig. Assign. 1952; never split. |
| 206 | Washington (western) | Orig. Assign. 1952; one split (509). |
| 207 | Maine | Orig. Assign. 1952; never split. |
| 208 | Idaho | Orig. Assign. 1952; never split. |
| 209 | California (Fresno) | Split from 916. |
| 210 | Texas (San Antonio) | Split from 512. |
| 212 | New York (NYC Manhattan) | Orig. Assign. 1952; one split (718). see 917. |
| 213 | California (Los Angeles) | Orig. Assign. 1952; three splits (310, 805, 818). |
| 214 | Texas (Dallas) | Orig. Assign. 1952; one split (903). |
| 215 | Pennsylvania (Philadelphia) | Orig. Assign. 1952; one split (610). |
| 216 | Ohio (northeast) | Orig. Assign. 1952; never split. |
| 217 | Illinois (Springfield) | Orig. Assign. 1952; one split (309). |
| 218 | Minnesota (northern) | Orig. Assign. 1952; boundaries changed ca.1958. |
| 219 | Indiana (northern) | Orig. Assign. 1952; never split. |
| 301 | Maryland (western) | Orig. Assign. 1952; one split (410). |
| 302 | Delaware | Orig. Assign. 1952; never split. |
| 303 | Colorado (northern) | Orig. Assign. 1952; one split (719). |
| 304 | West Virginia | Orig. Assign. 1952; never split. |
| 305 | Florida (Miami) | Orig. Assign. 1952; three splits (407, 813, 904). |
| 306 | Saskatchewan | Orig. Assign. 1952; never split. |
| 307 | Wyoming | Orig. Assign. 1952; never split. |
| 308 | Nebraska (western) | Split from 402. |
| 309 | Illinois (Peoria) | Split from 217 and 815. |
| 310 | Calif. (L.A. suburban) | Split from 213. |
| 312 | Illinois (Chicago) | Orig. Assign. 1952; one split (708). |
| 313 | Michigan (Detroit) | Orig. Assign. 1952; one split (810). |
| 314 | Missouri (eastern) | Orig. Assign. 1952; never split. |
| 315 | New York (Syracuse) | Orig. Assign. 1952; one split (607). |
| 316 | Kansas (southern) | Orig. Assign. 1952; never split. |
| 317 | Indiana (central) | Orig. Assign. 1952; never split. |
| 318 | Louisiana (western) | Split from 504. |
| 319 | Iowa (eastern) | Orig. Assign. 1952; never split. |
| 401 | Rhode Island | Orig. Assign. 1952; never split. |
| 402 | Nebraska (eastern) | Orig. Assign. 1952; one split (308). |
| 403 | Alberta | Orig. Assign. 1952; never split. |
| 404 | Georgia (Atlanta) | Orig. Assign. 1952; two splits (706, 912). |
| 405 | Oklahoma (western) | Orig. Assign. 1952; one split (918). |
| 406 | Montana | Orig. Assign. 1952; never split. |
| 407 | Florida (Orlando) | Split from 305. |
| 408 | California (Silicon Valley) | Split from 415. |
| 409 | Texas (Houston suburban) | Split from 713. |
| 410 | Maryland (eastern) | Split from 301. |
| 412 | Pennsylvania (Pittsburgh) | Orig. Assign. 1952; never split. |
| 413 | Massachusetts (western) | Orig. Assign. 1952; never split. |
| 414 | Wisconsin (southeast) | Orig. Assign. 1952; one split (608). |
| 415 | California (San Francisco) | Orig. Assign. 1952; three splits (408, 510, 707). |
| 416 | Ontario (Toronto) | Orig. Assign. 1952; two splits (519, 905). |
| 417 | Missouri (southwest) | Orig. Assign. 1952; never split. |
| 418 | Quebec (eastern) | Orig. Assign. 1952; never split. |
| 419 | Ohio (northwest) | Orig. Assign. 1952; never split. |
| 501 | Arkansas | Orig. Assign. 1952; never split. |
| 502 | Kentucky (western) | Orig. Assign. 1952; one split (606). |
| 503 | Oregon | Orig. Assign. 1952; never split. |
| 504 | Louisiana (eastern) | Orig. Assign. 1952; one split (318). |
| 505 | New Mexico | Orig. Assign. 1952; never split. |
| 506 | New Brunswick | Split from 902. |
| 507 | Minnesota (southern) | Split from 218 and 612. |
| 508 | Massachusetts (eastern) | Split from 617. |
| 509 | Washington (eastern) | Split from 206. |
| 510 | California (Oakland) | Split from 415. |
| 512 | Texas (Austin) | Orig. Assign. 1952; one split (210). |
| 513 | Ohio (southwest) | Orig. Assign. 1952; never split. |
| 514 | Quebec (Montreal) | Orig. Assign. 1952; one split (819). |
| 515 | Iowa (central) | Orig. Assign. 1952; never split. |
| 516 | New York (Long Island) | Orig. Assign. 1952; never split. |
| 517 | Michigan (central) | Orig. Assign. 1952; never split. |
| 518 | New York (upstate) | Orig. Assign. 1952; never split. |
| 519 | Ontario (Windsor) | Split from 416. |
| 601 | Mississippi | Orig. Assign. 1952; never split. |
| 602 | Arizona | Orig. Assign. 1952; never split. |
| 603 | New Hampshire | Orig. Assign. 1952; never split. |
| 604 | British Columbia | Orig. Assign. 1952; never split. |
| 605 | South Dakota | Orig. Assign. 1952; never split. |
| 606 | Kentucky (eastern) | Split from 502. |
| 607 | New York (Binghampton) | Split from 315. |
| 608 | Wisconsin (southwest) | Split from 414. |
| 609 | New Jersey (southern) | Split from 201. |
| 610 | Pennsylvania (Allentown) | Split from 215. |
| 612 | Minnesota (central) | Orig. Assign. 1952; boundaries changed ca. 1958. |
| 613 | Ontario (Ottawa) | Orig. Assign. 1952; two splits (705, 807) |
| 614 | Ohio (southeast) | Orig. Assign. 1952; never split. |
| 615 | Tennessee (eastern) | Split from 901. |
| 616 | Michigan (western) | Orig. Assign. 1952; one split (906). |
| 617 | Massachusetts (Boston) | Orig. Assign. 1952; one split (508). |
| 618 | Illinois (southern) | Orig. Assign. 1952; never split. |
| 619 | California (San Diego) | Split from 714. |
| 701 | North Dakota | Orig. Assign. 1952; never split. |
| 702 | Nevada | Orig. Assign. 1952; never split. |
| 703 | Virginia (northern) | Orig. Assign. 1952; one split (804). |
| 704 | North Carolina (western) | Orig. Assign. 1952; two splits (910, 919). |
| 705 | Ontario (eastern) | Split from 613. |
| 706 | Georgia (northern) | Split from 404. Formerly northwest Mexico. |
| 707 | California (northwest) | Split from 415. |
| 708 | Illinois (Chicago suburban) | Split from 312. |
| 709 | Newfoundland | Orig. Assign. ca 1961; never split. |
| 710 | United States Government | Orig. Assign. 9/18/94. |
| 712 | Iowa (western) | Orig. Assign. 1952; never split. |
| 713 | Texas (Houston) | Orig. Assign. 1952; one split (409). |
| 714 | California (Orange County) | Orig. Assign. 1952; two splits (619, 909). |
| 715 | Wisconsin (northern) | Orig. Assign. 1952; never split. |
| 716 | New York (Rochester) | Orig. Assign. 1952; never split. |
| 717 | Pennsylvania (Harrisburg) | Orig. Assign. 1952; never split. |
| 718 | NYC outer boroughs | Split from 212, but see 917. |
| 719 | Colorado (southeast) | Split from 303. |
| 801 | Utah | Orig. Assign. 1952; never split. |
| 802 | Vermont | Orig. Assign. 1952; never split. |
| 803 | South Carolina | Orig. Assign. 1952; never split. |
| 804 | Virginia (southern) | Split from 703. |
| 805 | California (Bakersfield) | Split from 213, 415 and 916. |
| 806 | Texas (Amarillo) | Split from 915. |
| 807 | Ontario (western) | Split from 613. |
| 808 | Hawaii | Orig. Assign. ca 1973; never split. |
| 809 | Caribbean Islands | Orig. Assign. ca 1973; never split. |
| 810 | Michigan (eastern) | Split from 313. |
| 812 | Indiana (southern) | Orig. Assign. 1952; never split. |
| 813 | Florida (Tampa) | Split from 305. |
| 814 | Pennsylvania (Altoona) | Orig. Assign. 1952; never split. |
| 815 | Illinois (Rockford) | Orig. Assign. 1952; one split (309). |
| 816 | Missouri (northwest) | Orig. Assign. 1952; never split. |
| 817 | Texas (Fort Worth) | Split from 915. |
| 818 | Calif. (San Fernando Valley) | Split from 213. |
| 819 | Quebec (western) | Split from 514. |
| 901 | Tennessee (western) | Orig. Assign. 1952; one split (615). |
| 902 | Nova Scotia; Prince Ed. Is. | Orig. Assign. 1952; one split (506). |
| 903 | Texas (Dallas suburban) | Split from 214. Formerly northwest Mexico. |
| 904 | Florida (northern) | Split from 305. |
| 905 | Ontario (Toronto suburban) | Split from 416. Formerly Mexico City. |
| 906 | Michigan (Upper Peninsula) | Split from 616. |
| 907 | Alaska | Orig. Assign. ca 1973; never split. |
| 908 | New Jersey (central) | Split from 201. |
| 909 | California (Inland Empire) | Split from 714. |
| 910 | North Carolina (central) | Split from 919 after 919 was split from 704. |
| 912 | Georgia (southern) | Split from 404. |
| 913 | Kansas (northern) | Orig. Assign. 1952; never split. |
| 914 | New York (Yonkers) | Orig. Assign. 1952; never split. |
| 915 | Texas (El Paso) | Orig. Assign. 1952; two splits (806, 817). |
| 916 | California (northeast) | Orig. Assign. 1952; two splits (209, 805). |
| 917 | New York (wireless overlay) | Orig. Assign. 1992; overlay on 212 and 718. |
| 918 | Oklahoma (eastern) | Split from 405. |
| 919 | North Carolina (eastern) | Split from 704; one split (910). |

*Assignments which existed in 1952 are identified as "original assignment 1952," although many were actually in use as "operator route" codes prior to 1952. Dates identified "ca" are approximate.*

investors. As part of its participation in NAFTA, it has agreed to reduce or eliminate tariffs on telecommunications equipment. And it has agreed to allow U.S. long-distance companies to operate in Mexico in competition with TelMex.

✔ Taking advantage of this situation, MCI recently announced a $450-million joint venture deal to "complete the first integrated North American network capable of providing service with identical features to customers throughout the continent."[2] It's safe to assume that MCI's competitors have their own plans as well. These companies will certainly want to make it easy ("seamless") for their U.S. and Canadian customers to call into Mexico.

## Number portability

The availability of all these new area codes will certainly alleviate the potential shortage of new telephone numbers. But the question now arises: once the cable television industry gets into the telephone exchange business, what telephone numbers will actually be available for cable's use?

This brings us to the issue of "number portability." Number portability means that any telephone subscriber can switch service providers without having to change telephone numbers.

Number portability is already a requirement for 800 numbers: all long-distance carriers share a common database of numbers, so that any subscriber can switch carriers without having the switch to a new 800 number.

In theory, this same technique can be applied to the local telephone exchange. If, for example, a cable television operator wished to provide telephone service in competition with the local telephone exchange carrier (LEC), the cable operator and the LEC would both use a common set of telephone numbers. A subscriber could then switch back and forth between the LEC to the cable operator without having to change numbers.

Putting this theory into practice may be very difficult. In order to implement number compatibility, the cable operator will have to negotiate at least three issues with the LEC:

✔ Number database sharing. If both companies use a common set of telephone numbers, a shared database of all local telephone numbers must be established so that both companies can access it for number assignments.

✔ Switch interconnection. In order to offer local service on the same basis as the LEC, the cable operator's switching equipment would have to be connected to the LEC's switching equipment.

✔ Directory listings. Telephone numbers assigned to the cable operator's telephone subscribers would have to be listed in all directories, including the directory published by the LEC itself.

But is number portability all that important? There are many situations in which a cable operator could assign numbers from a completely different group of numbers, and subscribers wouldn't care: price, reliability, and special features would be the deciding factors. Such situations include:

✔ Business PBX outgoing lines. The actual number assigned to a PBX outside line is not important: when someone dials 9 from an office or hotel room, they don't need to know the number of the line they're actually using.

✔ Residential unlisted lines. Separate lines used for security systems, computer modems, and the like, are usually not listed, so the subscriber isn't likely to care what the actual num-

ber is.

✔ Inbound WATS (800) lines. Most WATS "lines" actually aren't separate lines; they're just ordinary local lines with two numbers: the local number and the 800 number. When a caller dials an 800 number, the telephone equipment looks up the corresponding local number in a gigantic lookup table. It makes no difference what the local number is: the 800 number remains "portable" even of the local number isn't.

✔ Long-distance-only lines. A long-distance-only line can be used for one purpose only: inter-LATA long-distance calls through a specific long-distance company. By bypassing the LEC altogether, the long-distance company can avoid "access charges" imposed by the LEC for local call completion.

It's entirely possible that numbers used in these situations would have a different central office code. And it's even possible that they might have a different area code: one of those overlay area codes described earlier. A case in point: cable operators in the Houston area may well find themselves using area code 281.

Area code and central office code assignments are made by an organization known as the North American Numbering Plan Administration, or NANPA. Back in the pre-divestiture days, NANPA was part of the old Bell system. After divestiture, NANPA became part of Bell Communications Research, or Bellcore, the research organization owned by the seven regional holding companies (RHCs) that resulted from the breakup of AT&T.

NANPA is in a somewhat awkward position these days. Although it's owned by the seven RHCs, it assigns the area codes and central office codes needed by every telephone entity in the North American Numbering Plan: Bell operating companies, GTE, independent telephone companies, Canadian telephone companies, the U.S. and Canadian governments, municipally- and cooperatively-owned telephone exchanges, paging companies and cellular companies. No matter who wins the PCS auctions, PCS operators will have to get code assignments from NANPA. When cable television operators get into the telephone business, they, too, will have to get their assignments from NANPA.

In the view of some, this situation poses a conflict of interest: NANPA is owned by the seven RHCs, yet it is responsible for assigning codes to all telephone entities, owner and competitor alike. Can it do this fairly, without favoring its seven owners?

While there does not appear to be any evidence that NANPA has abused its position, Bellcore and the seven RHCs are understandably sensitive to the situation. As a result, Bellcore has concluded that it should give up the responsibility for numbering plan administration.

Several months ago, Bellcore formally notified the FCC of its desire to relinquish responsibility for NANPA. The Commission subsequently issued a Notice of Inquiry and a Notice of Proposed Rulemaking. In the NPRM, the Commission proposed to transfer numbering plan administration to a "non-government entity established by the Commission and subject to its oversight, but also separate from the Commission and not closely identified with any particular industry segment."[3] The NPRM also addressed the "international implications" of the Commissions's proposal, in recognition of the fact that World Zone 1 also includes Canada and several Caribbean islands.

Reply comments to the NPRM were due on June 30, 1994. Presumably, the Commission will adopt a Report and Order one of these days.

**Table 2:** *New "interchangeable" area codes*

*At least 14 interchangeable area codes will be introduced in 1995. Interchangeable area codes don't have 0 or 1 as the second digit; hence, they're interchangeable with (and indistinguishable from) central office codes.*

*Underscoring the immediate need for new area codes, three of these new codes will go into service during the first two weeks of January: 334 in Alabama, 360 in Washington state, and 630 in the Chicago area.*

*The table below lists new codes announced by Bellcore as of November 1, 1994. Codes with firm start dates have been formally assigned. Codes with pending start dates have been "reserved," subject to approval by the relevant state-level utility-regulatory agency.*

| DATE | CODE | LOCATION | DESCRIPTION |
|---|---|---|---|
| 1/95 | 334 | Alabama, southern | Split from 205. |
| 1/95 | 360 | Washington, southwest | Split from 206. |
| 1/95 | 630 | Illinois, Chicago metro | Overlay on 312 and 708. |
| 3/95 | 281 | Texas, Houston metro | Overlay on 713. |
| 3/95 | 520 | Arizona, state except Phoenix metro | Split from 602. |
| 4/95 | 970 | Colorado | Split from 303. |
| 5/95 | 941 | Florida, southwest | Split from 813. |
| 7/95 | 540 | Virginia, southwest | Split from 703. |
| Unknown | 456 | National | Inbound international. |
| Pending | 423 | Tennessee, eastern | Split from 615. |
| Pending | 562 | California, Los Angeles metro | Overlay on 213, 310 and 818. |
| Pending | 770 | Georgia, Atlanta metro | Split from 404 (*). |
| Pending | 954 | Florida, southeast | Split from 305 (*). |
| Pending | ? | Bermuda | Split from 809. |

*Source: Bell Communications Research; Telecom Digest.*

*(*) Depending on the outcome of pending negotiations between telephone companies and their respective state-level regulatory agencies, these codes may end up being overlays instead of splits.*

## Conclusion

In conclusion, here are some predictions about the future:

✔ Wireless electronic gadgets will continue to proliferate, and many of them will be designed around the new PCS frequencies. The wireless PDA, combining the functions of telephone, alphanumeric pager, voice mail box, e-mail box, fax message display, clock, calendar, calculator, caller ID display, personal telephone directory, and interactive game toy, will be a big whiz-bang consumer gadget.

✔ There will be a big demand for antenna sites to serve all these wireless gadgets, and for wireline networks to interconnect the antenna sites. Owners of existing wireline networks will be in a good position to provide these services.

✔ What we now call "area codes" will lose significance as indications of geographic location. Just as "LOcust" and "UPtown" dissolved into the regional inventories of seven-digit numbers, area codes will dissolve into the continentwide inventory of 10-digit numbers. CED

## Acknowledgments

The author wishes to thank the following persons and organizations for information used in this article: Ken Branson, Manager of Corporate Communications, Bellcore; Garry Benoit, former Manager, North American Numbering Plan Administration, Bellcore; MCI Public Relations; Telecom Digest, an Internet list server; and the State Historical Society of Wisconsin.

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*2. Press release, MCI Communications Corporation, Washington, January 1994.*

*3. Federal Communications Commission, Notice of Proposed Rulemaking, CC Docket No. 92-237, FCC 94-79.*

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# Technical overview of digital music services

## Gaining insight

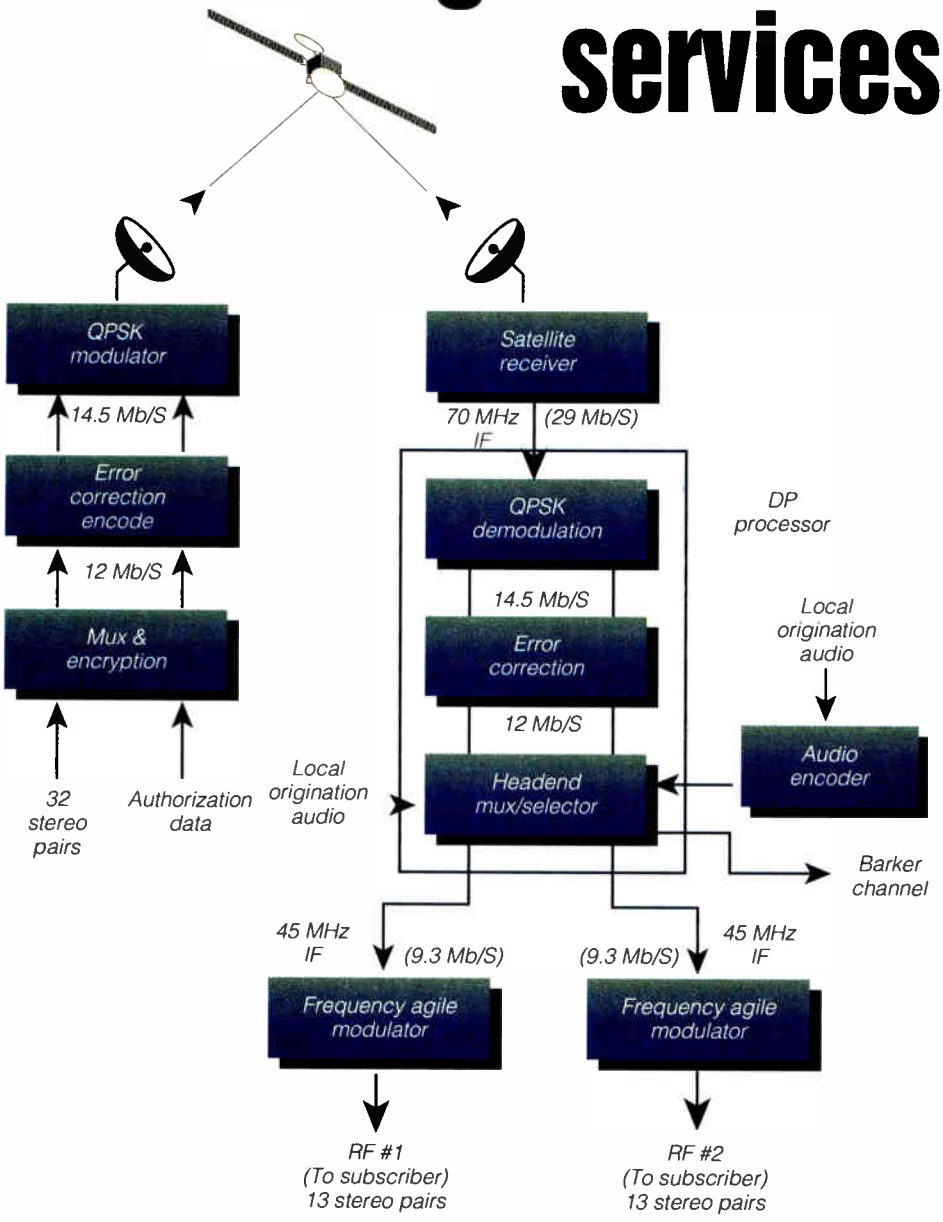


***Figure 1:*** *Basic DP transmission link*

*By Ed Krom, Consultant, Krom Technical Services*

Digital radio services delivered via the cable system are a recent addition to the subscriber service menu that augments normal television programming. These cable radio services consist of commercial-free, all-music format programming; television stereo simulcast audio; or special live local origination, such as concerts. Most of the digital cable radio services are equal in quality to digital compact discs. With the increasing emphasis on audio quality by the consumer and cable operator alike, it's imperative that the digital radio service chosen is easy to integrate into the cable system, easy to maintain, and above all, easy for the subscriber to integrate and interface with his existing consumer audio devices.

Equipment from three major suppliers of digital music programming for cable television systems was field tested and evaluated by Media General Cable of Fairfax, Va. to determine its suitability for cable transmission and subscriber satisfaction.

The evaluations were to be utilized in determining which one of the three systems might be the best overall service to deploy in the Media General Cable system. The following information provides a technical overview of how each of the three digital radio services operated, and how they performed through Media General's microwave (AML) and cable television plant during the evaluation time period. Many lessons were learned from the experience of "first-hand" installation, testing and evaluation of digital stereo radio. The experiences gained can also be applied to the new satellite-delivered, compressed video services now being deployed in cable television systems.

During the summer and autumn of 1991, equipment was requested and supplied to Media General Cable for evaluation by the following three companies:

✔ Digital Planet (DP), Digital Radio Labs Inc., Carson, Calif.;
✔ Digital Cable Radio (DCR), Jerrold Communications Inc., Hatboro, Pa.;
✔ Digital Music Express (DMX), Scientific-Atlanta Inc., Atlanta, Ga.

### DP–Digital Radio Labs

The Digital Planet (DP) basic service was digitally multiplexed and uplinked from its studio facilities in Holmdale, N.J. to a transponder on the GTE SpaceNet 1 satellite. The basic programming service provided a mixture of true digital audio (pre-recorded, digital audio tape, compact disc quality), four FM broadcast stations and six cable television stereo simulcast channels. Digital Planet planned to add six more stereo simulcast channels (Eastern time zone feeds) and more digital music offerings on a second SpaceNet 1 satellite transponder by the end of November 1991.

The Digital Planet music service is no longer available.

The Digital Planet service was received at the headend facility from SpaceNet 1 via MGC's Simulsat 7, seven-meter satellite earth station antenna. The satellite feed output was downconverted with a Drake Communications Inc. phased-locked-loop type, low-noise block convertor (LNB) to the standard satellite receiver frequency format of 950 MHz to 1450 MHz. Engineers from DP had suggested we use the more frequency stable type LNBs

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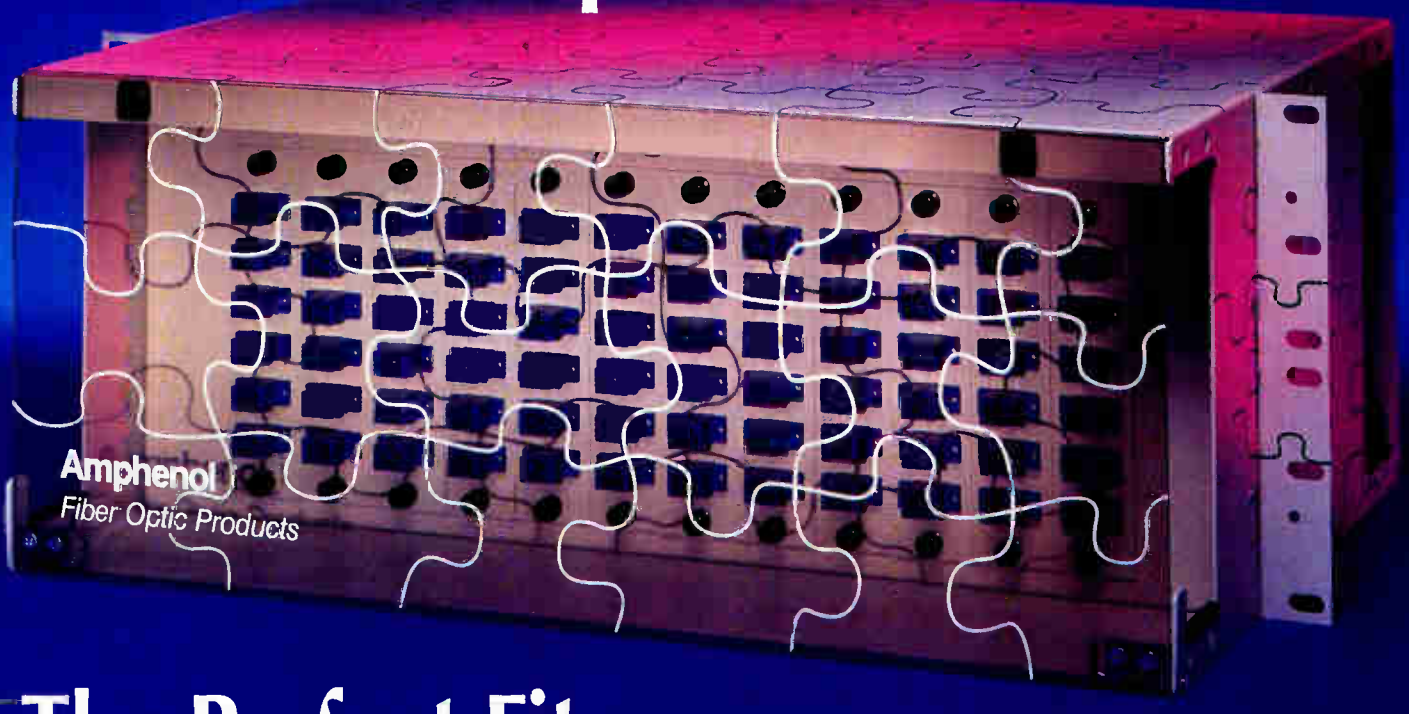


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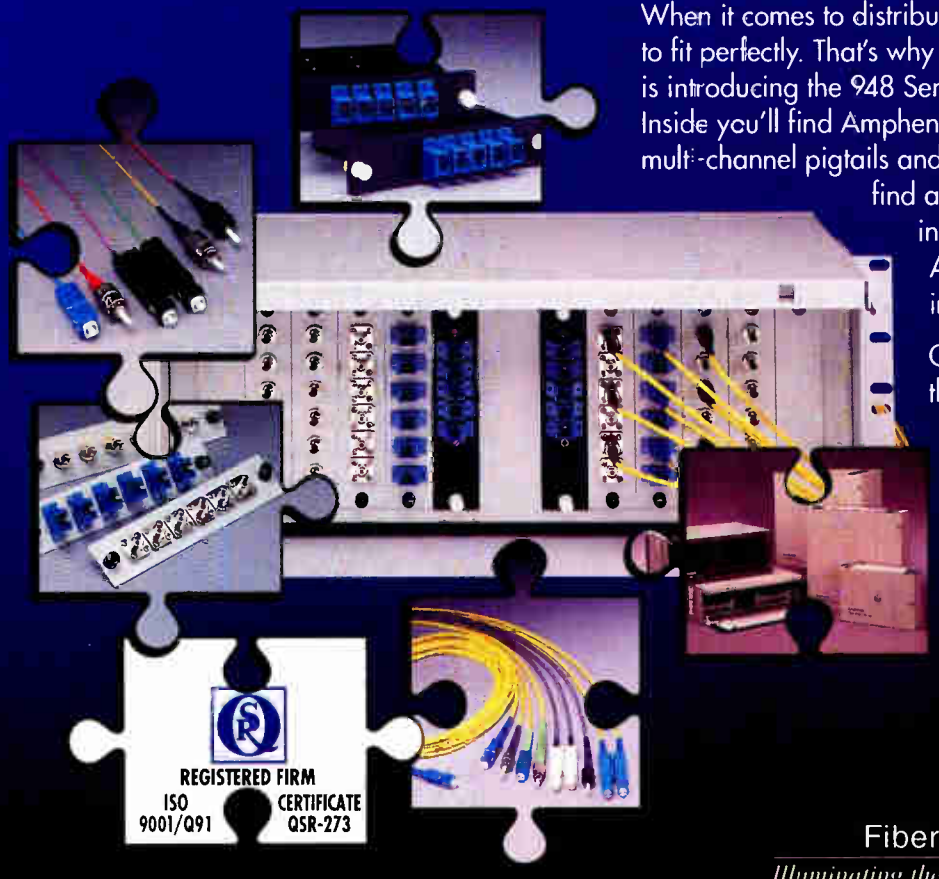


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*Figure 4: One discrete digital cable radio channel occupies 600 kHz of bandwidth*

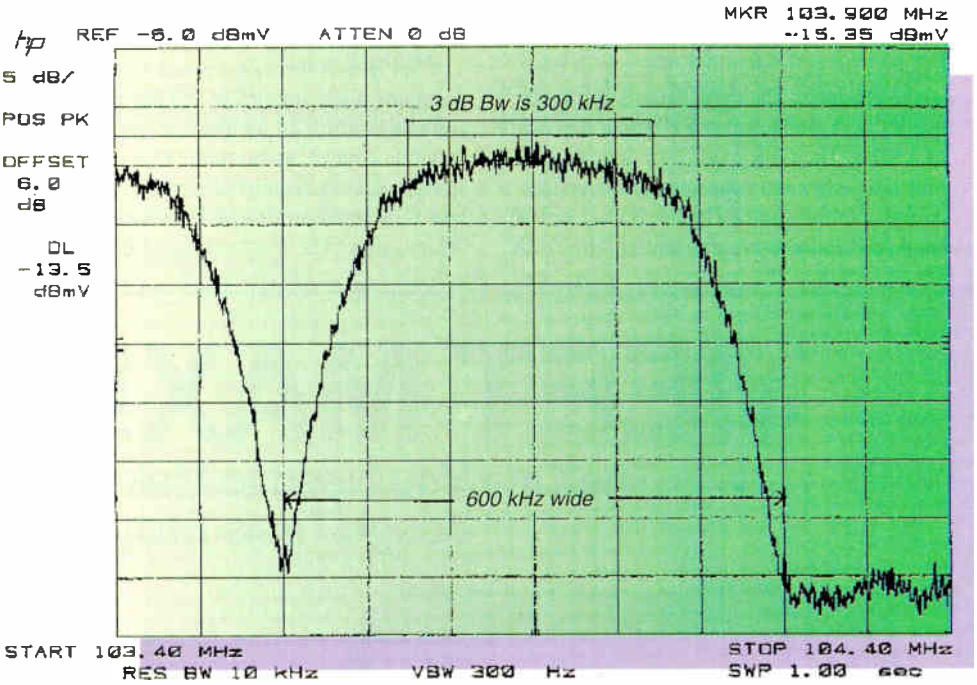
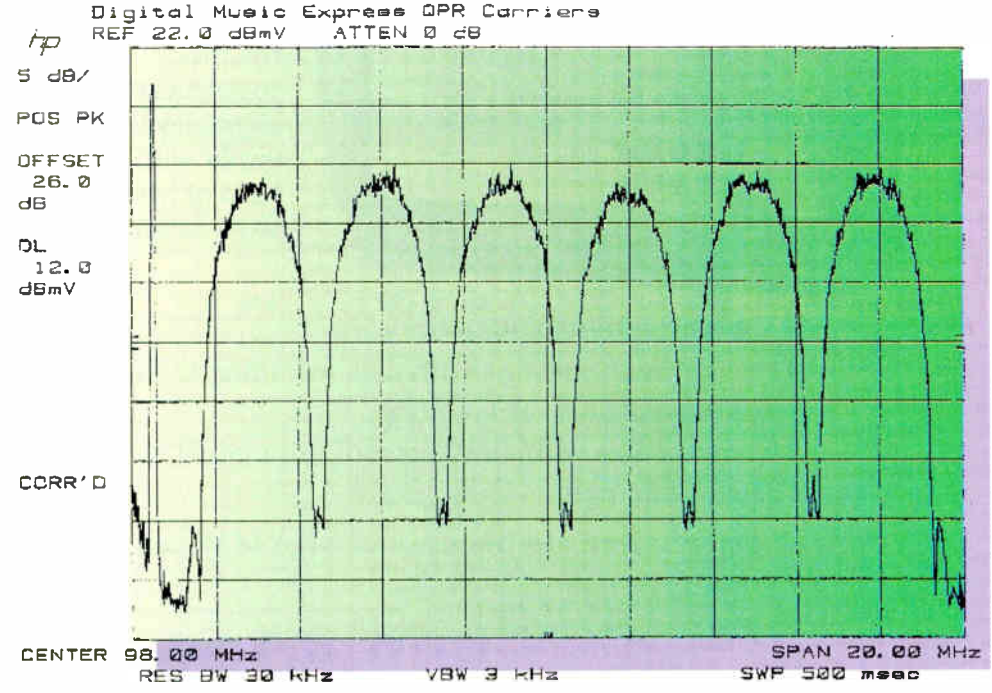



*Figure 5: Five multiplexed digital music channels on each QPR modulator*




be easily checked by placing the unit into a test mode. This diagnostic mode can directly display how much error correction is being performed by the tuner. This form of diagnostic testing is referred to as a bit error rate (BER) detection mode and can be helpful in troubleshooting during an installation or service call.

The DM-2000 tuner measured 10.5 inches wide by 7 inches deep by 2.5 inches high and weighed only three pounds. The DMT unit does conform with both UL 1409 and FCC Part 15 requirements. The Scientific-Atlanta DMR-22 remote control works well and is easy to use, even in a darkened room.

As good as this product appeared to be, we could still see room for improvement in its functionality. Most digital stereo tuners would be co-located with a subscriber's stereo system. A green or blue LED display with a dimmer control would be better suited and more appealing in a hi-fi system's environment. The unit also did not contain an unswitched AC power outlet, and lack of this feature might pose a problem with an already crowded entertainment system.

The DMX service was very impressive. Overall quality and performance were top notch. DMX works well in the open FM broadcast spectrum and with the AML microwave system. The DMX system design, using 3 MHz wide QPR carriers, was well suited to MGC's cable television plant and AML microwave applications. QPR carriers didn't cause any perceptible spurious or intermodulation distortion (IMD) beats in the cable system. DMX has not overlooked much in the design of a very high quality system. System documentation and product support was excellent. The most critical users of this system would be very pleased with the overall equipment design, performance, easy installation and variety of programming formats (See Table 1).

## Conclusion

Since this report was compiled in November 1991, Media General has not yet chosen to offer a digital music service. Digital Planet is no longer available; however, the two remaining major program suppliers, Digital Cable Radio (now Music Choice) and Digital Music Express, have expanded their subscriber base and both appear quite successful. Music Choice and DMX are now available on Satcom C3.

*Note: At the time of the field tests, Mr. Krom was Media General's senior headend technician/engineer in charge of the technical tests.* CED

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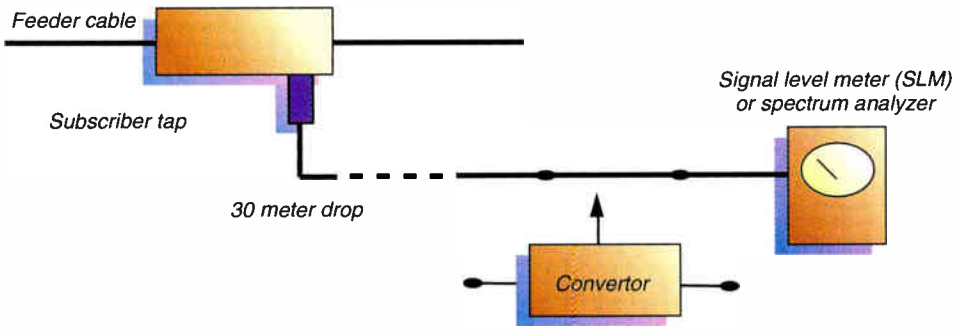
# Measuring visual and aural levels

## Complying with FCC specs

**Figure 1:** *Visual, Aural Carrier Level: 24-Hour Variation Test Equipment Setup*




*By Mike Long, Zenith Electronics*

*Signal level measurements are the cornerstone of all other cable system measurements. Without proper system signal levels, all other measurements are suspect. The following recommended practice, written by Mike Long, formerly of Zenith Electronics, outlines the NCTA recommended practice for measurements satisfying the FCC rules and regulations on technical standards.*

The visual carrier level in a cable television system is the RMS voltage of a channel's visual (picture) carrier, considered as a sine-wave, at the peak of the modulation envelope, measured across a termination impedance which matches the internal impedance of the cable system.

The aural carrier level in a cable television system is the RMS voltage of a channel's aural (sound) carrier measured across a termination impedance which matches the internal impedance of the cable system, generally expressed with reference to the channel's associated visual carrier level.

### Regulation requirements

According to FCC regulations, a cable system must perform semiannual tests to ensure that both carriers are within a stated threshold. Specifically, the visual signal level on each channel shall be measured and recorded, along with the date and time of the measurement, once every six hours (at intervals of not less than five hours or no more than seven hours after the previous measurement), to include the warmest and the coldest times, during a 24-hour period in January or February and in July or August.

Further, the FCC has determined a threshold which must be met. The visual signal level, across a terminating impedance which correctly matches the internal impedance of the cable system as viewed from the subscriber terminal, shall not be less than 1 millivolt across an internal impedance of 75 ohms (0 dBmV).

Additionally, as measured at the end of a 30-meter cable drop that is connected to the subscriber tap, it shall not be less than 1.41 millivolts across an internal impedance of 75 ohms (+3 dBmV). (At other impedance values, the minimum visual signal level, as viewed from the subscriber terminal, shall be the square root of 0.0133(z) millivolts and, as measured at the end of a 30 meter cable drop that is connected to the subscriber tap, shall be three times the square root of 0.00662(z) millivolts, where z is the appropriate impedance value).

The visual signal level on each channel, as measured at the end of a three-meter cable drop that is connected to the subscriber tap, shall not vary more than 8 decibels within any six-month interval, which must include four tests performed in six-hour increments during a 24-hour period in July or August, and during a 24-hour period in January or February, and shall be maintained within:

✔ 3 dB of the visual signal level on any visual carrier within a 6 MHz nominal frequency separation;

✔ 10 dB of the visual signal level on any other channel on a cable television system of up to 300 MHz of cable distribution system upper frequency limit, with a 1 dB increase for each additional 100 MHz of cable distribution system upper frequency limit (e.g., 11 dB for a system at 301-400 MHz; 12 dB for a system at 401-500 MHz, etc.); and

✔ A maximum level such that signal degradation due to overload in the subscriber's receiver or terminal does not occur.

Meanwhile, the RMS voltage of the aural signal shall be maintained between 10 dB and 17 dB below the associated visual signal level. This requirement must be met at the subscriber terminal and at the output of the modulating and processing equipment (generally the headend). For subscriber terminals that use equipment which modulates and remodulates the signal (e.g., baseband convertors), the RMS voltage of the aural signal shall be maintained between 6.5 dB and 17 dB below the associated visual signal level at the subscriber terminal.

### Test set-up and performance

To actually perform the test, the following equipment is required (see Figure 1):

✔ A signal level meter (SLM) or spectrum analyzer. The SLM should have been calibrated immediately prior to this test. If a spectrum analyzer is used, it

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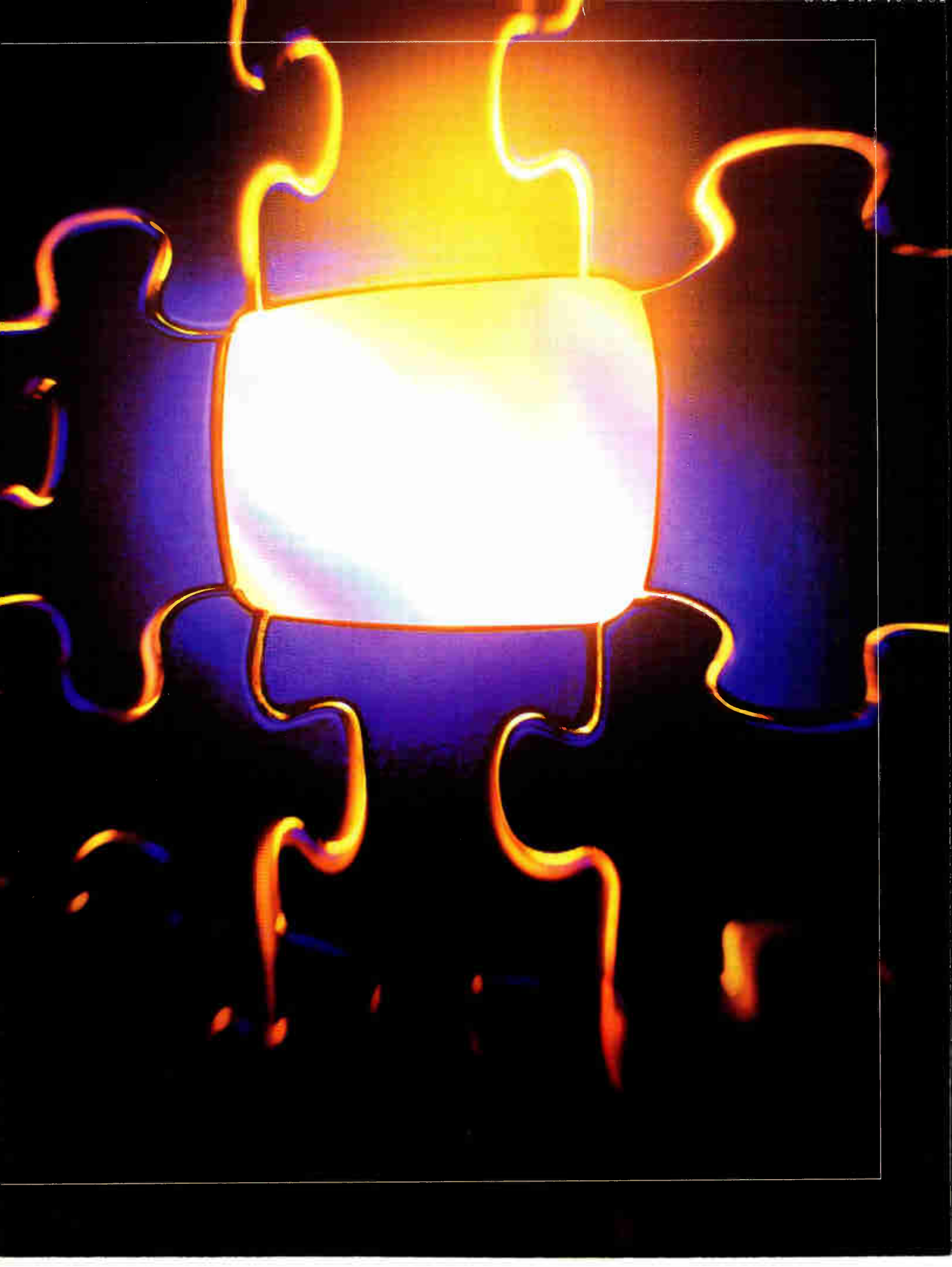
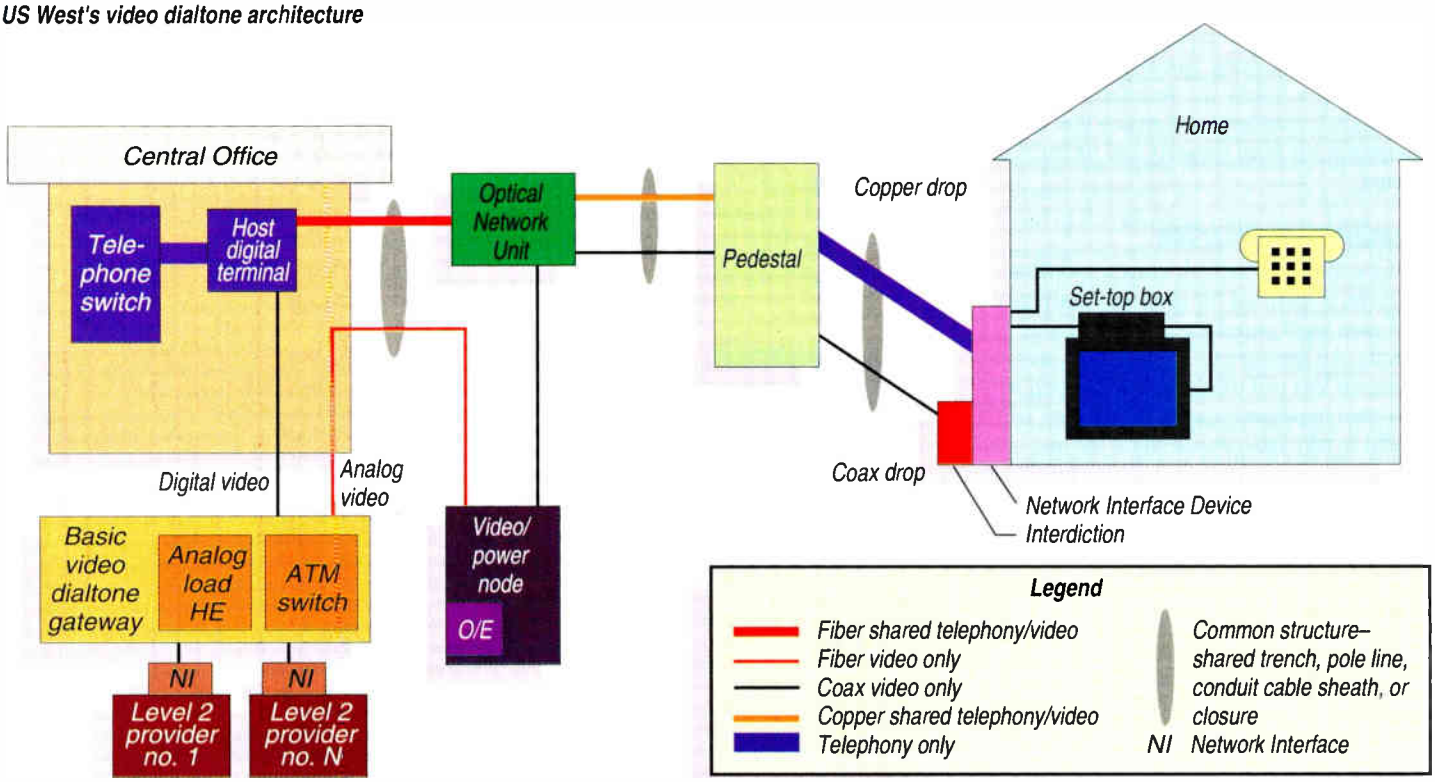


*US West's video dialtone architecture*




# Telco networks have come full-circle

## FTTC looks promising–again

*By Fred Dawson*

When it comes to resolving the long-debated question, "Is it HFC or FTTC?," the answer among a growing number of telcos is, "It's both."

While most local exchange carriers have been widely perceived to be making a choice of hybrid fiber/coax over fiber-to-the-curb as the most expedient approach to adding video services to their networks, the reality is that a growing number of network strategists are looking at ways to merge the two topologies into mutually supportive means to entering the video services arena.

"If you're not ready to offer a combined FTTC/HFC solution, you're not going to be in the running for an awful lot of contracts," says a senior executive at one leading network system supplier, asking not to be named. "It's amazing how fast things have changed."

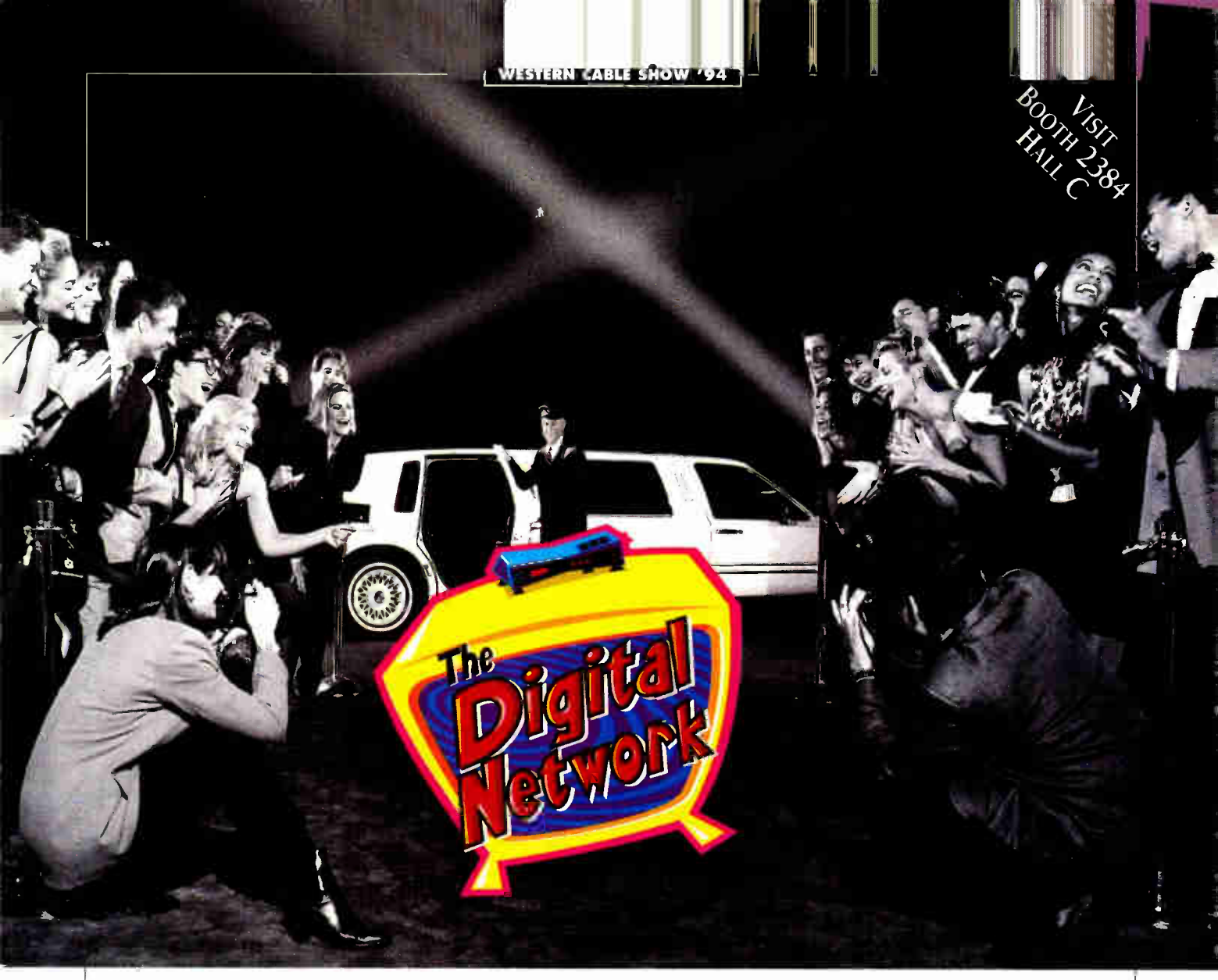
Most telephone companies are reluctant to divulge any shifts in network design strategies at this delicate moment of video dialtone scrutiny at the FCC, where major changes would add complications to the slow-moving Section 214 approval process. But they acknowledge that advancing technology makes it hard to stick with plans which, in some cases, have been on file for a year or more.

"It's hitting home to me what convergence is all about," says Pat Campbell, executive vice president for corporate strategy at Ameritech, which plans to connect six million households to VDT networks over the next six years. "Looking at the impact on our own deployment strategies, you have to ask how do we deploy aggressively now and not miss the opportunities to exploit major technical changes."

### An architecture change

In late October, US West Communications, which had been asking the same questions, suddenly switched gears, proposing major changes in its VDT network design. Where the RBOC had been planning to carry all video signals over an HFC facility that included dual coaxial distribution links, now the carrier will add ATM (asynchronous transfer mode) video to the already planned FTTC telephony facility, using HFC strictly for analog TV and eliminating the second coax.

"This expands digital video capacity while meeting our cost targets," says Larry Levine, vice president for multimedia and broadband services and technology.

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"Bascially, we're saying if there are more options and more demand on the switched video side than we originally anticipated, we can accommodate it."

US West hasn't named vendors yet, Levine says, but it is satisfied that the technologies supporting its move are available. In fact, it sounds as though the US West solution maps perfectly with the network design recently announced by AT&T Network Systems, in conjunction with its partnership with BroadBand Technologies.

Rick Jones, executive vice president for technology at BroadBand Technologies, says a variety of technological advances are driving the new hybrid approach embodied in the SLC 2000 system, offering a cost-competitive challenge to the recognized advantages of a pure HFC design. In particular, Jones says the following areas of development are pivotal to the changing scenario:

✔ rapid progress toward standardization of ATM (asynchronous transfer mode) to the home;

✔ emergence of coaxial cable as a preferred local loop powering medium;

✔ expansion in twisted pair capacity for short haul applications that support cost-effective positioning of fiber in FTTC designs; and

✔ the ability to passively combine RF and digital video signals from separate links onto a single drop from the tap or onto premises wiring in instances where signals are carried over separate drops to the house.

## ATM is coming on fast

Where asynchronous transfer mode is concerned, telephone network planners, much like planners in the cable industry, are divided over the usefulness of the technology, at least in the near-term, for video to the home. But the dividing line does appear to be moving, especially on the telco side, as Bell Atlantic, US West and Southwestern Bell have now signaled that their initial applications of digital video will in fact employ

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ATM in the final distribution run.

"ATM applications provide you with the option to offer a lot more than MPEG video," says Jon Boe, technical director for wireless and broadband architecture at US West. "You can't look at digital video by itself as the silver bullet."

By packetizing digital signals meant for PCs as well as TVs into the 53-byte cell structure of ATM, US West will be able to deliver whatever digital information customers choose without having to predetermine a frequency allocation scheme for each service category, as would be the case if different transport formats were used for different types of services. With a dedicated fiber serving a small number of households, there is ample bandwidth for each customer to consume as much service as the TVs and PCs in anyone's home can handle, Boe says.

Telephone signals will not be packetized into the ATM format, Boe adds, "at least not initially." But the jury is still out on how videoconferencing signals would be handled. "We're looking at a variety of approaches at this point, some of which might embody ATM," he says.

## Mapping

A new group, not formally part of the ATM Forum, known as "AL6" has begun working on establishing a standard for mapping MPEG into ATM, notes Kevin Kalajan, a product manager at Sun Microsystems. The company, in concert with several vendors, is using ATM for digital video demonstration at the Western Show CableNET exhibit put together by Cable Television Laboratories. "There's no problem doing this from a technology standpoint," Kalajan says, "but there has to be agreement on which way it will be done, and we hope to contribute to that process."

The AL6 group is working on algorithms that would avoid emulation over an adaptive layer in the ATM conversion process, which is a software intensive approach. "We want to optimize MPEG over ATM in a way that avoids translation, or at least minimizes the amount of translation processing," he says.

ATM is far from complete as a protocol, even for the higher level switching applications now in widespread use over various telephone and cable facilities. One of its chief problems is there is no standard for network-to-network interfaces, notes Bob Cruickshank, project manager for telecom projects at CableLabs.

Another problem is the lack of a communications protocol for signaling a sending party that congestion in the system requires a slowdown in the data flow, which means everyone must devise some such signaling method over some other protocol besides ATM, adding complexity and incompatibility to the system. And, Cruickshank adds, there is only a single bit in the cell header devoted to qualifying the importance of a given communication–it's either very important or not so important.

"There's no gray area, such as this is pretty important, so don't flush it out of the system unless you absolutely have to," Cruickshank says.

But the upshot of such problems is that the more localized the ATM application, the less significant these deficiencies become; in fact, most will be resolved over time in the standards-making process. Thus, ATM is finding many uses in LAN interconnection over private networks and is well-suited for positioning in the final distribution loop of telephone and cable networks, which is one reason US West is only using ATM in that portion of the network.

Using ATM over a dedicated line versus a point-to-multipoint distribution system also has advantages, says BBT's Jones. "The system doesn't have to pick a tiny piece of the transmission out of a big payload when you're going point-to-point," he notes.

**Using ATM over a dedicated line versus a point-to-multipoint distribution system has advantages.**

**A telco might choose HFC for integration of all services if the cost justification of the broadband network relies heavily on operation cost economies.**

## A greater reach with twisted pair

As for other aspects of the network design which BBT and AT&T are marketing under the SLC 2000 name, the linchpin to making it a cost-effective competitor with an all-HFC approach is new technology that allows use of existing twisted-pair copper plant for ATM transport at 52 Mbps over the last 500 feet from the optical termination point, Jones says. This greatly expands the number of households served from each node, as compared to previous FTTC designs.

"Use of twisted pair has been rigorously tested in all kinds of situations, and we find that the real-world application supports a reach of 500 feet," Jones says. "Whatever number of residences is subtended within a radius of 500 feet from the ONU is the number of homes we can serve, which can be anywhere from 16 in a suburban environment to 30 or more in more urban situations."

On average, he adds, the new design can be configured to cover 20 homes per ONU. This contrasts with eight homes per fiber termination point under previous designs using coaxial for transport from the ONU. Coax was a limiting factor because of problems with extending long coax runs across several properties in a given neighborhood. "T-pair is already there," Jones notes.

## New chipsets

BBT and AT&T Microelectronics are developing chips supporting the new ATM-over-T-pair capability, which relies on modulation techniques developed by AT&T Paradyne. Jones says the ATM component, while initially relying on hardware configurations developed by BBT, will comply with whatever ATM standard the ATM Forum chooses for delivery of the packetized signals to households.

The hybrid nature of the SLC 2000 design stems from a fortuitous combination of advantages in using coaxial for powering the ONU and for delivering analog services to the home, Jones says. Coaxial plant turns out to be the lowest cost means of powering the optical network unit (ONU) that terminates fiber at each neighborhood, which establishes a ready means for delivering analog cable services as well.

Analog signals transported over coax can be passively combined with digital broadband delivered over fiber and twisted pair copper at the point of interconnection with home wiring or at the tap. Coax is the medium for the final link beyond the point of combination.

"One of the primary disadvantages we've had in marketing our system in the past is that delivery of all services digitally requires a digital decoder at every home in an environment where all CPE (customer premises equipment) operates in analog," Jones says. "Now we've eliminated the need for a digital set-top, except in instances where subscribers take digital service."

The shift to reuse of existing copper plant and a higher house count per ONU changes the cost equation for FTTC, Jones says. "With this approach, the issue of cost versus an all-HFC design is off the table."

Dennis Morgen, vice president for consumer broadband offers at AT&T Network Systems, says telcos are likely to base their choices between an all-HFC approach to broadband and the SLC 2000 approach on three criteria. "One important consideration is how far do you want fiber to go in your network," Morgen says.

## Criteria for choice

In addition, while both approaches support the same array of services, the anticipated penetration of digital services is another crucial factor in design selection, Morgen says. HFC, with a much higher ratio of homes to bandwidth devoted to interactive digital services, supports an incremental approach to adding new revenue streams from digital services, while SLC 2000, with a 52 Mbps dedicated pipe into every home, has no limits on the volume of on-demand service.

Finally, Morgen notes, a telco might choose HFC for integration of all services, as Pacific Bell has done, if the cost justification of the broadband network relies heavily on operation cost economies. By terminating the integrated services at the network interface unit at the residence, PacBell is able to determine whether a problem in a particular customer's service is in the network, or in the wiring, or in the equipment on premises, thus greatly reducing the volume of service calls.

Jones says there might be a way to transfer this last advantage to the SLC 2000 system as well, which would create long-term as well as first-install cost parity between the two approaches. To do so would require installation of an active device at the home to send signals from that point back through the network, which would add a low marginal cost to the installation process, he says.

## Per-household expenditures

Costs listed in the new US West filings for Denver, Boise, Minneapolis/St. Paul, Portland and Salt Lake City indicate that the actual per-household expenditures for the new network approach will be lower than they were in the original filings. In Denver, for example, the plan now calls for total plant costs of $268.4 million, or $639 per passing across a 420,000-household base, versus the previous costs of $222.1 million, or $673 per passing across the initially projected base of 330,000 households.

With additional costs, including home terminals where subscribers take digital services, total per-household costs will remain below the $1,000 target originally set by the company, says Dave Banks, a spokesperson for US West.

Boe says system integration testing for the new scheme should be completed by the second quarter of next year, with "significant buildout" getting underway before the end of the year. CED

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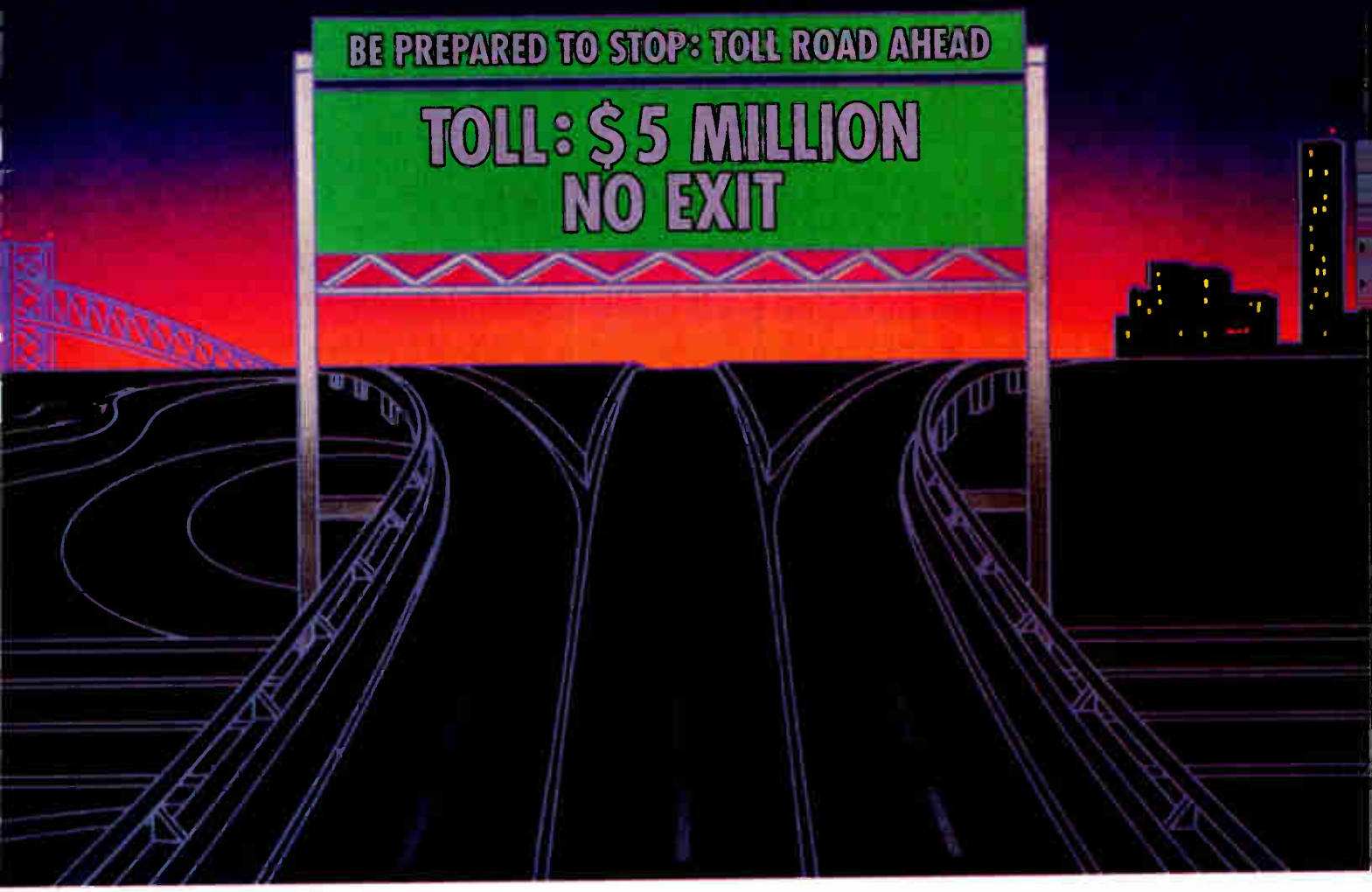


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# Training the trainers affordably

## A way to pool resources


*By Dana Cervenka*

You'd expect that an organization called the Association of Cable Trainers (ACT) would be heavily involved in educating those who are in charge of training the rest of the industry. And while that's certainly accurate, ACT offers much more, to a more diverse group of people, than the name implies.

Born about a year-and-a-half ago from an informal networking meeting of trainers, ACT grew out of an intense desire to share information and resources between cable companies. "We recognize that training is a major issue facing all industry professionals," explains Phil Hoffman, ACT second vice president and technical trainer with Adelphia Cable in Toms River, N.J. "Unfortunately, many of the companies don't have the budget or the resources to obtain specific cable-oriented training materials. Through ACT, we really hope to help solve some of these problems."

To address those problems, the association's offerings include seminars, a quarterly newsletter and a membership directory of those willing to network and share information and training materials. The newsletter offers everything from training tips to recruiting and job search notices.

### ACT's facts

ACT's members cut across many job titles, running the gamut from technical supervisors to customer service managers, and everything in between. Members may not even have the word "trainer" in their titles; nevertheless, they carry that responsibility. And in fact, it is the trend toward corporate generalization that makes the organization so necessary. While much of ACT's membership base is currently concentrated in the northeast (New York, New Jersey, Pennsylvania, Delaware, Maryland, Washington, D.C.), the group's board of directors is working hard to attract members from all across the United States.

The association's board is composed of a president, first vice president, second vice president, secretary, and assistant to the president, as well as officers in charge of resource development, marketing/communications, programming, membership/fundraising and public relations.

As a non-profit organization, ACT supports itself through membership dues ($50 per year), seminar fees (ranging from $75 to $100 per workshop) and corporate donations.

### Starting from scratch

The association's raison d'être is being driven by two challenges facing cable industry professionals today: increased competition, and rapidly changing technology. "With the onset of fiber optics, and [operators] starting to get into the telephony side of the business, our technologies are changing on almost a daily basis," notes Hoffman, "and that's one of the biggest things that we need to keep up with."

In order to build a strong foundation for a variety of training programs, ACT has started with the basics. The first of their seminar offerings was entitled, "Creating In-House Training Programs...Developing for Success." The rationale? "One day, people may be asked to be a supervisor, and another day, to be a trainer. And they don't have any skills with which to accomplish that training," explains Hoffman. The workshop offered an education in design cycles, creating effective exercises, performing needs assessment, writing objectives and measuring training results.

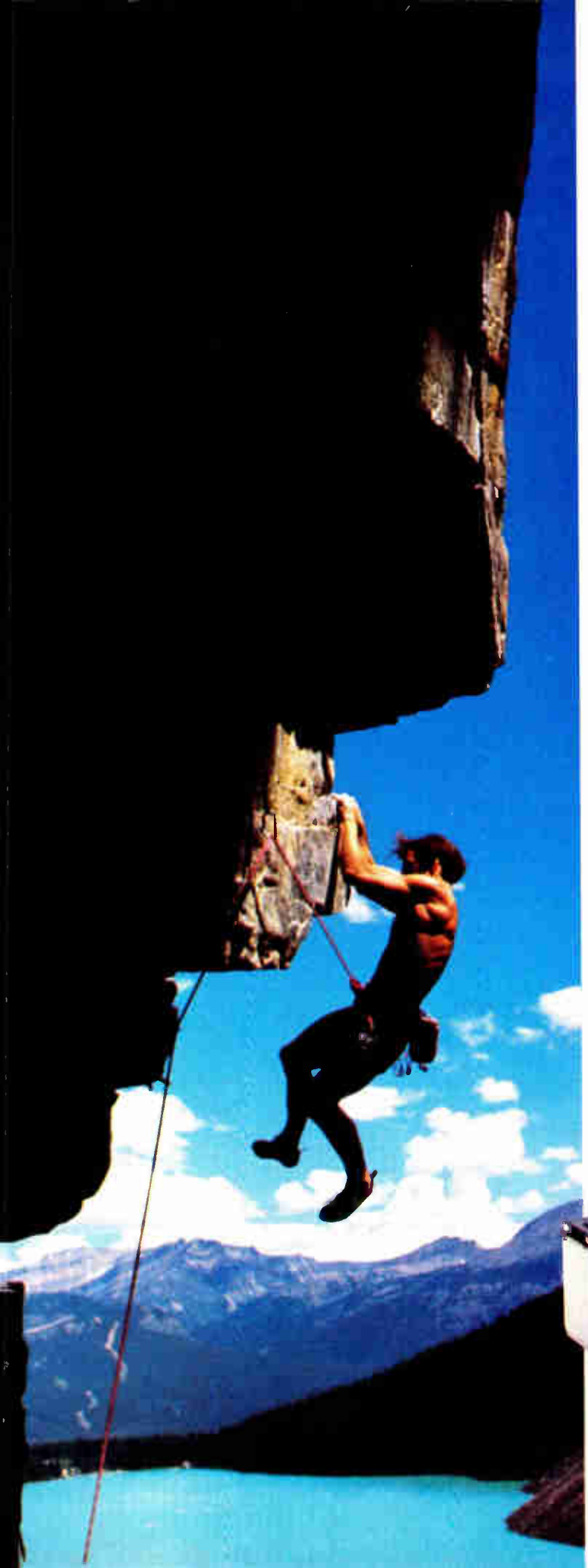
The second workshop, "Innovative Training Solutions for the '90s," held in conjunction with HBO, taught attendees how to identify obstacles and develop solutions, transfer skills, create accountability for those skills that are trained, and how to quantify the measurement of training skills.

ACT's programs are complementary–not competitive–with the industry training that's currently available from manufacturers, the SCTE and other training companies. Hoffman is careful to note that existing training entities like the SCTE and NCTI do a "fantastic" job. ACT is in *no* way trying to replace them, but instead, aims to assist in the development and facilitation of some of that training, while improving the performance of those who are out there delivering it, he says. In fact, there are synergistic relationships being built between ACT and several other groups. ACT has already produced the aforementioned workshop in conjunction with HBO, and is conducting talks with a wide variety of industry associations.

Future plans include producing the next batch of seminars and launching a resource library which will be available to all ACT members in about six months, according to Stephanie Lepre, ACT's director of Public Relations. The library will offer both "software" and "hardware," ranging from experts willing to consult to actual materials. "One of the areas that's really important is the lack of materials for people who are doing the training," notes Hoffman, "including programs and formal outlines which they can follow in order to do a professional customer relations training program, or sales skills for a technical force."

The third workshop in ACT's training series will be based on the D.I.S.C. (Dominance, Influence, Steadiness, Cautiousness) framework, a means to determine what motivates individuals in order to capitalize on their diverse work styles. The workshop is slated for early 1995.

For more information on ACT and its resources, call (908) 458-9182; or (908) 286-2959. CED



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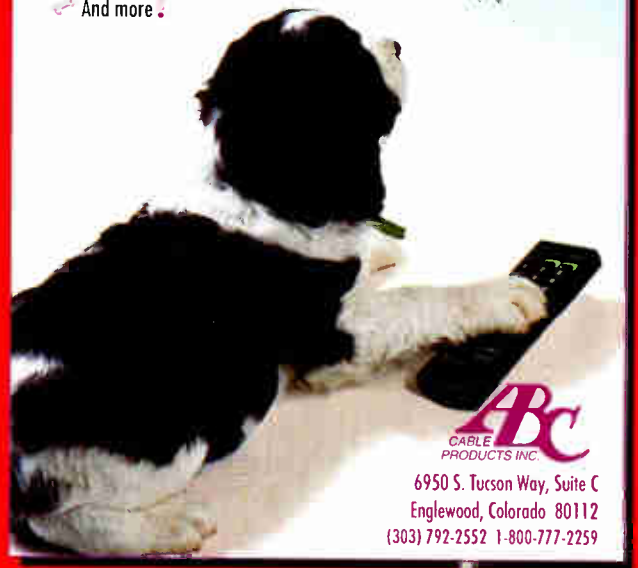

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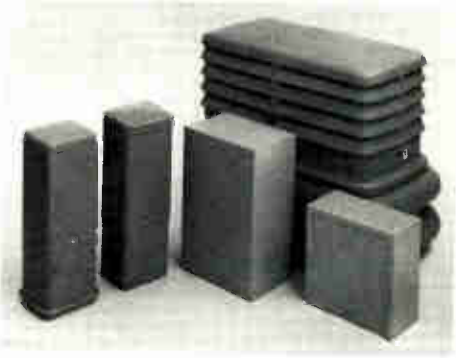

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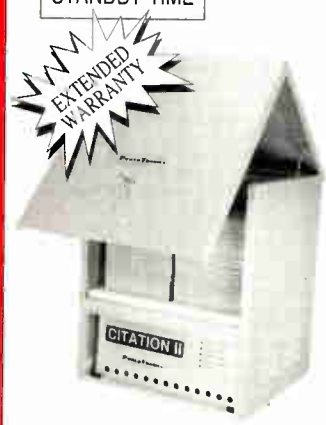


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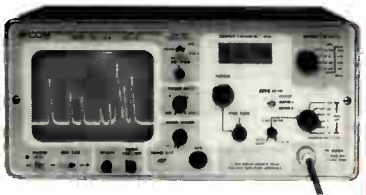

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## ENGINEERING/DESIGN/CONSTRUCTION



## PRODUCTS AND SERVICES

# Where in the world are we headed?

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

Recently, I was asked where I thought the cable TV industry was headed. I have been directly involved in cable TV, as an owner-engineer, a manager and a consulting engineer for more than 40 years. For 10 years before that, I was a broadcast radio and TV consulting engineer. I lived through the days when broadcasters tried in vain to kill CATV by any means, fair or foul. I watched in utter disbelief as the telephone companies tried, with unusual incompetence, to lease channel facilities to naive operators under Section 214 of the Communications Act. It didn't work, and the operators had to buy back the leased plants, which promptly had to be rebuilt.

## My crystal ball

Obviously, my views tend to be biased by the experiences of the last 40 years. However, circumstances have changed. The Bell System is no longer completely monolithic. Competition is in the wind to replace regulation.

The concept underlying my perception is that cable TV will one day provide residential voice and data telephony services in direct competition with a new breed of telephone companies, which will bear little resemblance to traditional, regulated telco utilities. If not, cable TV stands to lose its dominant role as distributor of video entertainment, although its position as program provider might be enhanced.

The question, therefore, is not whether to develop the two-way infrastructure, but how and when. Three developments appear to be inevitable:

✔ The architectural goal will be totally passive coaxial networks, with electronic amplification only at the optical node. Fiber to the home still seems to be too remote even for speculation.

✔ Increasingly large fiber counts and extensive wavelength division multiplexing (WDM) may be needed close to the headend (central office), depending on a host of as-yet unknown criteria and designs. More upstream fiber than downstream may be needed.

✔ Distributed intelligence will be essential at the node, hub, concentrator, or even at customer premises. The truth is that the nature of the intelligence and how it should be distributed remain open questions, with many possible answers.

Timing is likely to be affected more by the capriciousness of the political and judicial processes, operating under conflicting pressures from diverse parties at interest, than by technological or commercial wisdom. Perhaps, within the next two years, sufficiently significant guidelines may begin to emerge as economic and technological beta testing gets under way. But it may be several years, perhaps not until the turn of the century, before systematic preparations to enter competitive telephony become widespread.

The technical requirements for full scale interactivity are basically the same as for voice and data telephony. Marketing experiences with less than full scale interactivity, limited by traditional CATV architecture, have been disheartening, at best.

## Be prepared–but don't panic

What should be done to prepare for telephony when the present uncertainties clear away? Some ideas that have been suggested are:

✔ Install lots of dark fiber
✔ Decrease the number of households per optical node
✔ Be prepared to provide controlled environment housings at nodes and hubs
✔ Tighten up the return system against ingress
✔ Provide effective monitoring and maintenance
✔ Install redundant routing and self-healing rings.

Over the years, I have become wary of construction intended to anticipate poorly defined future needs. Too often, you find that it's not really what you need after all. Or, it has been damaged in the inactive period. Or, it was not done right in the first place.

Fiber is being installed in cable TV networks for two reasons:

✔ To improve downstream performance and reliability, with reduced maintenance, by shortening amplifier cascades.

✔ To prepare for upstream voice and data services by segmenting the network into many small serving areas, in order to reduce the risk of accumulated noise and interference, and to increase the bandwidth available to potential users for all kinds of communications.

The need for improved downstream performance is driven by the imminent onset of competition from DBS and MMDS, and later, from telephone company entry. The need is immediate, or only a few months away. Fiberization should not be delayed, extending as deep into the network as can be economically managed. The incremental cost of fiber penetration to 1,500 to 2,500 households per node is quite nominal, when designed into a general rebuild.

However, investment dedicated primarily to prepare for future telephony services should perhaps be delayed until the needs are more clearly known, and the entry strategy can be more definitely charted. Moreover, substantial savings probably can be realized as prices for the optical links continue to tumble.

The future is not for the timid. Rewards are likely to be munificent, but the risks are formidable. Some may seek the power of consolidation. Others, like Telecable and Cablevision Industries, may look for other worlds to conquer. Actually, small independent systems and groups may be able to hide under the telco's radar beams by joining forces with similarly independent local telephone companies. CED

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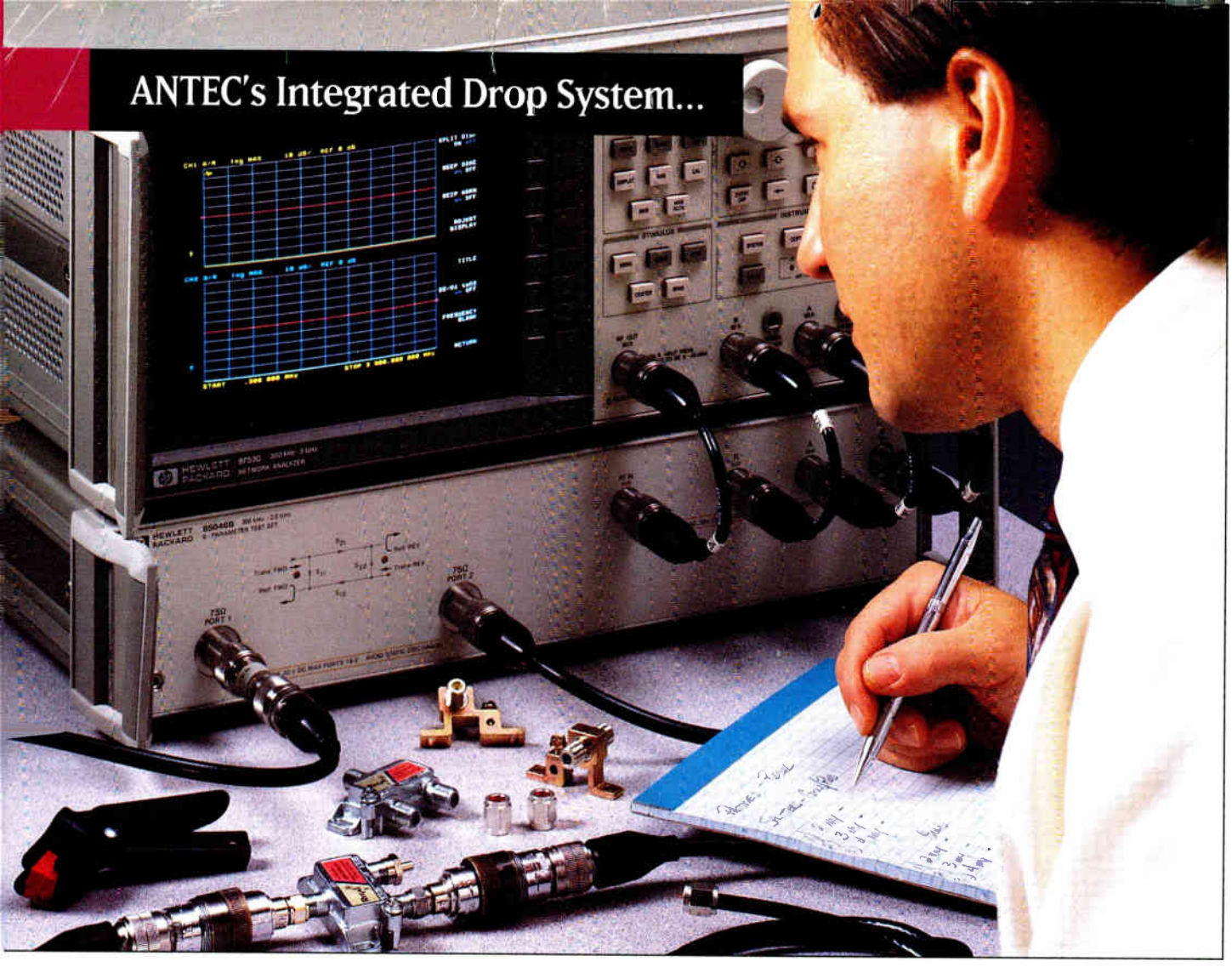


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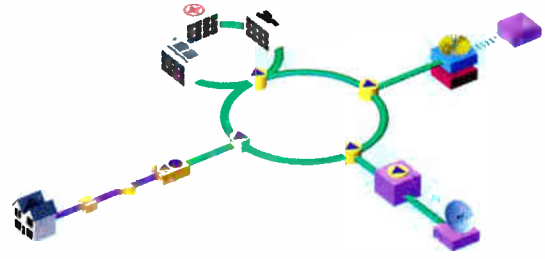

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